JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CE/CE(PC)401/2021-22
2022
SOIL MECHANICS I

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.
(Note: Arrange for mm graph paper)

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

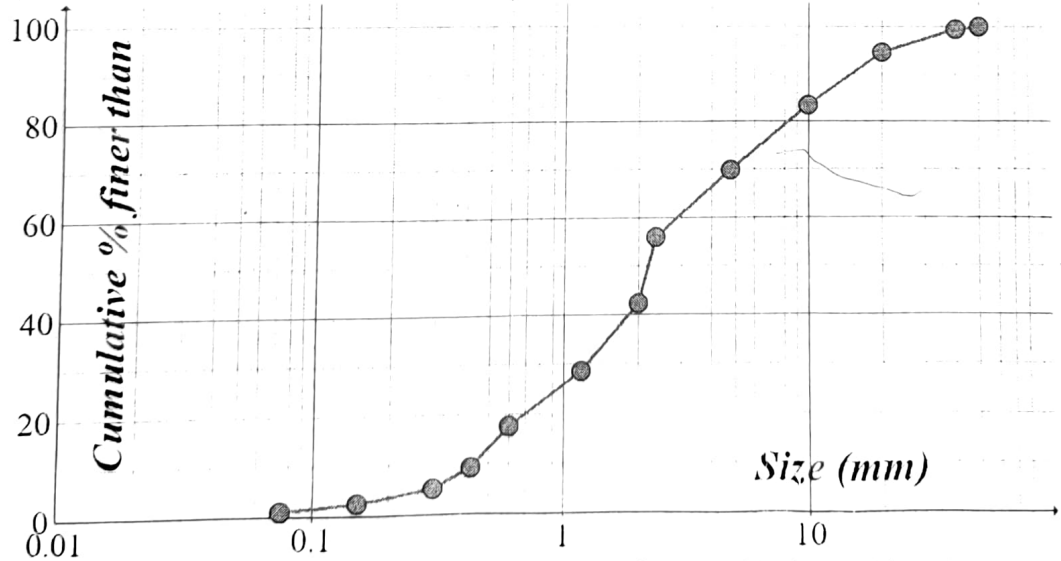
1. Determine effective stress at Ground level when water level is 2m above ground surface. 2
2. Why correction for dispersing agent in calibration of hydrometer reading is always negative? 2
3. What is the major structural difference between ellite and montmorillonite? 2
4. In a wet soil mass, air occupies one sixth of its volume and water occupies one-third of its volume. Determine void ratio. 2
5. What is residual soil?. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***five*** questions 12x5 =60

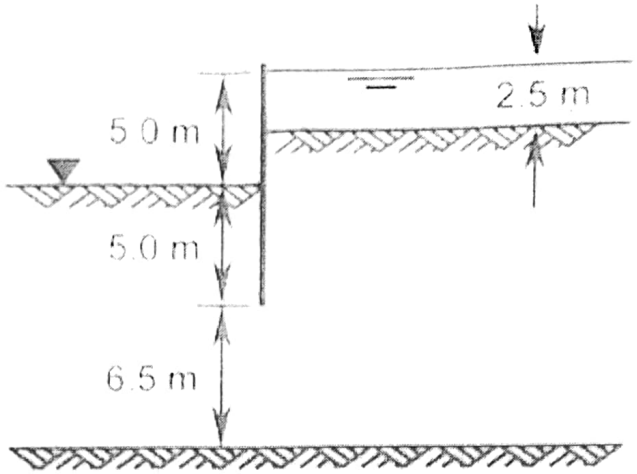
6. i) Bulk unit weight of a soil = **17.6kN/m^3**, moisture content = **10%**, Specific gravity = **2.7**. Draw phase diagram. 4
   ii) How pore pressure is determined at any depth '***d***' below Ground Level? 2
   iii) Comment on the behavior of in-situ clay soil if its water content is close to liquid limit. 2
   iv) How will you identify plasticity of soil without using any instrument? 2
   v) What is over consolidated clay? 2

7. i) Grain Size distribution of a soil is given figure below. Classify the soil as per unified Classification system. 5



   ii) Write the difference in characteristics between less sensitive and highly sensitive clay. 2
   iii) Pore pressure coefficient ***B*** is measured as **0.8** at the initial stage of a tri-axial test. In view of this comment on the condition/ state of the sample. 2
   iv) Data of Liquid limit experiment (using Casagrande apparatus) is plotted below. Determine LL and flow index. 3

10. i) For a sheet pile system shown in figure 2 below, calculate flow rate in m^3/day by constructing a flow net. Given: $k = 5\times10^{-5}$ m/s. 6



ii) Describe pumping out test to determine permeability of in-situ soil. 6

11. i) Data obtained from a drained tri-axial test are as follows: 5

Test No.	σ3, kPa	(σ1-σ3), kPa at peak
1	50	191
2	100	226
3	150	261

Determine the drained shear parameters.

ii) What is dilatency? 2

iii) Draw shape tri-axial sample (loose sand) after failure. 1

iv) Major principal stress, σ_1 at point in soil (having cohesion,**c = 50 kPa** and $\phi = 0°$) is **150 kPa**. Determine minor principal stress, σ_3. 2

v) Write effect of withdrawal of ground water on void ratio of soil. 2

12. i) A sand is composed of solid constituents having **Gs = 2.60**. The void ratio **e = 0.572**. Compute unit weight of sand when dry and when saturated and compare the effective unit weight when submerged. 3

ii) Water table in a deep deposit of very fine sand is**1.2m** below the ground surface. Above the water table, the sand is saturated by capillary water. The unit weight of the saturated sand is **20 kN/m^3**. What is the effective vertical pressure on a horizontal plane at a depth of **3.5m** below the ground surface? 3

iii) Specific gravity of sand is **2.66**, the porosity in the loose state is **45%**. What is the critical hydraulic gradient for this state? 2

iv) On a plane in soil, total normal stress is **295kPa** and pore pressure is **120kPa**. Effective strength parameters of the soil: **c′=12 kPa, ϕ′ = 30°**. Determine shear strength in terms of effective stress. 2

v) Cu for two different soils are same. State where two grain size distribution curves will collapse (coincide) with each other. 2

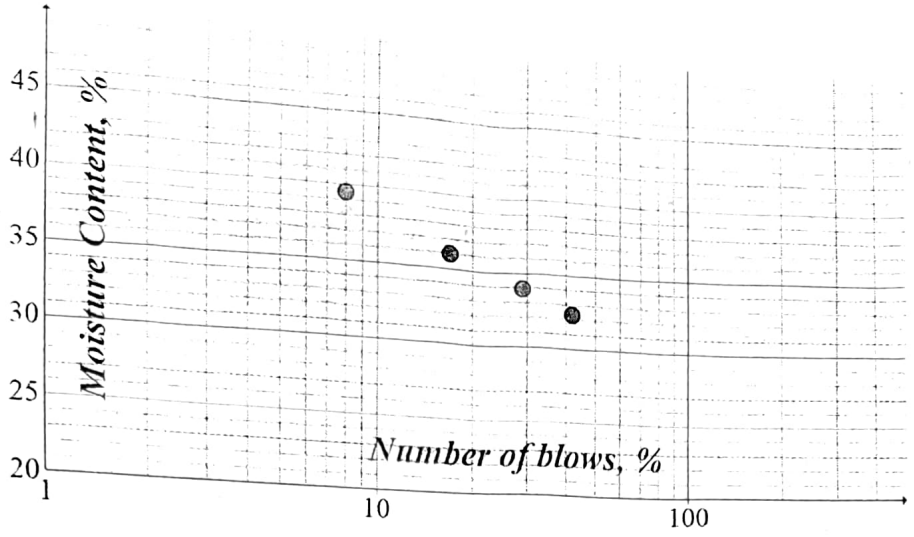
13 i) What is strain controlled test? 2

ii) Write the name of different of tri-axial tests. 2

iii) A direct shear test was conducted on a cohesion less soil (**c = 0**) specimen under a normal stress of **200kPa**. The specimen failed at a shear stress of **100kPa**. Determine angle of internal friction. 2

iv) Draw Mohr circle for the above direct shear test. Find pole/origin of planes, major principal stress **σ1**, and minor principal stress **σ3**. 3

v) Vane shear test was conducted with a vane of diameter, **D = 65mm**, Ratio of height/diameter of vane = **2**. Maximum torque is measured as **300 N.m**. Determine cohesion in kPa. 3



i) A circular area on the surface of an elastic mass of great extent carries a uniformly distributed load of **120kPa**. The radius of the circle is 3m. What is the intensity of vertical pressure at a point **4.5m** beneath the center of the circle? At a point at the same depth beneath the edge of the circle? 5

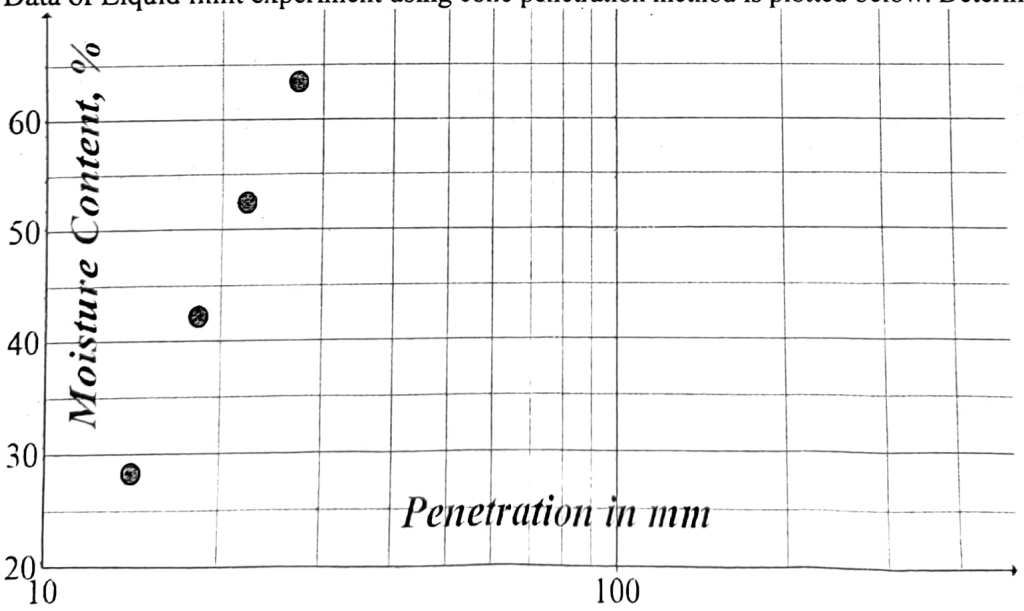
ii) A footing **2m×1m** exerts a uniform pressure of **150kPa**on soil. Assuming a load dispersion of **2**vertical to **1** horizontal, determine average vertical stress at **1**m below the footing. 3

iii) Write one major difference in the concept of Boussinesq theory and Westergaard theory of stress distribution. ? 2

v) Write behavior of a sand subjected to shear at critical void ratio. 2

i) In a laboratory constant head test, a cylindrical sample **100mm** in diameter and **150mm** high is subjected to an upward flow of **540 cm^3/min**. The head loss over the length is measured to be **360mm**. Calculate the coefficient of permeability in **m/s** and velocity head. 3+1

ii) Data of Liquid limit experiment using cone penetration method is plotted below. Determine LL. 2



ii) Classify the soil having LL = 60%, and PI = 20% as per Unified classification. 2

iv) An undisturbed clay soil is collected from field. Which test is suitable for this soil to determine its permeability:- constant head test or falling head test. Why? 2

v) In an Unconfined Compressive Strength test on a clay, major principal stress at failure is measured as 150kPa. Determine its cohesion. 2

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ CIVIL/CE(ES)402/ 2021-22
2022
INTRODUCTION TO SOLID MECHANICS

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable. Plain graph paper will be supplied for question no- 10(ii)

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Define Modulus of Elasticity and factor of safety 2
2. What is core of a section of short Column? 2
3. Find out degree of indeterminacy of a single span beam with one end fixed and other end hinged. 2
4. Draw nature of bending moment diagram and shear force diagram of a cantilever beam with concentrated load at free end. 2
5. Define hoop stress in a pressure vessel 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***five*** questions 12x5 = 60

6. i) An aluminum bar 2.0m long has a 2.0cm-square cross sections over 1.0m of its length and a 2.0cm diameter cross section over the other 1.0m. How much will the bar elongate under a tensile load P=2000kg if E=750000.0 kg/sq.cm 6
   ii) Define - Possion,s ratio, Yield strength and Complementary stresses 6

7. i) A simply supported beam carrying a uniformly distributed transverse load of intensity w. Establish relationships $dM_x/dx = V_x$ and $dV_x/dx = -w$ where M_x, V_x are bending moment and Shear force at any section x distance from the support . 6
   iii) A simply supported beam AB of span 5.0m is subjected to concentrated loads of 60.0 KN and 90 KN at 2.0m and 4.0m from the left support respectively. **Draw bending moment and shear force diagram for the beam.** 6

8. i) Derive in pure bending $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ 7
   ii) Calculate maximum bending stress for a simply supported beam of span 5.0m and subjected to a uniformly distributed load w=30KN/m over the span. Size of the beam is 250mmX500mm and E=25000.0 N/mm^2 5

9. For the given truss shown in Fig –A, find member for forces for all the members and prepare a table for the same 12

10. i) For a thin plate subjected to biaxial tension , derive equation for Mohr's Circle 6
    ii) Draw Mohrs circle for a case of biaxial stress if σ_x =400.0 kg/cm^2 and σ_y = - 800.0 kg/cm^2 From this circle find σ_n and τ for the element whose $\varphi=30^0$ 6

11. i) Calculate safe internal pressure P for spherical pressure vessel made of thin magnesium plate 0.25cm thick if mean diameter of sphere is D=600.0cm and allowable stress in tension =900.0 kg/cm^2 6
    iii) Determine the proper diameter d for a solid steel shaft to transmit 200hp at 105 rpm if working stress in shear 420.0 kg/cm^2 6

12. i) Derive Euler's basic formula for critical load for column having one end fixed and other end free. 7
    ii) A hollow cast iron column whose outside diameter is 200 mm has thickness of 20mm. It is 3.0m long and is fixed at both the ends. Calculate the safe load by Euler's formula using factor of safety of 3. 5

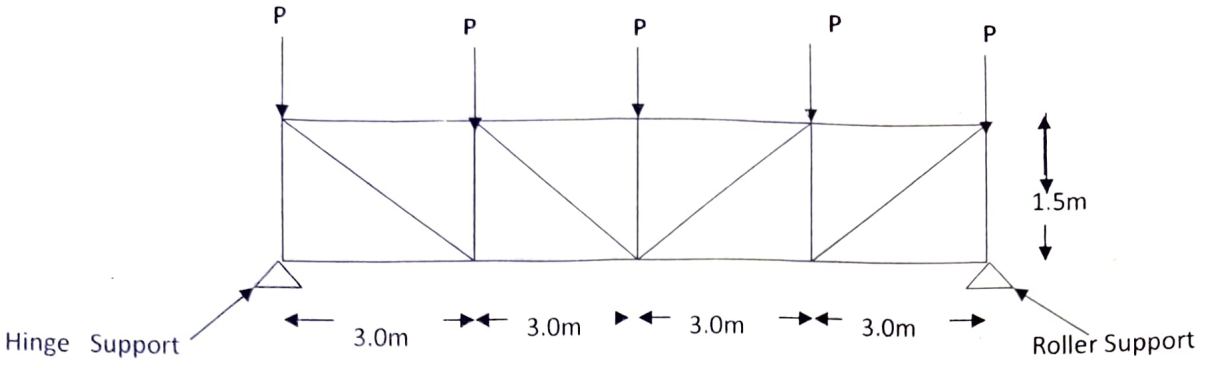


FIG-A

3600 rotation → 60 seconds

1 " → $\frac{60}{3600}$ "

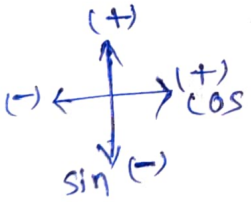
$= 1/60$ "

Data transfer rate = no. of heads x storage capacity x time for one rotation

$= 19 \times 69 \times \frac{1}{60}$

$= 21.85$ MBPS

≈ 22 MBPS



$\tan \frac{1}{2} =$

$\frac{450}{300}$ $P = \frac{P \times 300}{300} = 450$

$\frac{P \times 300}{2 + 0.25} = 900$

$\frac{P}{2} = 450$

$\sqrt{0.866025403}$

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE

[A GOVERNMENT AUTONOMOUS COLLEGE]

COE/B.TECH./CE/CE(PC)402/2020-21

2022

ENVIRONEMENTAL ENGINEERING - I

ull Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.

All the notations have their usual meanings unless specifically mentioned.

Candidates are requested to write their answers in their own words as far as practicable.

Please write the answer of all part questions of a broad type question successively as far as practicable.

GROUP-A

[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5×2=10

1. Establish the relationship between peak demand and annual average hourly demand. 2
2. Differentiate between shallow well and deep well. 2
3. Why measurement of turbidity is more commonly practiced than measurement of suspended solids? 2
4. Write down the objective of aeration process. 2
5. Why alkalinity must be present for effective coagulation? 2

GROUP-B

[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4×15=60

6. i) Average % increase in the population of a town per decade over the last 4 decades was 12. If the population at the end of the 4^{th} decade is 125000. Then find out the maximum daily draft in MLD at the end of the 6^{th} decade considering per capita water demand as 135 L/day. 5

   ii) Represent graphically how a demand in water varies over a day. Explain how it affects the design of various components of water supply scheme. 3+4

   iii) Enumerate the points of difference among surface water, ground water and wastewater in respect of quality. 3

7. i) A 100 ml sample of water is titrated with 0.02 (N) H_2SO_4. The initial pH is 10 and 7 mL of acid is required to reach pH 8.3 end point. An additional 9 mL is required to reach the pH 4.5. Determine the species of alkalinity present and concentration of each species. 9

ii) In a water analysis, the concentration of hydrogen carbonate (HCO_3^-) has not been determined due to instrumental break-down. Other analysis is given as shown under. From the theory of electro neutrality find out the concentration of hydrogen carbonate in mg/L. 6

Cation			Anion	
Ion	Concentration (mg/L)		Ion	Concentration (mg/L)
Ca^{2+}	98		HCO_3^-	?
Mg^{2+}	22		SO_4^{2-}	125
Na^+	71		Cl^-	89

The atomic weight (gm) of Ca=40; Mg=24; Na=23; K=39; H=1; C=12; O=16; S=32; Cl=35.5.

8. i) In a continuous flow settling tank 3 m deep and 60 m long, what flow velocity of water would you recommend for effective removal of 0.025 mm particle at 25° C. The specific gravity of the particle 2.65 and kinematic viscosity of water is 0.01 cm^2/sec (assuming free board along with depth for sludge deposition as 0.5 m). 6

ii) Show that depth is not a governing factor for settling of solids in a sedimentation basin. 5

iii) Discuss the disinfection process with chlorine and its compounds. Mention the predominance of ions with respect to pH. 4

9. i) Find the dimension of a circular clariflocculator along with flash mixer for the following data: 10

a) Desired outflow = 400 m^3/hr and water lost in desludging = 2%

b) Detention time for flash mixer= 30 s

c) Ratio of ht to dia for flash mixer = 2:1

d) Velocity Gradient (G) for flash mixer = 500 s^{-1}

e) Detention time in flocculation zone = 30 min

f) Average G value for flocculator =30 s^{-1}

g) Surface overflow rate for clarifier = 40 m^3/day/m^2

ii) Write down the procedure to remove hardness using lime soda-ash. 5

10. i) Design a R.G. F. along with under drainage system and wash water trough for the following data

a) Desired outflow = 400 m^3/hr

b) Quantity and time lost during back wash are 3% of filter output and 30 min respectively 15

c) Design rate of filtration = 5m^3/hr/m^2

d) Ratio of length to width = 1.3:1

e) Under drainage system: Laterals with central manifold. Size of perforation = 9 mm

f) Total area of perforations= 0.3% of area of filter bed

g) Total cross sectional area of laterals= thrice of area of perforations

h) Area of central manifold = twice the area of laterals

i) Use the formula $Q = 1.376 \times bXH^{1.5}$ for design of wash water trough.

11. i) Estimate the 'moisture content' and 'as discarded density' of a municipal solid waste with the following composition 8

Component	% by mass	Moisture content (%)	Typical density (kg/m^3)
Food waste	20	70	280
Paper	40	6	90
Cardboard	10	5	50
Plastic	15	2	60
Garden trimming	10	60	105
Wood	5	20	220

ii) Explain the terms 'Recycle', 'Reuse' and 'Remanufacture' for a product. 3

iii) Draw a flowchart showing interrelationship of functional elements comprising a solid waste management system. 4

----End---

Ca^{2+} = 98 mg/L = $\frac{98}{(40/2)}$ = 4.9 milligram equivalent

Mg^{2+} = 22 mg/L = $\frac{22}{(24/2)}$ = 1.83 "

Na^{+} = 71 mg/L = $\frac{71}{(23/1)}$ = 3.1 "

SO_4^{2-} = 125 mg/L = $\frac{125}{(96/2)}$ = 2.6 "

Cl^{-} = 89 mg/L = $\frac{89}{35.5/1}$ = 2.5 "

Total milligram equivalent /L of cations = 4.9 + 1.83 + 3.1 = 9.83 milligram equiv/

" " " " " = 2.6 + 2.5 + x

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
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JGEC/B.TECH/CIVIL ENGINEERING/CE(PC)502/2022-23
2023
ENGINEERING HYDROLOGY

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable. Use graph paper where necessary.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Determine mean velocity of a river from the following three observations in a vertical: $V_{0.2d}$ =0.544 m/s, $V_{0.6d}$ = 0.523 m/s and $V_{0.8d}$ =0.450m/s . 2
2. Define basin lag and time of concentration. 1+1
3. Slope of the mass curve denotes _____ and area under hyetograph represents _____. 1+1
4. A watershed got transformed from rural to urban area over a period. What is the effect of urbanization on storm runoff hydrograph? 2
5. Define shape factor and form factor for a catchment. 1+1

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***five*** questions 12x5 =60

6. i) A catchment area has seven rain gauge stations. In a year, the annual rainfall recorded by the gauges are as follows: 4+2

Station	Jalpaiguri	Nagrakata	Dhupguri	Rajganj	Maynaguri	Mal	Matiali
Rainfall (cm)	130	142.1	118.2	108.5	165.2	102.1	146.9

a) Determine the standard error in the estimation of mean rainfall in the existing set of rain gauges.
b) For a 4.5% error in the estimation of the mean rainfall, calculate the minimum number of additional rain gauge stations required in that catchment.

ii) Define drainage density. 1
iii) If a flood wave with known inflow hydrograph is routed through a large reservoir, what shall be the characteristics of outflow hydrograph? 2
iv) For a drainage basin of 700 km^2 isohyetals drawn for a storm gave the following data: 3

Isohyetals (interval) (cm)	15-12	12-9	9-6	6-3	3-1
Inter-isohyetal area (km^2)	92	128	121	185	90

7. i) For the infiltration data set given below establish the Green-Ampt equation. Use graph paper. 7

Time since start (Min.)	10	20	30	50	80	120	160	200	280	360
Cumulative Infiltration (mm)	10	19	27	40	56	78	95	110	137	163

ii) A 45 g/l solution of a fluorescent tracer was discharged into the stream at a constant rate of 15 cm^3/s. The background concentration of the dye in the stream water was found to be 1.5 ppb. At a downstream section sufficiently far away, the dye was found to reach an equilibrium concentration of 5ppb. Estimate the stream discharge. 3
iii) Give Expression for Bowen's Ratio. 2

8. i) The stage-discharge data of a river are given below. Establish a stage-discharge relationship to predict the stage for a known discharge. Assume the stage value for zero discharge as 20.5 m. Determine the stage of the river corresponding to a discharge of 3000 m^3/s. 8

Stage (m)	Discharge (m^3/s)	Stage (m)	Discharge (m^3/s)
21.95	100	24.05	780
22.45	220	24.55	1010
22.8	295	24.85	1220
23	400	25.4	1300
23.4	490	25.15	1420
23.75	500	25.55	1550
23.65	640	25.9	1760

ii) In 300 ha watershed the CN value was assessed as 70 for AMC-III. Estimate the value of direct runoff volume for the following 4days of rainfall. The AMC on July 1st was of category III. Use standard SCS-CN equations.

Date	July 1	July 2	July 3	July 4
Rainfall (mm)	45	20	35	10

4

9. i) Draw DRH for a catchment before and after urbanization. 1

ii) In Jalpaiguri rainfall depth of 450 mm had a return period of 30 years. Determine the probability of a one-day rainfall depth equal to greater than 450 mm at Jalpaiguri occurring a) once in 10 successive years and b) at least once in 10 successive years. 3

iii) The coordinates of the IUH of a catchment are given below. Derive the direct runoff hydrograph (DRH) for this catchment due to storm of a duration 5 hours and having a rainfall excess of 4 cm. 8

Time (hours)	0	1	2	3	4	5	6	7	8	9	10	11	12
IUH ordinate (m^3/s)	0	9	32	51	48	39	30	22	14	9	5	2	0

10. i) Develop a 30-minute SCS triangular unit hydrograph for a watershed of an area 600 ha and time of concentration 55 min. 6

ii) The mass curve of an isolated storm over a watershed is given below. 6

Time from start (hr.)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Cumulative rainfall (cm)	0	0.25	0.5	1.1	1.6	2.6	3.5	5.7	6.5	7.3	7.7

Estimate ϕ index & duration of rainfall excess if the storm produced a direct runoff of 3.5 cm at the outlet of the catchment

11. i) Characteristics of two catchment M and N measured from a map are given below: For the 6-h unit hydrograph in catchment M, the peak discharge is 250 m^3/s and occur at 37 h from the start of the rainfall excess. Assuming the catchments M and N are meteorologically similar, determine the elements of 6-h synthetic unit hydrograph for catchment N by using Snyder's method. 8

Item	Catchment M	Catchment N
L_{ca}	76 km	52 km
L	148 km	106 km
A	2718 km^2	1400 km^2

ii) For catchment area of 500 ha somewhere in Western Ghats, calculate peak discharge of flood by the necessary empirical formula. 2

iii) What is attenuation? 1

iv) Define IUH. 1

12. i) The mean value and standard deviation of a flood series are 850 m^3/s and 230 m^3/s, respectively. What is the magnitude of a flood of return period 400 years in this stream? Assume that the annual flood series flow Gumbel's distribution and the sample size is very large. 4

ii) Explain the two basic assumptions of unit hydrograph. 2

iii) Route the following flood hydrograph through a river reach for K (storage-time constant) = 11 h and x = 0.2. At the start of the inflow flood, the outflow discharge is 12 m^3/s. 6

Time (h)	0	6	12	18	24	30	36	42	48	54
Inflow (m^3/s)	10	25	45	65	58	50	40	32	24	16

SCENT VEDANT Eqn

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
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JGEC/B.TECH/ CE/ CE(PC)404/ 2021-22
2022
CONCRETE TECHNOLOGY

Full Marks: 70 Times: 3 Hours

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Candidates are instructed to write the answers in their own words as far as practicable. Use of IS 10262(2019) and IS 383 are allowed. Assume any other suitable data, if required.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Name the major compounds of cement and mention the approximate percentage of each. 2
2. Define bleeding. 2
3. What do you mean by super plasticizer? 2
4. Define the phenomenon of bulking. 2
5. What is fineness modulus? 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4x15 = 60

6. i) Explain the process of manufacture of cement. 8
   ii) What are the physical properties of cement? Explain. 7
7. i) Explain the effect of properties of aggregates on concrete. 7
   ii) What are the different types of aggregate tests? Explain. 8
8. i) What is meant by workability of a concrete? 5
   ii) Enumerate the various methods to ascertain the workability. Discuss any one of them. 10
9. i) What is heat of hydration? Explain. 7
   ii) List with chemical formula for Bogue's compounds. 8
10. i) Explain the classification of aggregates. 7
    ii) What is curing of concrete? Explain in detail the methods of curing of concrete 8
11. Determine the mix proportion for concrete mix of grade 40 to suit the following data by IS method
    i) Type of cement – OPC grade 43
    ii) Type of aggregates – Crushed angular
    iii) Maximum size of aggregate – 20 mm
    iv) Maximum free water-cement ratio – 0.45
    v) Minimum cement content – 320 kg/m^3
    vi) Slump required – 50 mm
    vii) Quality control – Good
    viii) Exposure condition - Severe (RCC)
    ix) Specific gravity of cement – 3.15
    x) Specific gravity of coarse aggregates – 2.7
    xi) Specific gravity of fine aggregates – 2.65
    xii) Water absorption: Coarse aggregate = 0.5%
    Fine aggregate = 1.0%
    Grading of coarse aggregate is conforming to table 2 IS 383 and grading of fine aggregate is conforming to zone II 15
12. Write short notes on
    i) Nondestructive testing 5
    ii) Light weight concrete 5
    iii) Flexural Strength of concrete 5
