Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Civil Engineering

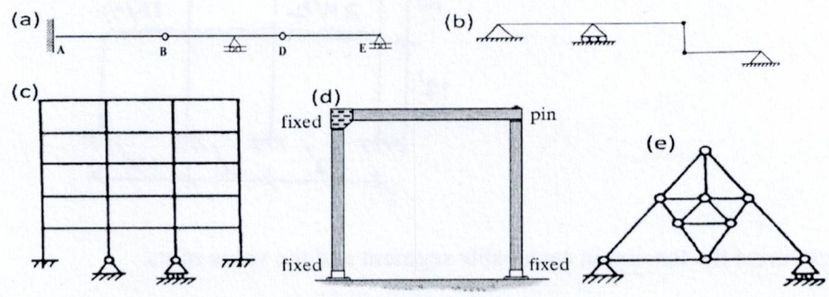
Final Examination, 2023 — **3rd Year 1st Semester**
Course No.: CE 511 — **Course Title: Structural Analysis I**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A-------

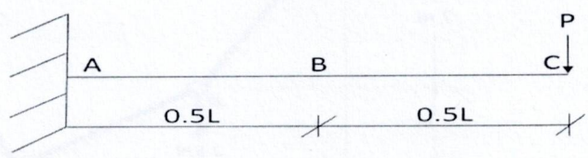
PART- A

(Answer any three questions)

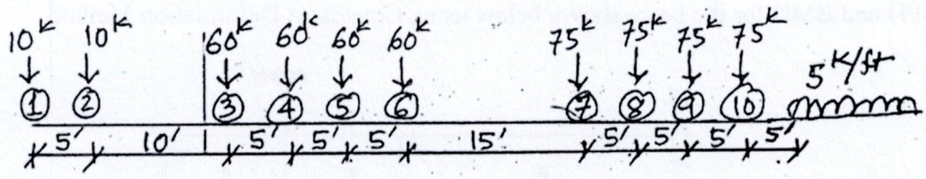
1. (a) Determine whether the structures shown below are stable and determinate or not. **2.5**



(b) To get a vertical displacement at C four times that at B, what would be the change in the value of P? Use the Virtual Work Method. **7.5**



2. (a) For the wheel loads shown in Figure, find the maximum moment at quarter point of a simply supported beam of 80 ft. **10**

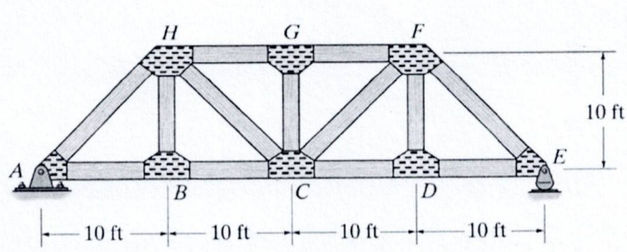


3. (a) If a 10-storey, with 3.3 m each, building has a time period equal to its frequency, what would be the type of structure of the building? **2.5**

(b) Calculate the seismic load at each story of a five-storied concrete moment-resisting frames hospital building with a uniform dimension of 60' X 100' located in Sylhet using the equivalent static force method (BNBC2020). The building is to be a Special Moment Resisting Frame (SMRF), with the value of C_S = 2.7, and it carries a Dead Load of 100 psf. **7.5**

Structure type	C_t	m
Concrete moment-resisting frames	0.0466	0.9
Steel moment-resisting frames	0.0724	0.8
Eccentrically braced steel frame	0.0731	0.75
All other structural systems	0.0488	0.75

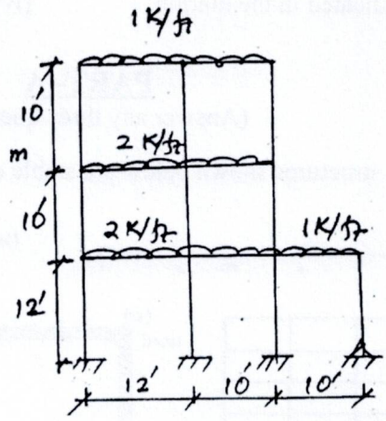
4. (a) Draw the influence line for the force in members CD, CG, and CF of the truss. Using the fundamental concept of IL is suggested. **10**



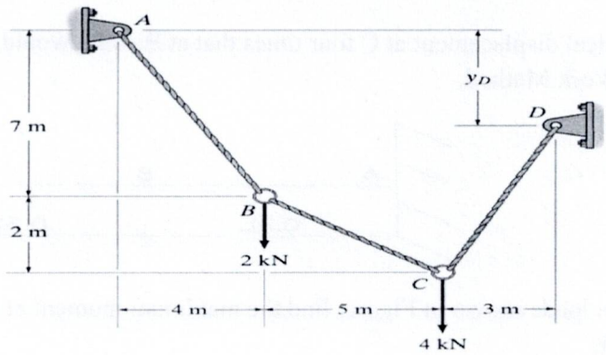
PART- B

(Answer any three questions)

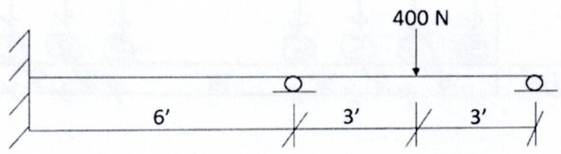
5. (a) Draw the axial force, shear force and bending moment diagrams for the building frame loaded as shown in Figure. **10**



6. (a) Determine the tension in each cable segment and the value of y_D. **10**

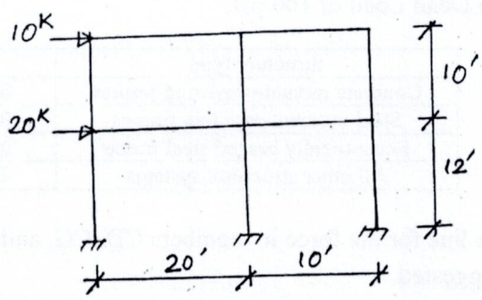


7. (a) Draw SFD and BMD for the beam shown below using Consistent Deformation Method. **10**



8. (a) What are the assumptions for the portal method for analyzing fixed-supported building frames? **2**

(b) Draw the shear force and bending moment diagrams of the beams and columns for the building frame as shown in Fig. Use Portal method. **8**



Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology, Sylhet)
Department of Civil Engineering

Final Examination, 2023 — **3rd year 1st Semester**
Course No: CE 523 — **Course Title: Design of Concrete Structures I**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART A

1.a) (i) Draw standard bar hooks, both for main reinforcements and stirrups. **05**
(ii) Name the factors influencing the development length of a reinforcing bar.

1.b) A 15×18 in. column is made of concrete and reinforced with six No. 8 bars. The stress-strain diagrams of reinforcing steel and concrete are shown in Figure 01. Determine (i) the axial load that will stress the concrete to 1200 psi; (ii) the load at which the steel starts yielding; (iii) the share of the total load carried by the reinforcement at these two stages of loading. Use curves a and c. **05**

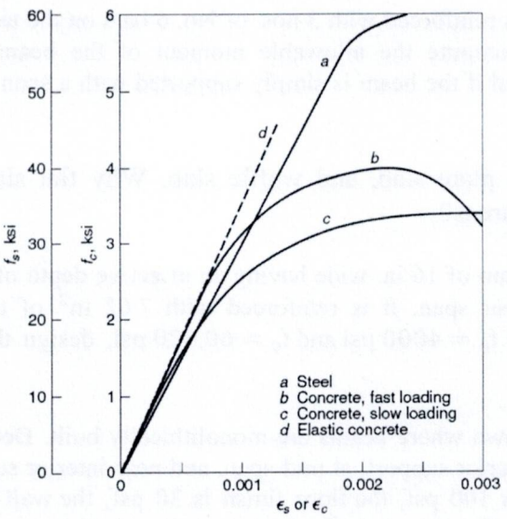


Figure 01: Concrete and steel stress-strain curves

2.a) A rectangular beam has the dimensions b= 10 inches, h= 25 inches, and d= 23 inches. It is reinforced with three No. 8 bars. The concrete compressive strength f_c' is 4000 psi, and the tensile strength in bending (modulus of rupture) is 475 psi. The yield point of the steel f_y is 60,000 psi. Determine the cracking moment. Use the transformed beam section. **05**

2.b) Define singly & doubly reinforced beam. When doubly reinforced beam is used? What are the advantages of R.C structure? **05**

3.a) A floor system consists of a 4″ concrete slab supported by continuous T beams of 24′ span, 47″ on centers. Consider the dimensions of the beams below the slab are 10″x16″. What tensile steel is needed at mid-span to resist an ultimate moment of 2000 kip-inch if f_y= 60 ksi and f_c' = 3 ksi. Show the cross-section. **05**

3.b) Find the concrete cross-section and the steel area required for a simply supported rectangular singly reinforced beam with a span of 15 ft that is to carry a computed dead load of 1.27 kips/ft and a service live load of 2.15 kips/ft using the graph shown in Figure 02. f_c' = 4000 psi, and f_y = 60,000 psi. Use a reinforcement ratio of 0.60 $\rho_{0.005}$. **05**

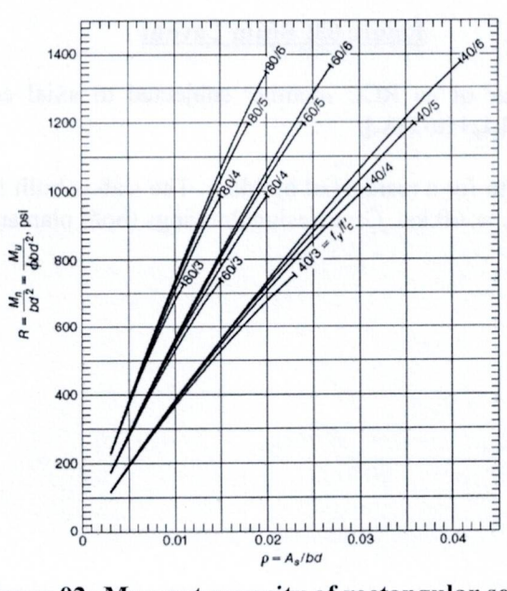


Figure 02: Moment capacity of rectangular sections

4.a) A rectangular concrete beam of width b= 24 in. is limited by architectural considerations to a maximum total depth h= 16 in. It must carry a total factored load moment M_u= 400 ft-kips. Design the flexural reinforcement for this member, using compression steel if necessary. Allow 3 in. to the center of the bars from the compression or tension face of the beam. Material strengths are f_y= 60,000 psi and f_c'= 4000 psi. Select reinforcement to provide the needed areas, and show a sketch of your final design, including provision for No. 3 stirrups. **05**

4.b) How bar cutoff and bend points of main bars in beams are determined? Discuss with figures. **05**

PART-B

5.a) Discuss different types of failures of RC beams. How failure criteria are considered in RC beam design? **05**

5.b) A simply supported beam having a span of 18 ft supports a uniform live load of 800 lb/ft and a concentrated load of 3500 lb at midspan. If $f_c' = 3000$ psi and $f_y = 60{,}000$ psi, determine the required cross-section and steel area. Use the **WSD method**. **05**

6.a) A rectangular beam 12 in x 24 in is reinforced with 3 nos. of No. 6 bars on the tension side and 2 nos. of No. 5 bars on the compression side. Compute the allowable moment of the beam section. Also, compute the allowable uniformly distributed load if the beam is simply supported with a span of 20′. Given that: f_y= 60 ksi, f_c' =3 ksi, n=8. Use **WSD**. **05**

6.b) Draw sketches of flat slab, flat plate slab, and waffle slab. Why flat slabs and flat plate slabs are vulnerable in earthquake-prone areas? **05**

7.a) A simply supported rectangular beam of 16 in. wide having an effective depth of 22 in. carries a total factored load of 9.4 kips/ft on a 20 ft clear span. It is reinforced with 7.62 in^2 of tensile steel, which continues uninterrupted into the supports. If $f_c' = 4000$ psi and $f_y = 60{,}000$ psi, design the web reinforcement for the beam. **05**

7.b) In Figure- 03 a floor system is shown where beams are monolithically built. Determine the moments in beam (10″x15″) indicated by (√) near exterior support, at mid-span, and near interior support. The slab thickness is 5 inches, the live load on the slab is 100 psf, the floor finish is 30 psf, the wall thickness over the beam is 5 inches, and the story height is 10 ft. Consider it as fixed supported. **05**

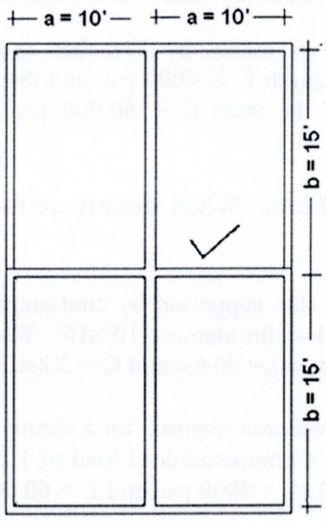


Figure 03: Beam Layout

8.a) Discuss briefly the elastic behavior of an RCC member subjected to axial compression. Also, derive the equation with usual notations: $\mathbf{P=f_c\{A_g+(n-1)A_s\}}$. **04**

8.b) Design a one-way slab of 14 ft width for a residential building. The slab is built integrally with the beams. Use the **USD Method.** $f_c' = 3$ ksi and $f_y = 60$ ksi. Give design drawings (both plan and section). **06**

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Final Examination, 2023 — **3rd Year 1st Semester**
Course No.: CE 531 — **Course Title: Environmental Engineering I**
Time: 02 (Two) hours — **Full Marks: 40**

N.B. : (i) Answer any two question from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART- A

(Answer any two questions)

1. **(a)** Describe the application of Low Lift Pump and High Lift Pump. **2.0**

   (b) Differentiate between the "Gridiron System" and "Ring System" with relative figures. **4.0**

   (c) Describe "Single Well Type Intake" with relative figures. **4.0**

2. **(a)** Find the B.H.P of the pumping units for the following data (water is to be lifted from a tube well): Tube well discharge= 60 liters/sec, R.L of water in tube well= 180 m, R.L of ground= 201.5 m, R.L of the bottom of overhead tank= 220.5m, Depth of water tank= 3.5m, Length of rising main=100m, efficiency=70%, velocity of water= 2 m/sec, Depression head during pumping= 4m, co-efficient of friction (f)=0.04 **6.0**

   (b) What is the Shutoff Head, explain with a relative figure. Describe the Specific speed of the pump. **4.0**

3. **(a)** What are the objectives of water supply system? What are the elements of water supply system? Draw sketches. **5.0**

   (b) The thickness of the aquifer is 20.0 m. There is a 15% open area in the strainer. The sandy aquifer overlain and underlain by impervious formation has a maximum discharge capacity of 1200 L/min. What should the screen wall length be if the borehole diameter is proposed as 15cm? **5.0**

PART- B

(Answer any two questions)

4. **(a)** Proof that the efficiency of the sedimentation tank is independent of the depth of the tank. **3.0**

   (b) A sedimentation tank is proposed to treat 45 m^3 of raw water per hour with an overflow rate of 0.5 m/hr and detention time is 3 hrs. Find the dimension of the sedimentation tank. **4.0**

   (c) Enumerate your idea on the flocculation and coagulation in the sedimentation process. **3.0**

5. **(a)** What is an aquifer? How the cone of depression is related to pumping? **2.0**

   (b) Draw and explain a schematic diagram of how the groundwater is extracted and recharged. **6.0**

   (c) What is an artesian well? Should a community utterly depend upon the groundwater sources? Give rational reasons behind your position. **2.0**

6. **(a)** Why BOD is greater than COD? Explain. **2.0**

   (b) State the classification of water distribution system? Which one do you think to be preferable for a city like sylhet and why? **3.0**

   (c) Determine 2-days and ultimate BOD of a wastewater which has BOD_5 of 250 mg/l at 20^0 C. The reaction constant k = 0.23 d-1. What would have been the BOD if the test would have been performed at 30^0 C. **5.0**

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Final Examination, 2023 — **3rd Year 1st Semester**
Course No.: CE 565 — **Course Title: Open Channel Flow**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART- A

(Answer any three questions)

1. **(a)** Derive Bernoulli's energy equation? **04**

   (b) In a wide river, the velocity varies linearly along a vertical from 0.10m/s at the bottom to 2.1 m/s at the surface. (i) Compute the discharge per unit width (ii) Determine the state of the flow if the depth of the flow is 4m. **06**

2. **(a)** Show that Froud number 1 is critical flow. 'Flow at or near critical state is unstable' give reasons. **03**

   (b) Water flows in a 6m wide rectangular channel with a depth of 2m and velocity of 2m/s. The channel is contracted to a width of 3m. How much channel bottom is to be simultaneously raised or lowered for the possible flow as specified? Neglect energy loss and α=1. **07**

3. **(a)** Derive Manning's formula for velocity U. **04**

   (b) An open channel lined with concrete (d50=1.3 m m) is laid a slope of 0.23%. The channel is trapezoidal width b = 8 m & s = 2. Compute uniform flow discharge in channel if depth of flow is 4 m. Also compute numerical values of Chezy's is 'C & Manning's n & friction factor 'f'. **06**

4. **(a)** Write down the governing equations for the 1-D steady flow? Briefly explain their applicability. **05**

   (b) Illustrate pressure distribution for different types of streamlines. How slope effects pressure distribution? Describe. **05**

PART- B

(Answer any three questions)

5. **(a)** Define channel bends by showing the equations based on the difference in water surface elevation at the outside and inside the bend. **03**

   (b) A straight channel will be excavated with a very rounded clay (n=0.023) having a void ratio 0.3. The channel will have a bottom slope of S_0 = 0.016 and it will convey Q = 10m^3/s. Note that the coefficient used in freeboard calculation is 0.6m. Proportion the channel using the following figures. **07**

6. **(a)** Distinguish between composite- and compound- channel with necessary figures and equations. **02**

   (b) The width of a channel is planned to be reduced; however, this reduction must not cause an increase of more than 1.5 ft in the flow depth of 25 ft for the discharge of 80,00 ft3/s. The encroachment will be over a long distance, and we can assume that normal flow will occur throughout the encroached portion of the channel. Assume $S0$ = 0. 0008.Determine the minimum allowable channel width, B. Use Fig – 1. **08**

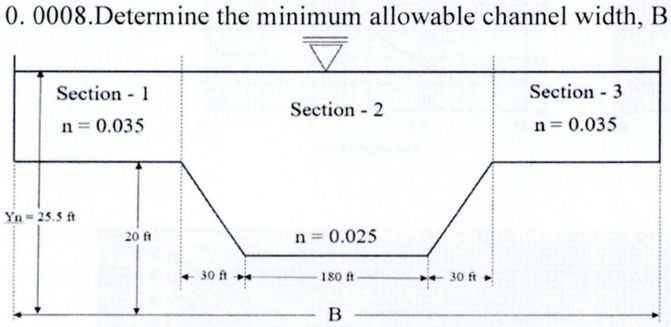


Fig – 1

7. **(a)** Define flow resistance? **02**

   (b) A straight cohesionless channel to be lined with bare soil will convey discharge Q =50 cumecs over a slope of S_0 = 0.0005. Proportion of the section dimensions using the maximum permissible velocity method when the Mannings roughness coefficient (n) of the channel is 0.002 **08**

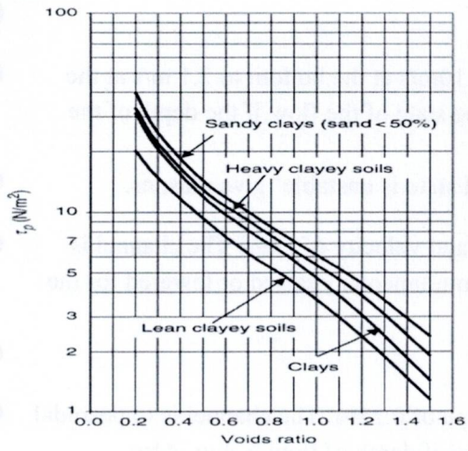
8. **(a)** How boundary roughness affects the flow resistance? **04**

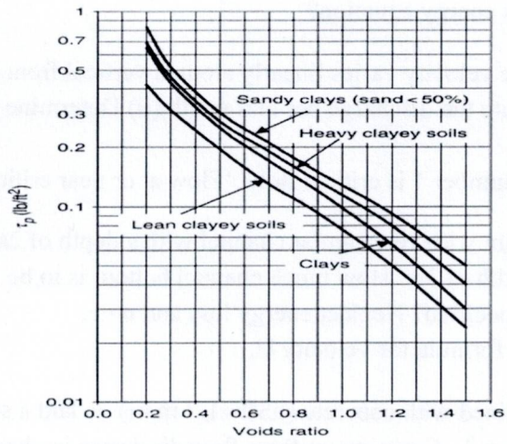
   (b) Write down the design procedure of a channel lined with vegetation of the lowest retardance class. Note that the discharge (Q) and the bottom slope (S0) are given. **06**

$$V_{max} = \begin{cases} [values\ in\ following\ table]\ for\ flow\ depth\ \leq 1m \\ [values\ in\ following\ table + 0.15m/s]\ for\ flow\ depth\ \geq 1m \end{cases}$$

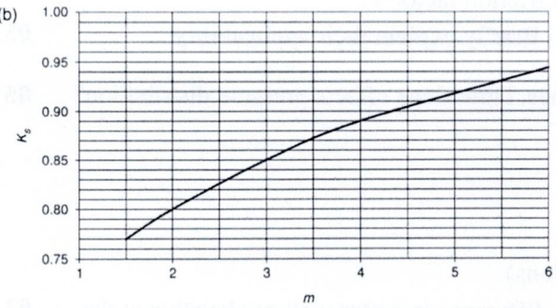
Channel material	V_{max} (m/s)	Steepest side slope, m
Bedrmuda grass on silt	1.8	3.0
Bedrmuda grass on clay	2.4	1.5
Clay	1.8	1.0
Silt clay	1.0	1.5
Fine sand	0.6	2.0

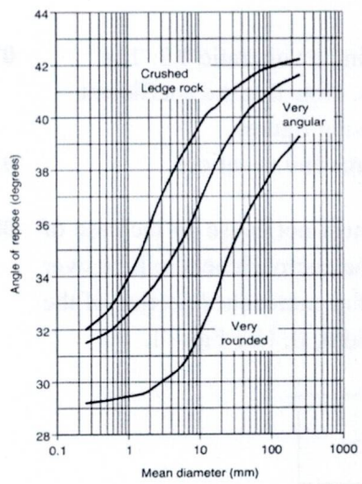
Figures

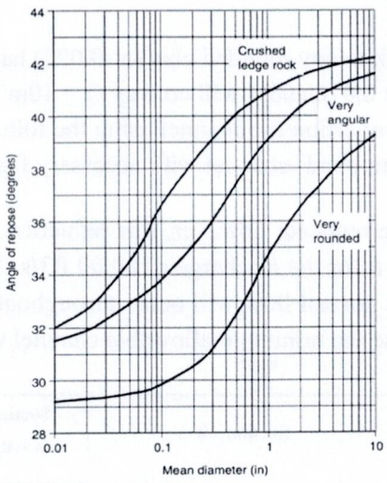


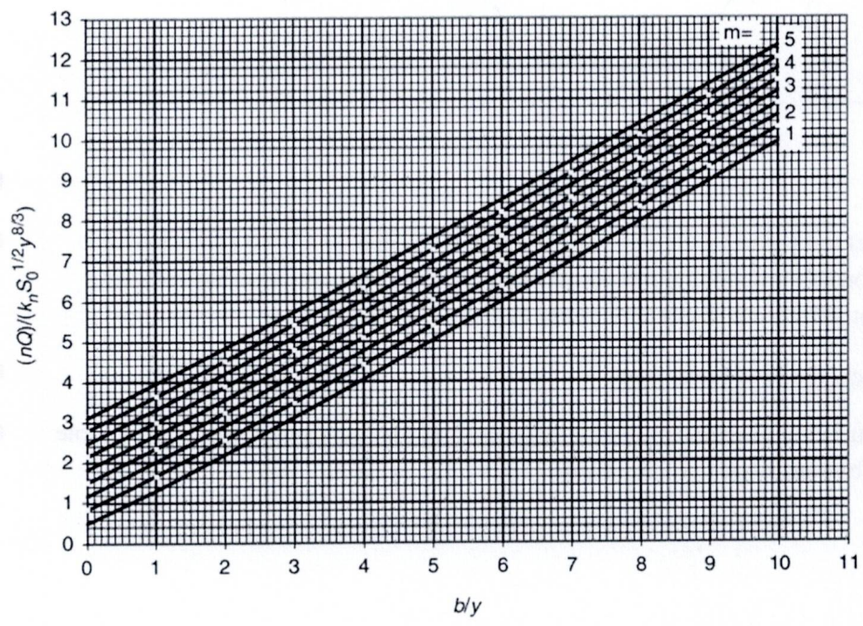


(b)









Sylhet Engineering College, Sylhet
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Department of Civil Engineering

Final Examination, 2023 — **3rd Year 1st Semester**
Course No.: CE 541 — **Course Title: Geotechnical Engineering I**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any three question from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART- A

(Answer any three questions)

1. (a) Describe the soil as per AASHTO, USCS and BNBC classification syste **05**

(b) Suppose you collected a soil sample from a construction site having a volume of 0.005 m^3 and mass 10 Kg. From laboratory test, its moisture content 10% and Specific Gravity 2.6. Determine: **i)** Moist density (ρ) ; **ii)** Dry Density (ρ_d) ; **iii)** Void ratio (e), and **iv)** Porosity (n). **05**

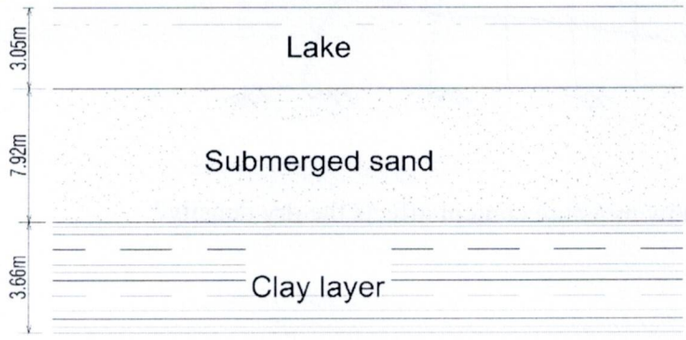
2. (a) Draw a three-phase diagram of a soil mass. From this diagram show that, $e = \frac{n}{1-n}$ with usual notation **05**

(b) The data from a standard proctor compaction test on a soil (G_s=2.65) is given below. Plot the compaction curve with zero air void line and find the OMC and MDD **05**

Standard Proctor Test						
Water Content (%)	9.3	11.8	14.3	17.6	20.8	23.0
Dry density (t/m^3)	1.691	1.715	1.755	1.747	1.685	1.619

3. (a) What are the Atterberg limits. Define Plasticity index and Flow index. **04**

(b) A Clay layer 3.66m thick rests beneath a deposit of submerged sand 7.92m thick. The top of the sand is located 3.05m below the surface of a lake. The saturated unit weight of the sand is 19.62 kN/m^3. Compute (a) The total vertical pressure, (b) the pore water pressure, (c) the effective vertical pressure at mid height of the clay layer **06**



4. (a) Establish the relationship $\rho_d = \frac{G_s \gamma_w}{1+e}$ with usual notations **06**

(b) From the following Data complete the table and draw a sieve analysis curve. **04**

Sieve No.	Opening (mm)	Sieve Wt (gm)	(Sieve+Soil) Wt (gm)	Weight of soil retained (gm)	Percent Retained	Cumulative Percent Retained (gm)	Percent Finer
4	4.75	521	521	0	0	0	
8	2.36	491.8	504	12.2	4.07	4.07	
16	1.18	426	450.5	24.5	8.17	12.24	
30	0.60	401.8	490	88.2	29.4	41.64	
50	0.297	375.5	478	102.5	34.17	75.81	
100	0.149	355.30	410	54.7	18.23	94.04	
200	0.75	351.1	368.2	17.1	5.7	99.74	
Pan		364.2	365	0.8	-	-	

PART- B

(Answer any three questions)

5. **(a)** Define Compaction and Consolidation. What Factor affecting compaction? **04**

(b) An earth embankment is compacted at a water content of 18% to a bulk density of 19.2 kN/m^3. If the specific gravity of the sand is 2.7, find the void ratio and the degree of saturation of the compacted embankment. **06**

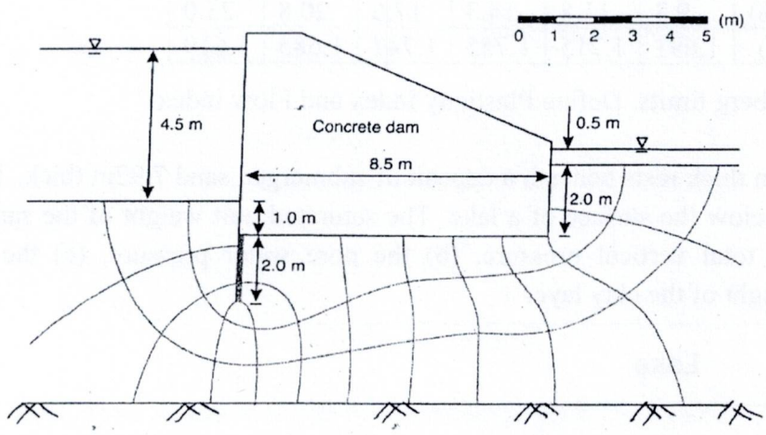
6. **(a)** Describe Darcy's law. Also draw the relationship nature of variation of velocity and hydraulic gradient. **02**

(b) Differentiate among coefficient of permeability, absolute permeability and relative permeability **03**

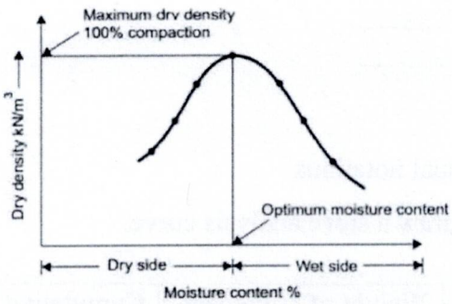
(c) A sand sample of 35 cm^2 cross sectional area and 20 cm long was tested in a constant head permeameter. Under a head of 60 cm, the discharge was 120 ml in 6 min. The dry weight of sand used for the test was 1120 g, and $G_s = 2.68$. Determine (a) the hydraulic conductivity in cm/sec, (b) the discharge velocity, and (c) the seepage velocity. **05**

7. **(a)** Seepage takes place beneath the concrete dam with vertical cut off (2 m length) is shown in figure. The permeability of the fine, silty sand beneath the dam is 3.5 x 10^{-4} cm/sec. Find the seepage loss in m^3/day. **06**

a)



(b) From following graph describe how moisture content affects the dry density? **04**



8. **(a)** What is shear strength of soil? What are the factors influencing the shear strength? **03**

(b) Based on drainage conditions of shear test, describe Unconsolidated undrained test, and Consolidated Undrained test **03**

(c) A Layer of soft clay is 6m thick and lies under a newly constructed building. The weight of sand overlying layer produces pressure of 260kN/m2 and the new construction increases the pressure by 100 kN/m2. If the compression index is 0.5, compute Settlement. Water content is 45%, and Specific gravity of soil is 2.65. **04**