University of Asia Pacific
Department of Civil Engineering
Mid Term Examination Fall 2021
Program: B.Sc. Engineering (Civil)

Course Title: Project Planning and Management — Course Code: CE 401
Time: 1 Hour — Credit Hours: 3.00 — Full Marks: 60

Answer all the questions.

1. (i) "Administration is a thinking and decision-making function whereas Management is an executing function." **[15]**
   In reference to the above quoted statement, compare between management and administration on the basis of nature, functions and required skills.

2. Draw the bar chart for "**Finalization of designs and work order**" for a **Bridge Construction Project**. Assume appropriate activities and their relationships. Number of total activities and the duration of the project should be as follows: **[15]**

Last two digits* of your Student ID	Number of total activities	Duration of the project (Weeks)
01-15, 31-45, 61-75	8	27
16-30, 46-60, 76-99	7	25

*If your Student Id is 18105001, then the last two digits of your Student ID is **01.**

3. The expected time of completion (in days) for each activity of a network is shown in **Fig. 1(a)** and **Fig. 1(b)**. ***Select one from these two figures for you in accordance to the following Table.***

Condition	Figure
If the summation of the last two digits** of your Student ID is an **Odd Number**. (**If your Student Id is 18105001, then the summation of the last two digits of your Student ID = **0 + 1 = 1, which is an Odd Number**).	**Fig. 1(a)**
If the summation of the last two digits*** of your Student ID is an **Even Number**. (***If your Student Id is 18105002, then the summation of the last two digits of your Student ID = **0 + 2 = 2, which is an Even Number**).	**Fig. 1(b)**

For your selected network:

(i) Determine the Earliest Expected Time and Latest Allowable Occurrence Time for each event. **[20]**

(ii) Determine the slack for various events; (*The Scheduled Completion Time of the project = The Latest Allowable Occurrence Time of the Final Event = The Earliest Expected Time of the Final Event*). **[05]**

(iii) Show the Critical Path on the diagram. **[05]**

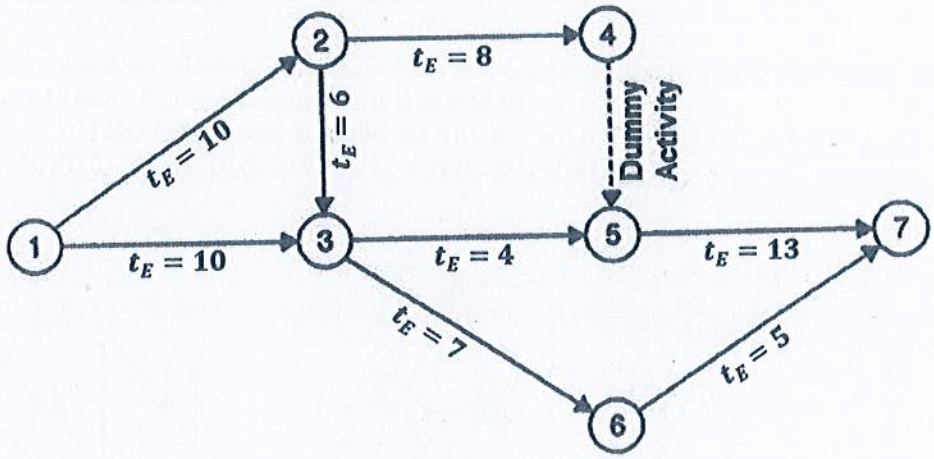

Fig. 1(a)

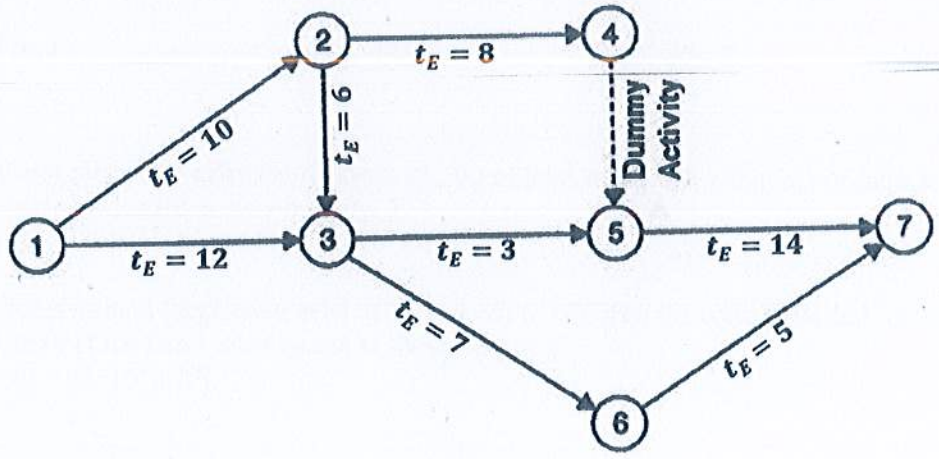

Fig. 1(b)

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University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall 2021
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering III
Time: 1 hour
Credit Hour : 3.0
Course Code: CE 411
Full Marks: 40 (= 4 × 10)

ANSWER ALL QUESTIONS. Any missing data can be assumed reasonably.

1. Identify zero-force members of the truss loaded as shown in ***Fig. 1***.
   Determine the horizontal and vertical displacements of joint ***a***.
   Also calculate the member forces
   [Given: EA/L = 1200 k/ft].

2. Ignore zero-force members of the space truss ***abcdefghij*** shown in ***Fig. 2*** and apply boundary conditions to formulate its stiffness matrix and load vector
   [Given: S_x = 1200 k/ft, Nodal Coordinates (ft) are *a*(0,0,0), *b*(3,10,0), *c*(6,20,0), *d*(6,20,–8), *e*(3,10,–8), *f*(0,0,–8), *g*(9,10,0), *h*(9,10,–8), *i*(12,0,–8) and *j*(12,0,0)].

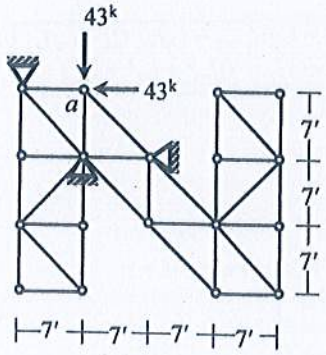


Fig. 1

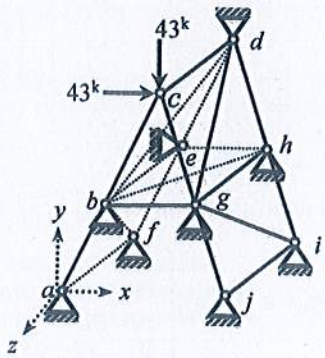


Fig. 2

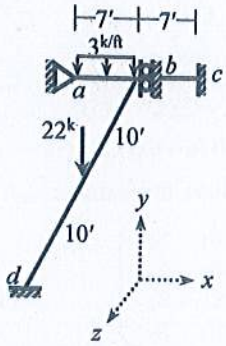


Fig. 3

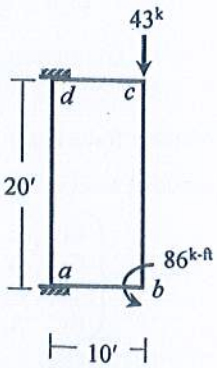


Fig. 4

3. Use stiffness method to calculate rotations (θ_x, θ_z) of joint ***a*** and deflection (u_y) of joint ***b*** of the grid system ***abcd*** loaded as shown in ***Fig. 3***
   [Given: EI = 43×10^3 k-ft^2 and GJ = 12×10^3 k-ft^2].

4. Use stiffness method (neglecting axial deformations) to calculate the deflections and rotations of joints ***b*** and ***c*** of the frame ***abcd*** loaded as shown in ***Fig. 4***
   [Given: EI = 43×10^3 k-ft^2].

List of Useful Formulae for CE 411

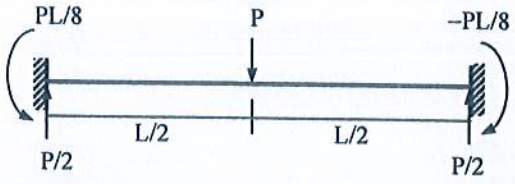
* The stiffness matrix K_m^G of a 2D truss member in the global axis system is given by

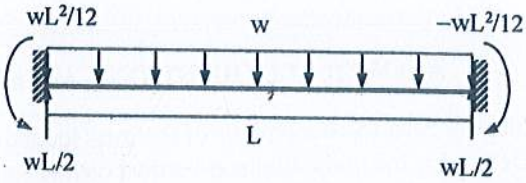
$$K_m^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix}$$

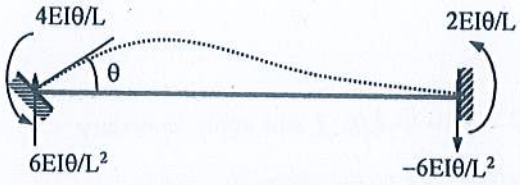
and Truss member force, $P_{AB} = S_x [(u_B - u_A) C + (v_B - v_A) S]$

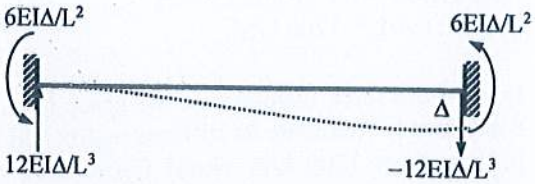
[where $C = \cos\theta$, $S = \sin\theta$]

Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings









* The stiffness matrix of a 3D truss member in the global axes system [using $C_x = \cos\alpha$, $C_y = \cos\beta$, $C_z = \cos\gamma$] is

$$K_m^G = S_x \begin{pmatrix} C_x^2 & C_xC_y & C_xC_z & -C_x^2 & -C_xC_y & -C_xC_z \\ C_yC_x & C_y^2 & C_yC_z & -C_yC_x & -C_y^2 & -C_yC_z \\ C_zC_x & C_zC_y & C_z^2 & -C_zC_x & -C_zC_y & -C_z^2 \\ -C_x^2 & -C_xC_y & -C_xC_z & C_x^2 & C_xC_y & C_xC_z \\ -C_yC_x & -C_y^2 & -C_yC_z & C_yC_x & C_y^2 & C_yC_z \\ -C_zC_x & -C_zC_y & -C_z^2 & C_zC_x & C_zC_y & C_z^2 \end{pmatrix}$$

$C_x = L_x/L$, $C_y = L_y/L$, $C_z = L_z/L$
where $L = \sqrt{[L_x^2 + L_y^2 + L_z^2]}$

* Member force $P_{AB} = S_x [(u_B - u_A) C_x + (v_B - v_A) C_y + (w_B - w_A) C_z]$

* Ignoring axial deformations, the matrices K_m^L and G_m^L of a frame member in the local axis system are

$$K_m^L = \begin{pmatrix} S_1 & S_2 & -S_1 & S_2 \\ S_2 & S_3 & -S_2 & S_4 \\ -S_1 & -S_2 & S_1 & -S_2 \\ S_2 & S_4 & -S_2 & S_3 \end{pmatrix}$$

$$G_m^L = (P/30L) \begin{pmatrix} 36 & 3L & -36 & 3L \\ 3L & 4L^2 & -3L & -L^2 \\ -36 & -3L & 36 & -3L \\ 3L & -L^2 & -3L & 4L^2 \end{pmatrix}$$

where $S_1 = 12EI/L^3$, $S_2 = 6EI/L^2$, $S_3 = 4EI/L$, $S_4 = 2EI/L$

*The general form of the stiffness matrix for any member of a 2-dimensional frame is

$$K_m^G = \begin{pmatrix} S_xC^2+S_1S^2 & (S_x-S_1)CS & -S_2S & -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & -S_2S \\ (S_x-S_1)CS & S_xS^2+S_1C^2 & S_2C & -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & S_2C \\ S_2S & S_2C & S_3 & S_2S & -S_2C & S_4 \\ -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & S_2S & S_xC^2+S_1S^2 & (S_x-S_1)CS & S_2S \\ -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & -S_2C & (S_x-S_1)CS & (S_xS^2+S_1C^2) & -S_2C \\ -S_2S & S_2C & S_4 & S_2S & -S_2C & S_3 \end{pmatrix}$$

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Fall 2021

Course # CE 441 — Course Title: Geotechnical Engineering II
Full Marks: 40 — Time: 1 Hour

Answer the following questions

1. (a) What is subsurface exploration in terms of geotechnical engineering? Mention two major purposes of subsurface exploration. Step down the phases (mention only) of geotechnical subsurface exploration. 6

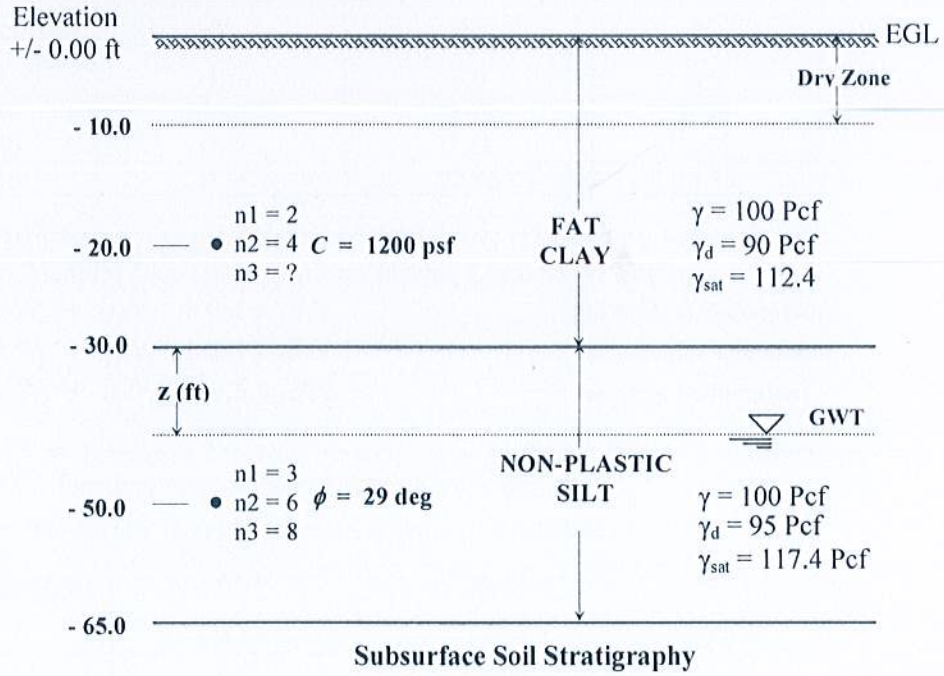
   (b) Compare on the extent and significant depth up to which exploration is generally intended from the perspective of geotechnical engineering with other types of exploration as such in the field of agronomy and petroleum engineering. 6

2. For a site actual depth of geotechnical exploration is maintained as $2.5D + D_f$. Utilizing 10% stress criterion and the following information, check, whether this depth of exploration is adequate. Justify your answer. 10

   Square foundation system.
   P_{max} = 400 Kips
   q_a = 4.0 ksf
   Foundation bearing level is to be 10 feet below EGL.

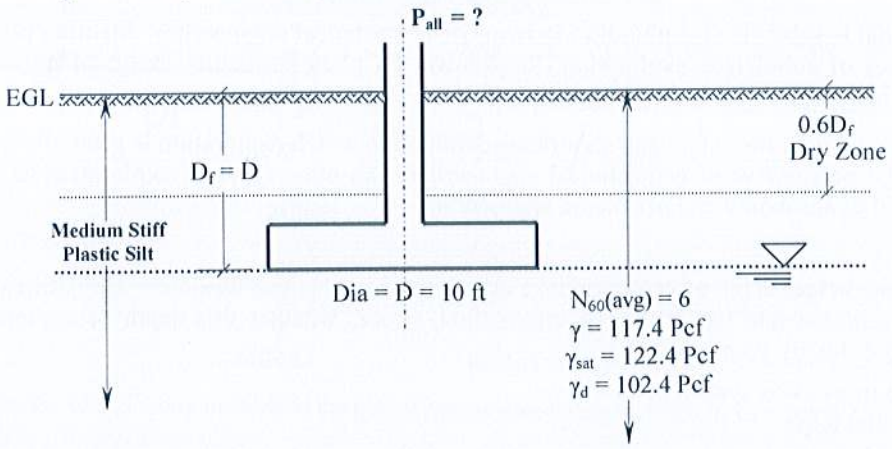
3. A geotechnical site investigation was conducted at a site in Bangladesh. Estimate n3 at corresponding depth of 20 ft below EGL. Also estimate z as shown in the figure below. Use *APPENDIX A* in conjunction with the following information: 10
   - Borehole dia = 4 inches
   - No liner was used during drilling
   - Hammer efficiency as 52.6%

   n1 = SPT blow counts for first 6-inch penetration
   n2 = SPT blow counts for second 6-inch penetration
   n3 = SPT blow counts for third 6-inch penetration



Subsurface Soil Stratigraphy

4. Using Terzaghi's bearing capacity equation (TBCE), determine the allowable column load for the following circular spread footing. Use F. S. = 2.5. 8



APPENDIX A

Parameter for 60% Energy Correction For Field SPT

E_m = Hammer Efficiency (Donut + Cathed) = 0.55 to 0.60

C_B = Correction for Borehole Diameter = 1.0 (For Dia 2.5" – 4.5")
= 1.05 (For Dia of 6")
= 1.15 (For Dia 8")

C_S = Correction for Sampler = 1.0 Standard Sampler
= 1.2 Sampler Without Liner

C_R = Correction for Rod Length = 0.75 for L = (3-4) m
= 0.85 for L = (4-6) m
= 0.95 for L = (6-10) m
= 1.0 for L > 10 m

Relevant Empirical Correlations

$$CF_1 = \sqrt{\frac{2000}{\sigma_{v0}'}}$$

$$q_{unc} = 300\ N_{60}$$

$$\phi' = 15 + \sqrt{20(N_1)_{60}}$$

BEARING CAPACITY OF SOIL

(A) TERZAGHI'S ULTIMATE BEARING CAPACITY EQUATIONS

Applicable For Dense/Stiff Soil Considering General Shear Failure

c-part q-part γ-part

$$q_u = 1.3\, c'N_c + q_f N_q + 0.4\, \gamma_{bf} B N_\gamma \quad \text{(For Square Foundation)}$$

$$q_u = 1.3\, c'N_c + q_f N_q + 0.3\, \gamma_{bf} B N_\gamma \quad \text{(For Circular Foundation)}$$

$$q_u = c'N_c + q_f N_q + 0.5\, \gamma_{bf} B N_\gamma \quad \text{(For Strip Foundation)}$$

Table: Terzaghi's Bearing Capacity Factors (General Shear Failure)

φ′ (degree)	N_c	N_q	N_γ
0	5.7	1.0	0.0
10	9.61	2.69	0.56
20	17.69	7.44	3.64
30	37.16	22.46	19.13

(B) TERZAGHI'S MODIFIED ULTIMATE BEARING CAPACITY EQUATIONS

Applicable For Medium Dense/Stiff Soil Considering Local Shear Failure

$$q_u = 0.867\, c'N_c' + q_f N_q' + 0.4\, \gamma_{bf} B N_\gamma' \quad \text{(For Square Foundation)}$$

$$q_u = 0.867\, c'N_c' + q_f N_q' + 0.3\, \gamma_{bf} B N_\gamma' \quad \text{(For Circular Foundation)}$$

$$q_u = 0.67\, c'N_c' + q_f N_q' + 0.5\, \gamma_{bf} B N_\gamma' \quad \text{(For Strip Foundation)}$$

N_c', N_q', N_γ' = Terzaghi's Modified Bearing capacity factors (for local shear failure) that are functions only of the soil friction angle φ′

Table: Terzaghi's Bearing Capacity Factors (Local Shear Failure)

φ′ (degree)	N_c'	N_q'	N_γ'
0	5.7	1.0	0.0
10	8.02	1.94	0.24
20	11.85	3.88	1.12
30	18.99	8.31	4.39

University of Asia Pacific
Department of Civil Engineering
Midterm Examination – Fall 2021
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering II | Course Code: CE 451
Time: 1 hour | Credit Hour: 3:00 | Full Marks: 60

1. a) What are the special qualities required for bitumen to be used in pavement construction? How these qualities are be achieved? (6)

   b) Differentiate between the different types of rigid pavement. (4)

2. a) Determine the proportions of separate aggregates (coarse, fine and filler materials) to make a typical mix for highway pavement construction that will give a gradation within the specified limits shown in Table 1. Table 1 also shows the results of a sieve analysis of samples from the materials available. (15)

Table 1

Passing Sieve Designation (mm)	Retained on Sieve Designation	Required Gradation Range	Percent by Weight		
			Coarse Aggregate	Fine Aggregate	Mineral Filler
19	½ in	5-45	25		
12.5	3/8 in	10-65	43		
9.5	No 4	8-35	55		
4.75	No 10	5-60	16	15	
2	No 40	20-45		32	25
0.075	-	4-10		6	33

   b) Design an asphalt concrete mixture for the pavement [question 2(a)] you have to construct to support light traffic. Use the aggregate characteristics obtained from previous question 2 (a). Table 2 shows data obtained from Marshall method. Determine the optimum asphalt content for this mix for the specified limits given in Table 3. (The nominal maximum particle size in the aggregate mixture is 1 in.) (25)

   c) Do you think this mixture is suitable for the construction of a highway pavement? Does the aggregate used in the mix design can withstand compressive load and impact load comes from the moving traffic and adhere to bitumen; Justify your answer. (10)

Table 2: Marshall Test Result

Asphalt % by Weight of Total Mix	Weight of Specimen in air (gm)	Weight of Specimen in water (gm)	Stability (lb)	Flow (0.01 in)	Maximum Specific Gravity of Paving Mixture
4	1505	890	1600	5	2.65
4.5	1670	750	1700	8	2.74
5.0	1252	930	1500	7	2.55
5.5	1327	880	1400	9	2.73
6.0	1431	760	1500	6	2.60

Table 3 Suggested Test Limit

Marshall Method Mix Criteria	Light Traffic	Medium Traffic	Heavy Traffic
Compaction (No. of blows each end of Specimen)	35	50	75
Stability N (lb)	3336(750)	5338(1200)	8006(1800)
Flow 0.25 mm (0.01 in)	8 to 18	8 to 16	8 to 14
Air Voids (%)	3 to 5	3 to 5	3 to 5
Mineral Percentage of Voids in Mineral Aggregates			
Standard Sieve Designation		%	
No. 16		23.5	
No. 4		21	
No. 8		18	
3/8 in.		16	
½ in.		15	
¾ in.		14	
1 in.		13	
1 ½ in.		12	
2 in.		11.5	
2 ½ in.		11	

Required Formula:

$$G_{mb} = \frac{W_a}{W_a - W_w} \qquad P_a = 100\frac{G_{mm} - G_{mb}}{G_{mm}}$$

$$G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{\frac{P_{ca}}{G_{bca}} + \frac{P_{fa}}{G_{bfa}} + \frac{P_{mf}}{G_{bmf}}} \qquad G_{se} = \frac{100 - P_b}{(100/G_{mm}) - (P_b/G_b)}$$

University of Asia Pacific
Department of Civil Engineering
Midterm Examination, Fall 2021 Semester
Program: B.Sc. Engineering (Civil)

Course code: CE 461
Course title: Irrigation and Flood Control
Time: **1 hour** Total marks: **40**

Answer all questions

1. a) Propose four alternative strategies that could help Bangladesh to reduce flood in monsoon season as well as increase the crop production and irrigation efficiency in non-monsoon season. **(6)**

   b) Explain the differences between weir and dam. **(2)**

2. a) Explain how salinity of soil and irrigation water effects the leaching requirement. **(3)**

   b) Do you agree that promoting conjunctive use of water will be beneficial for reducing water scarcity, increase groundwater availability and irrigation efficiency in Bangladesh? Justify your answer. **(5)**

3. a) Do you agree that too much reliance on "embankments" for flood management in Bangladesh is sustainable in the long run? Justify your answer. **(5)**

   b) Explain how integrated water resources management could help promoting sustainable flood and irrigation management in Bangladesh. **(5)**

4. Estimate depth of ground water evaporation that may turn **X** cm depth of soil saline over a period of **Y** months. The electrical conductivity of groundwater is 5.5 mmhos/cm. The electric conductivity (EC) value of saturated extract of soil is 1.1 mmhos/cm. The soil has a mean bulk density of 1.45 g/cm^3 and saturation point of 43 percent. The density of water is assumed as 1 g/cm^3. (**X** = 01 + your roll number; **Y** = your roll number) **(4)**

5. a) Do you agree that *drip irrigation* is an appropriate irrigation method for the food production in Bangladesh? Justify your answer. **(6)**

   b) Determine the time required to irrigate a strip of land containing sandy loam from a tube-well with a discharge of 0.12 m^3/s by using border flooding method. The infiltration capacity of the soil may be taken as 6.9 cm/h and the average depth of flow on the field as **Z** cm. (**Z** = 2.90 + last digit of your roll number). **(4)**