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

Course Title: Principles of Management | Course Code: IMG 301
Time: Two hours | Credit Hour: Two | Full Marks: 50

(Answer any five of the following questions.)

1. Describe formal and informal organization. 10
2. Analyze span of management with their advantages and disadvantages. 10
3. Explain the bases of power and empowerment policy with examples. 10
4. Write about organization culture. 10
5. Describe personal characteristics that a manager should possess. 10
6. Evaluate Maslow's hierarchy of needs theory of motivation. 10

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

Course Title: Structural Engineering II | Course Code: CE 313
Time: 3 hours | Credit Hour : 3.0 | Full Marks: 100

ANSWER ALL QUESTIONS. Assume any missing data reasonably.

PART-A

1. Analyze the frame in ***Fig.1*** by Force Method and draw the final bending moment diagram (Consider the vertical reaction at H as the redundant ...X1). **[14]**
P= Last Digit of Roll*3 + 20, EI=Constant.. Show all the Bending Moment diagrams (M_0,M_1 etc) with loads and reactions.

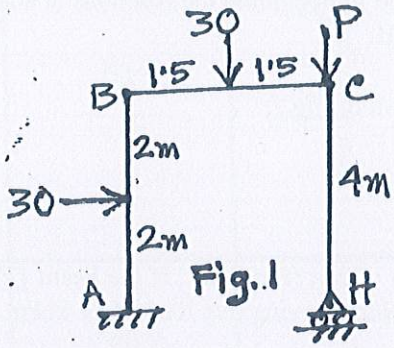


Fig.1

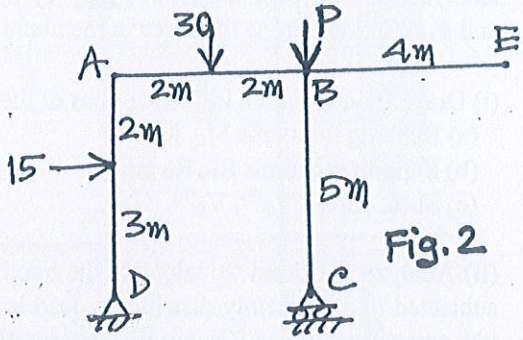


Fig.2

2. Calculate (i) the horizontal deflection at C and (ii) vertical deflection at E or rotation at E for the frame in ***Fig.2*** by the Unit Load Method.
P= Last Digit of Roll*3 + 20, EI=Constant. Show all the Bending Moment diagrams (M_0,M_1 etc) with loads and reactions. **[12]**

3. Analyze the Beam in ***Fig.3*** by Force Method and draw the final bending moment diagram (Consider the vertical reaction at C as the redundant ...X1). **[12]**
P= Last Digit of Roll*3 + 20, EI=Constant. Show all the Bending Moment diagrams (M_0,M_1 etc) with loads and reactions.

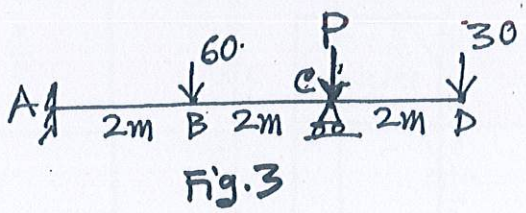


Fig.3

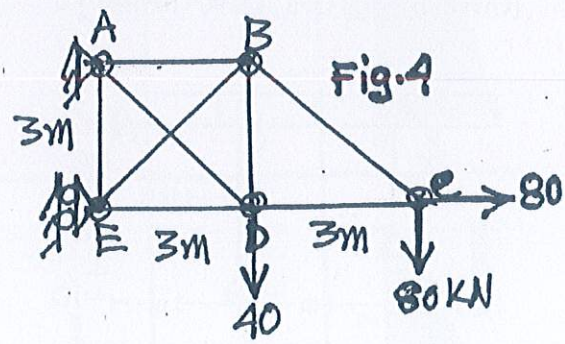


Fig.4

4. Analyze the Truss in ***Fig.4*** by Force Method and Calculate the final bar forces (Consider the bar force in BE as the redundant X1) **[12]**
EA is constant. Show all Bar force diagrams (N0, N1 etc) separately with loads, reactions and bar forces (Tension or compression)

PART-B

5. Analyze the frame shown in shown in ***Fig.5*** by Cantilever Method to draw the axial force and moment diagram of columns. **[10]**

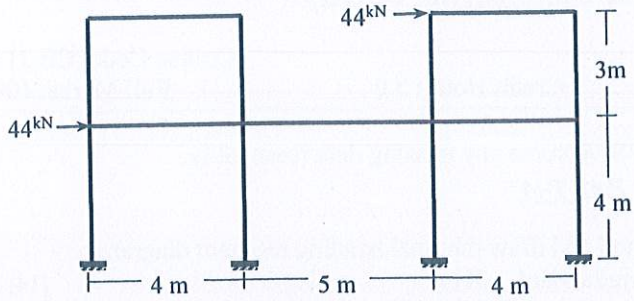


Fig.5

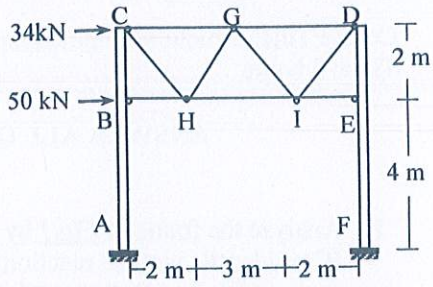


Fig.6

6. Analyze the mill bent shown in ***Fig.6*** by Portal Method to determine the reactions at support **A** and **F**. Also, determine the force in members **GD** and **CH**. **[05]**

7. (i) Draw the qualitative influence lines of the beam shown in ***Fig.7***, **[05]**
   (a) Bending moments M_C, M_G
   (b) Support reactions R_B, R_D and
   (c) Shear forces $V_D^{(L)}$, $V_E^{(L)}$

   (ii) Analyze the beam to calculate the maximum value of M_G (Positive) , if the beam ***(Fig.7)*** is subjected to a uniformly distributed dead load of 30 kN/m, moving live load of 14 kN/m and 44 kN concentrated load [Given: EI = constant]. **[10]**

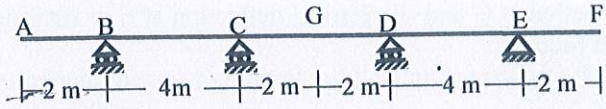


Fig.7

8. Use Moment Distribution Method to draw bending moment diagram of the frame shown in ***Fig.8*** [Given: E = 200 GPa , I = 90×10^6 mm^4]. **[15]**

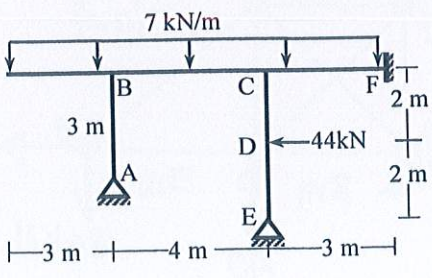


Fig.8

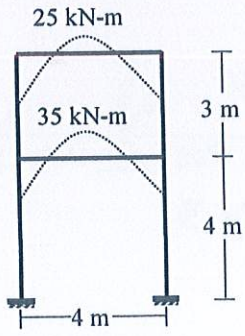
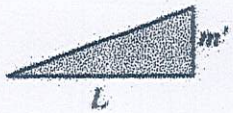
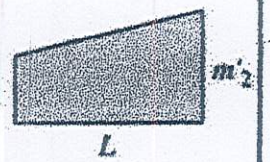
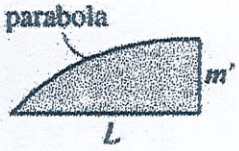
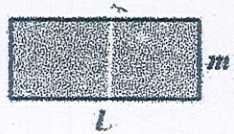
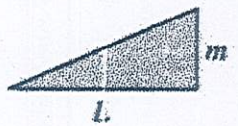
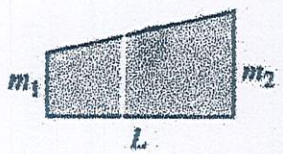
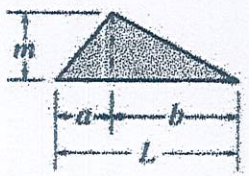
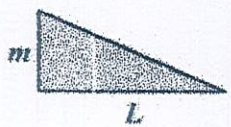


Fig.9

9. The positive moments of beams are shown in ***Fig.9*** .Analyze the frame to calculate gravity load using Vertical Load (Approximate) Method and draw the shear force diagram of the frame. **[05]**

For CE 313

Table for Evaluating $\int_0^L m\,m'\,dx$

$\int_0^L m\,m'\,dx$				
	$mm'L$	$\frac{1}{2}mm'L$	$\frac{1}{2}m(m'_1 + m'_2)L$	$\frac{2}{3}mm'L$
	$\frac{1}{2}mm'L$	$\frac{1}{3}mm'L$	$\frac{1}{6}m(m'_1 + 2m'_2)L$	$\frac{5}{12}mm'L$
	$\frac{1}{2}m'(m_1 + m_2)L$	$\frac{1}{6}m'(m_1 + 2m_2)L$	$\frac{1}{6}[m'_1(2m_1 + m_2) + m'_2(m_1 + 2m_2)]L$	$\frac{1}{12}[m'(3m_1 + 5m_2)]L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'(L + a)$	$\frac{1}{6}m[m'_1(L + b) + m_2(L + a)]$	$\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'L$	$\frac{1}{6}m(2m'_1 + m'_2)L$	$\frac{1}{4}mm'L$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: BSc in Civil Engineering

Course Title: Design of Concrete Structures II — Course Code: CE 317
Time: 3 hours — Credit Hour: 3.00 — Full Marks: 100

Assume reasonable values for any missing data. Symbols used have their usual meanings.
[Use $f_c' = 24$ N/mm^2 and $f_y = 420$ N/mm^2 for Questions 1 and 2]

QUESTION 1 [20 MARKS]

a. A corner panel of beam supported reinforced concrete slab of an office building as shown in **Figure 1** is to be designed. The slab is subjected to 7.8 kN/m^2 dead load (including self-weight, random wall and finishes) and 2.4 kN/m^2 live load. Thickness of the slab could be assumed as 150 mm. Apply the concept to design the short span of the slab for negative (supports) moments. The co-efficient of moments are shown in Appendix. [10 Marks]

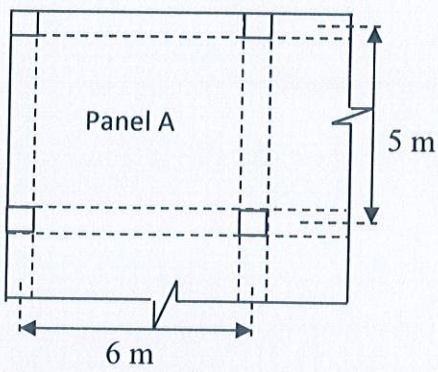


Figure 1. Interior slab panel

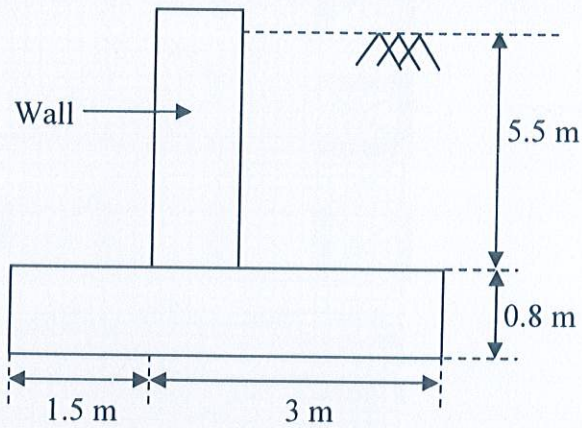


Figure 2: Retaining wall of an artificial lake

b. A reinforced concrete cantilever retaining wall of an artificial lake as shown in **Figure 2** is subjected to lateral load due to soil and pore water (50% void) pressure. Thickness of the wall could be considered as 700 mm. Apply the concept to design the wall (only) for flexure. The density of soil and water are 1800 kg/m^3 and 1000 kg/m^3 respectively; coefficient of active soil pressure is 0.33. Assume required data to design the wall. [10 Marks]

QUESTION 2 [20 MARKS]

a. A simply supported post-tensioned pre-stress concrete beam of 10-meter span is carrying 20 kN/m live load and 30 kN/m dead load (including self-weight of beam). Section of the rectangular beam is 200 mm x 800 mm. A tendon could be provided as (i) straight at the centroid of the section or, (ii) 200 mm below the centre at mid span of the beam. Apply the concepts to analyse the section to obtain the stresses (top and bottom) of the section at mid-span of the beam under dead and live loading condition with minimum pre-stressing forces in both cases. [10 Marks]

b. A reinforced concrete column (300 mm x 600 mm) is supported by pad footing. The column is subjected to 1000 kN of dead load and 400 kN of live load. The bearing capacity of soil is 180 kN/m^2. Apply the concept to design the footing for long span. The depth (h) of footing could be assumed as 800 mm. [10 Marks]

QUESTION 3 [20 MARKS]

The floor slab layout plan of a 10 storeyed office (live load 2.4 kN/m^2) building is shown in **Figure 3**. The floor will be constructed with **flat plate slab system** and it carries 3 kN/m^2 dead load due to random wall and floor finishes. Design the **long span column strip** of the slab **panel A** as shown in **Figure 3**. Assume required data for Design. Thickness of the slab could be considered as minimum in design as per the requirements of code of practice. [20 Marks]

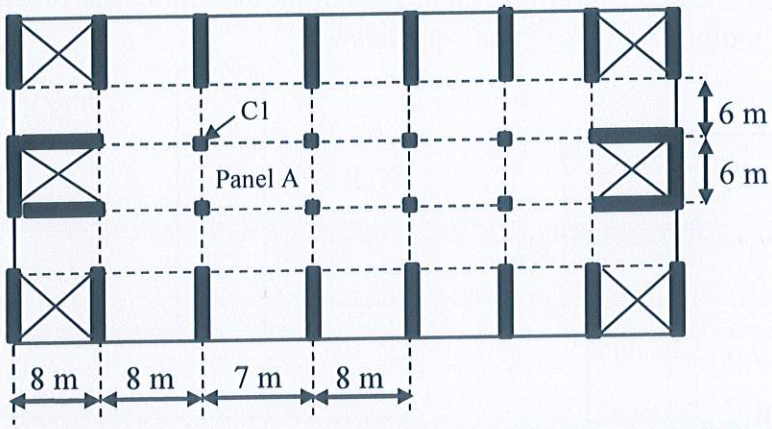


Figure 3. Structural model (floor plan) of high-rise building

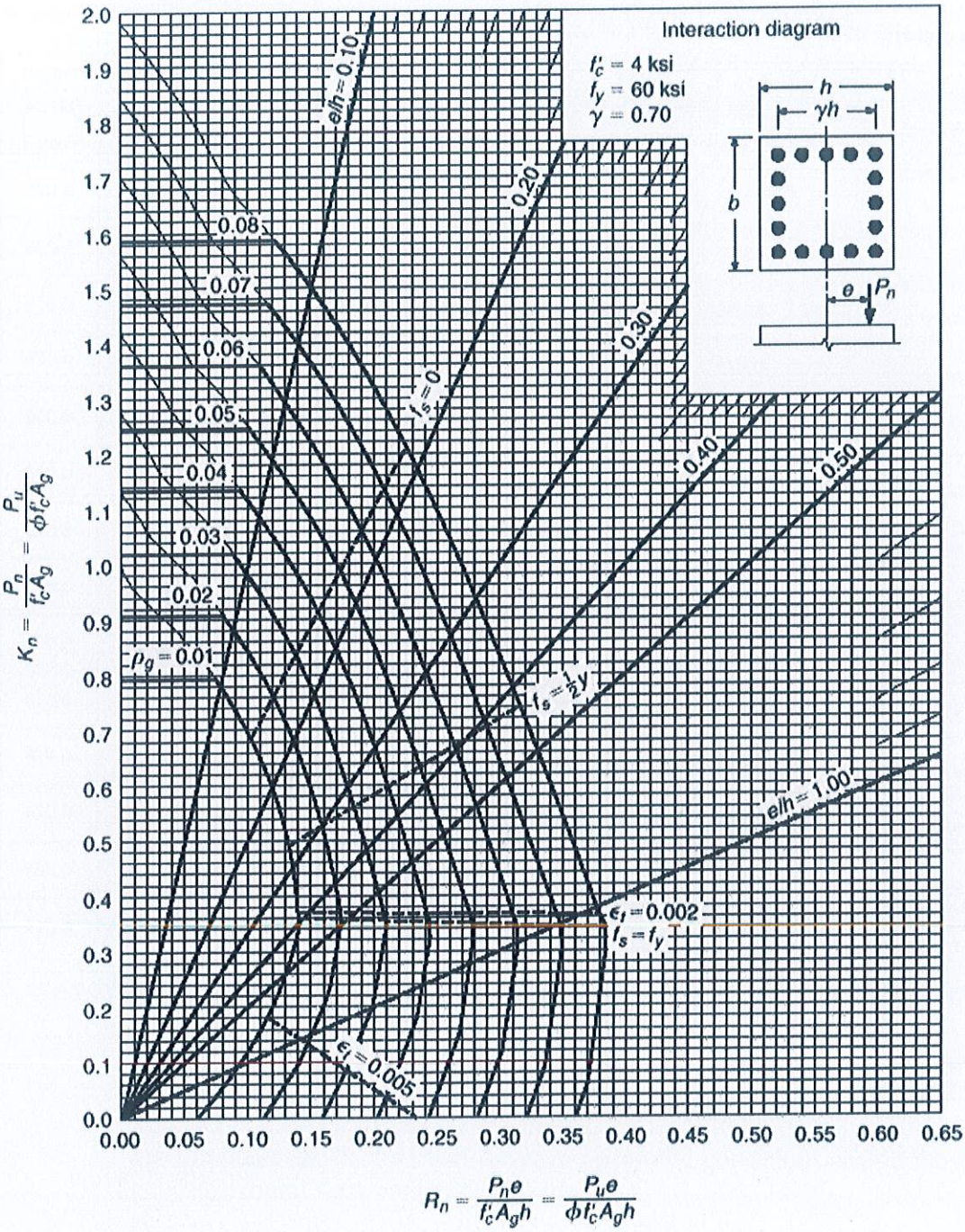
QUESTION 4 [20 MARKS]

The ground floor column of the structure of **Question 3** as shown in **Figure 3** (Column C1) has to be designed. The column is subjected to equivalent uni-axial bending moment of 450 kN.m due to lateral load. Design the column as tie column considering the possible minimum dimension of the column in design. Assume required data for design. [20 Marks]

QUESTION 5 [20 MARKS]

Pile foundation will be used for the structure of **Question 3**. The capacity and size of bore pile could be considered as per engineering judgment. Propose a solution for minimum thickness of pile cap for the column of C1 (Question 3) as shown in **Figure 3** in accordance to all possible considerations of code of practice. Design the pile cap with the minimum thickness. Assume required data for design. [20 Marks]

APPENDIX


Interaction diagram
f'_c = 4 ksi
f_y = 60 ksi
γ = 0.70
h
γh
b
e
P_n
e/h = 0.10
0.20
0.30
0.40
0.50
e/h = 1.00
0.08
0.07
0.06
0.05
0.04
0.03
0.02
ρ_g = 0.01
f_s = 0
$f_s = \frac{1}{2} f_y$
$f_s = f_y$
ϵ_t = 0.002
ϵ_t = 0.005
$K_n = \frac{P_n}{f'_c A_g} = \frac{P_u}{\phi f'_c A_g}$
$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_u e}{\phi f'_c A_g h}$
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65

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

Course Title: Environmental Engineering II — Course Code: CE 333
Time: 3.00 Hours — Credit Hour: 3.00 — Full Marks: 120

There are five (5) questions. Answer all the questions. Assume any missing data. All questions bear equal marks [5×24=120]

1. (a) Discuss the necessity of maintaining an appropriate distance between the pit latrine and drinking water tubewell. **[8]**

   (b) Calculate the dimension and other required operational parameters of: (i) rectangular sedimentation tanks; and (ii) circular tanks employing the following dataset: **[16]**

   - Average flow rate, Q_{av}=20,000 m^3/d.
   - Peak hourly flow rate, Q_p=40,000 m^3/d.
   - The specific gravity of the particles to be removed, s=1.25.
   - Diameter of the particles, d=100 μm.
   - Darcy-Weisbach fraction factor, f=0.025.
   - Scouring material constant, k=0.05.

   Use the following equations if required.

   $$V_H = \left[\frac{8k(s-1)gd}{f}\right]^{1/2} \qquad \text{BOD/TSS removal} = \frac{t}{a+bt}$$

2. (a) Explain why the bacterial growth curve could not be accurately explained with the first-order kinetics? **[8]**

   (b) Illustrate the interrelation between the F/M ratio and organic removal performance in an activated sludge process. Provide reasoning on why compressed air is applied in the tapered aeration process. **[16]**

3. (a) Indicate the factors that develop anaerobic conditions inside the bed matrix of horizontal flow constructed wetlands. **[8]**

   (b) Illustrate the mechanisms that would allow the occurrence of denitrification prior to nitrification in a tertiary wastewater treatment system. "Phosphorus pre-precipitation is better than simultaneous phosphorus precipitation"-justify the statement. **[16]**

4. (a) Describe the advantages of two-stage high-rate anaerobic sludge digesters over single-stage anaerobic sludge digesters. **[8]**

   (b) Mean wastewater flow from an area is 5000 m^3/d during December (winter) and 8000 m^3/d during July (summer). The average temperature in December is 8^0C, and in July average temperature is 35^0C. The mean concentration of influent BOD_5 is 500 mg/L. Reaction coefficient K is 0.23 d^{-1} at 20^0C, and θ is 1.06. Select and design a facultative pond treatment system for the area to remove 90% of the incoming BOD. Use the following graph if required. **[16]**

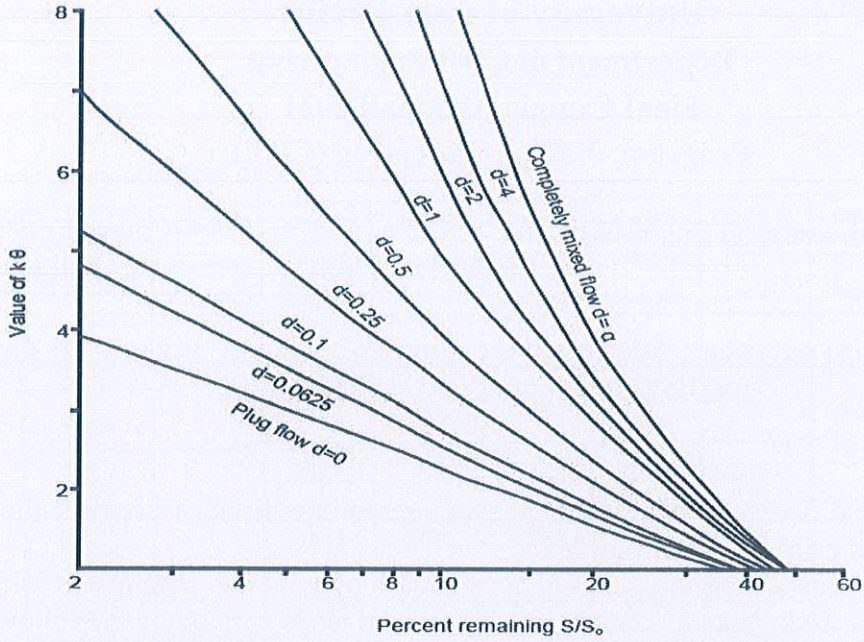


Figure. Graphical plot of the Thirumurthi equation.

5. As an environmental engineer, you have been assigned to design municipal, domestic and industrial wastewater treatment systems. You have collected wastewater samples and analyzed the samples in a laboratory following standard protocols. The environmental and chemical parameters of the wastewater samples are provided in the following table. [24]

	Unit	**Municipal**	**Domestic**	**Industrial**
pH	--	16	7.3	5
DO	mg/L	1.0	1.2	0.8
NH_4-N		20	----	700
NO_3-N		5	50	5
TN		15	60	720
BOD		700	300	1800
COD		200	550	5000
TSS		700	500	4700
TP		4	2	----

Answer the following questions:

I. Assess the reliability/accuracy of the provided data set.
II. Select an appropriate activated sludge process for domestic wastewater treatment.
III. Choose natural systems for industrial wastewater treatment. *Land availability is limited due to proposed expansion of the industry.*

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

Course Title: Transportation Engineering I (Transport and Traffic Design) Course Code: CE 351
Time: 3 hours Credit Hour: 3.00 Full Marks: 150

There are **five** questions. Answer **all** of them.

1. a) Animate briefly the different components of Passing Sight Distance for a two-lane highway in left driving rule. 12
   b) What are the different types/ techniques of traffic calming? Explain any one of the types. 8
   c) Design the offsets at some interval for a transition curve which is to be employed to join the ends of a 7^0 circular curve with the straight. The length of transition curve is 300 m. Draw the transition curve. 10

2. a) Briefly explain the impacts of transportation sector in Economic and Cultural developments of Bangladesh. 16
   b) An accident evaluator hypothesized that a truck collided with a tree at a speed of 22 km/hr. determined by her judgment of damage. Examining the accident location she identified skid marks of 90 m on the Asphalt pavement (f=0.65) and 45 m on the grass shoulder (f=0.35). There is +4% grade. Determine the speed of the vehicle at the commencement of skid marks. 14

3. a) 50 vehicles navigating a section of a primary road with spot speeds as below: 25
   83, 81, 78, 57, 47, 65, 39, 58, 37, 72, 32, 56, 49, 74, 54, 49, 56, 51, 35, 55, 67, 63, 48, 77, 42, 84, 53, 75, 40, 33, 62, 65, 72, 47, 42, 68, 52, 76, 55, 79, 67, 41, 85, 44, 53, 87, 66, 36, 68, 67.
   Determine the, safe speed, design speed, average speed, median speed and lower limit of speed. Consider pace as 11-20, 21-30 and so on.
   b) List the problems faced by pedestrians during striding in sidewalks in Dhaka city. 5

4. a) Determine the minimum length of sag vertical curve that must be provided to connect a -7% grade with +2% grade on a highway with a design speed 85 mi/hr. Driver reaction time is the AASHTO standard 2.5 sec for simple highway stopping reactions. Assume height of driver's eye to be 3.5ft, object height to be 2.5 ft. 14
   b) Mayor of city corporation is planning to erect a digital notice board at a distance 40 ft from the centerline of the inside lane near the Mogbazar-Mouchak flyover. The safe stopping sight distance of the road is 225 ft. The inside lane in 12 ft wide. Compute the speed limit of that section of the roadway. Assume reaction time as 2.5 second and friction factor as 0.62. 16

5. a) A driver tests examines the braking ability of her car revealed that he needed 35 ft more to stop her car when driving down grade on a particular road than when driving upgrade at 75 mph. Assume coefficient of friction 0.34. Determine the braking distance downgrade and the grade of the highway at that section of the road. 18
   b) An urban secondary road with 65 ft pavement width having a reflectance of 9% carries a maximum of 2250 vph at night-time in both directions. Design the lighting system considering Tungsten source with mounting height of 22 ft and a maintenance factor of 0.87. Draw the lighting layout. 12

Table for Question 5 b)

TABLE 1 RECOMMENDED AVERAGE ILLUMINATION (LUMENS/FT^2)

Pedestrian traffic[1]	Vehicular traffic[2] (vph)			
	Very light (<150 vph)	Light (150 – 500 vph)	Medium (500 – 1,200 vph)	Heavy (>1,200 vph)
Heavy	-	0.8	1.0	1.2
Medium	-	0.6	0.8	1.0
Light	0.2	0.4	0.6	0.8

Notes: (1) Heavy: As on main business street
Medium: As on secondary business streets
Light: As on local streets
(2) Night hour flow in both directions

TABLE 2 ADJUSTMENT FACTORS FOR RECOMMENDED AVERAGE ILLUMINATION VALUES

Surface Reflectance	Adjustment Factors
3 % or less	1.5
10%	1.0
20% or more	0.75

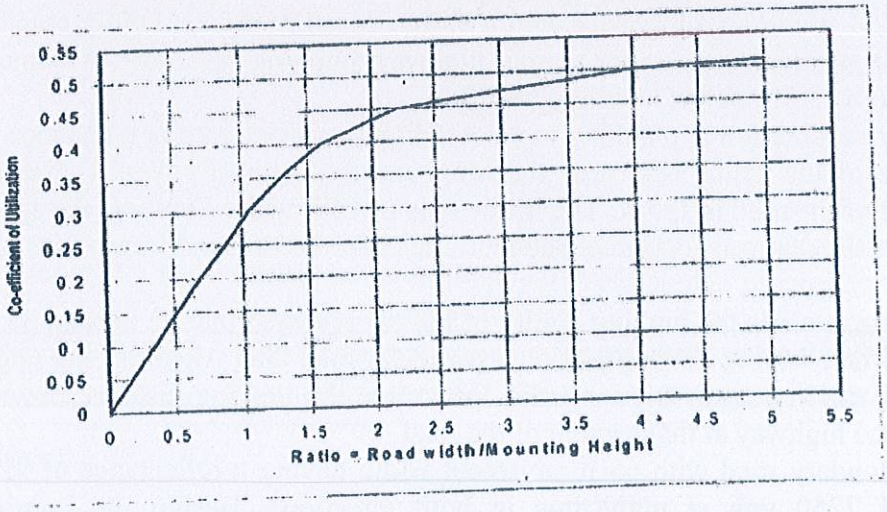
TABLE 3 LIGHTING SOURCE CHARACTERISTICS

Source Types	Expected Life (hrs)	Lighting Efficiency (Lumens/Watt)	Wattage (Watt)
Tungsten	1000	8 – 14	Up to 1000
Fluorescent	6000	50 – 75	Up to 250
Sodium	6000	100 – 120	Up to 160
Mercury	7500	20 – 60	Up to 400

TABLE 4 RECOMMENDED ARRANGEMENT OF STREET LIGHTING

Type of Arrangement	Pavement Width
One side	Width <= 30ft
Both sides – Staggered	30ft > Width <= 60ft
Both sides – Opposite	Width > 60ft

FIGURE 1 CO-EFFICIENT OF UTILIZATION CURVES (FOR LIGHT DISTRIBUTION TYPE III)



Note: Due to poor maintenance, the actual co-efficient of utilization is reduced by a factor usually 0.8 (i.e. taken as 80%).

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

Course Title: Engineering Hydrology
Time: 3.0 hour
Credit Hour: 3.0
Course Code: CE 363
Full Marks: 120

There are SEVEN questions. Answer all the questions.
Assume any missing data if needed

1. **(a)** Define infiltration with diagram. State the factors affecting infiltration. **[2+7=9]**
   (b) Define flood hydrograph. What are the characteristics of flood hydrograph? **[2+7=9]**
   (c) Define stage. Describe vertical and horizontal axis meter in brief. **[2+7=9]**
   (d) Define baseflow. Also discuss baseflow separation technique. **[2+7=9]**

2. Consider the following two catchment areas: **[12]**
   Two runoff coefficients are given 0.2 and 0.8.

	Catchment A	Catchment B
Slope	0.002	.02
Length of water travel	1500	3000
Soil Type	Sandy	Clay
Soil Condition	High vegetative cover	No vegetative cover
Area	200 km^2	300 km^2

Calculate the peak discharge for catchment **A** and **B** for a return period of 100 years applying the Rational method. Use IDF curves **(see figure IDF Curve in page 4)**. Also state the reason of one being higher than the other.

3. **(a)** Data from a stream gauging site is given below. Rating equation, v= 0.62Ns+ 0.05 m/s. Calculate the discharge. **[12]**

Distance from left water edge (m)	Depth (m)	Revolutions of a current meter kept at a depth of .6 depth	Duration of observation (s)
0	0	0	0
2	2.2	28	100
4	2.5	40	200
6	3	59	300
8	2.8	41	250
10	2.5	28	200
11	0	0	0

OR

(b) The data pertaining to a stream-gauging operation at a section of the river. Calculate the discharge in the stream with the following data. **[12]**

Distance (m)	0	1	2	2	2	2	2	1
Depth (m)	0	1.1	2	2.5	2.0	1.7	1.0	0
Velocity (m/s)	0	0.299	0.326	0.411	0.336	0.260	0.183	0

4. The ordinates of a 6-hour unit hydro graph of a catchment are given below. **[15]**

Time(hr)	0	6	12	18	24	30	36	42	48
6h UH (m3/s)	0	45	110	135	170	155	120	100	75
Time(hr)	54	60	66						
6h UH (m3/s)	50	32	15						

Develop the 6-hour flood hydrograph in the catchment for the storm given below. The storm loss rate is estimated 0.2 cm/h. The base flow is 12 m^3/s and increased by 3.0 m^3/s for every 12 hours till the end of the direct runoff hydrograph.

Time from start of storm (Hour)	0	6	12	18
Accumulated Rainfall (cm)	0	3	10	16

5. Two storms each of 4-h duration and having rainfall excess values of 2.4 cm and 1.6 cm respectively occur successively. The 1.6 cm ER rain follows the 2.4 cm rain. The 4-h unit hydrograph for the catchment is given below. Calculate the resulting DRH. **[15]**

Time (hr)	0	2	4	6	8	10	12	14
UH ordinate (cumec)	0	20	40	68	100	128	148	128
Time (hr)	16	18	20	22	24	26	28	32
UH ordinate (cumec)	88	48	29	20	13	6.5	4	0

6. The ordinates of 10-hr UH are given below. Derive the ordinates of a 5-hr UH by the S-curve method. **[15]**

Time (Hour)	0	10	20	30	40	50	60	70	80
10 hr UH ordinates (m3 /s)	0	50	200	325	375	325	225	130	68
Time (Hour)	90	100	110	120					
10 hr UH ordinates (m3 /s)	38	25	12	0					

7. Flood frequency computations by using Gumbel's method for a particular canal had the following results. **[15]**

Return Period (year)	100	200
Peak Flood (m^3/s)	3435	3748

Predict the flood magnitude in this canal with a return period of 400 years. Also estimate the 90% confidence limits for these estimates if the probable error is 75. **(Use values from the table provided in page 4 if necessary)**

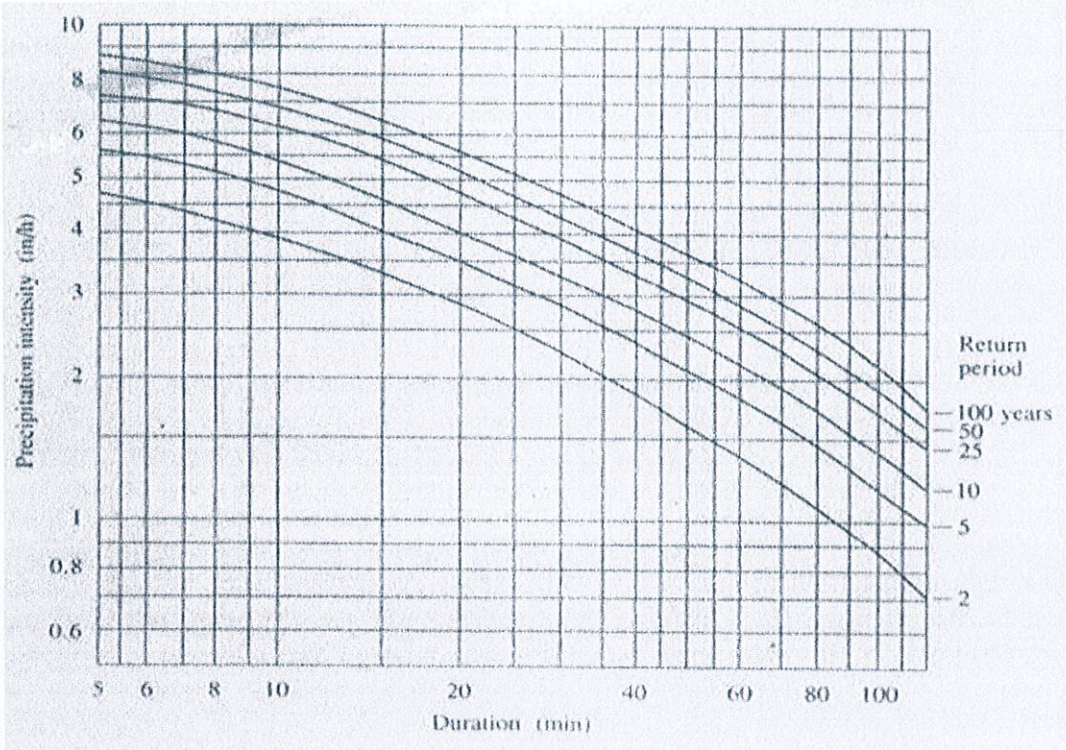


Figure: IDF Curve

TABLE 7.3 REDUCED MEAN $\bar{y}_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTION

N = sample size

N	0	1	2	3	4	5	6	7	8	9
10	0.4952	0.4996	0.5035	0.5070	0.5100	0.5128	0.5157	0.5181	0.5202	0.5220
20	0.5236	0.5252	0.5268	0.5283	0.5296	0.5309	0.5320	0.5332	0.5343	0.5353
30	0.5362	0.5371	0.5380	0.5388	0.5396	0.5402	0.5410	0.5418	0.5424	0.5430
40	0.5436	0.5442	0.5448	0.5453	0.5458	0.5463	0.5468	0.5473	0.5477	0.5481
50	0.5485	0.5489	0.5493	0.5497	0.5501	0.5504	0.5508	0.5511	0.5515	0.5518
60	0.5521	0.5524	0.5527	0.5530	0.5533	0.5535	0.5538	0.5540	0.5543	0.5545
70	0.5548	0.5550	0.5552	0.5555	0.5557	0.5559	0.5561	0.5563	0.5565	0.5567
80	0.5569	0.5570	0.5572	0.5574	0.5576	0.5578	0.5580	0.5581	0.5583	0.5585
90	0.5586	0.5587	0.5589	0.5591	0.5592	0.5593	0.5595	0.5596	0.5598	0.5599
100	0.5600									

TABLE 7.4 REDUCED STANDARD DEVIATION S_n IN GUMBEL'S EXTREME VALUE DISTRIBUTION

N = sample size

N	0	1	2	3	4	5	6	7	8	9
10	0.9496	0.9676	0.9833	0.9971	1.0095	1.0206	1.0316	1.0411	1.0493	1.0565
20	1.0628	1.0696	1.0754	1.0811	1.0864	1.0915	1.0961	1.1004	1.1047	1.1086
30	1.1124	1.1159	1.1193	1.1226	1.1255	1.1285	1.1313	1.1339	1.1363	1.1388
40	1.1413	1.1436	1.1458	1.1480	1.1499	1.1519	1.1538	1.1557	1.1574	1.1590
50	1.1607	1.1623	1.1638	1.1658	1.1667	1.1681	1.1696	1.1708	1.1721	1.1734
60	1.1747	1.1759	1.1770	1.1782	1.1793	1.1803	1.1814	1.1824	1.1834	1.1844
70	1.1854	1.1863	1.1873	1.1881	1.1890	1.1898	1.1906	1.1915	1.1923	1.1930
80	1.1938	1.1945	1.1953	1.1959	1.1967	1.1973	1.1980	1.1987	1.1994	1.2001
90	1.2007	1.2013	1.2020	1.2026	1.2032	1.2038	1.2044	1.2049	1.2055	1.2060
100	1.2065									