University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering II — Course Code: CE 313

Time: 3 Hours — Full Marks: 100

QUESTION 1 [20 MARKS]

a) State fundamental assumptions to analyze statically indeterminate frame structure for gravity (vertical) load using approximate method and lateral load using Cantilever Method. [2+2]

b) Formulate the equation to calculate deflections of truss and frame using Virtual Work Method. [2+2]

c) Explain the basic principle of force method to analyze statically indeterminate beam and frame. [2+2]

d) Draw the qualitative influence lines of shear forces $V_{C(Left)}$, $V_{C(Right)}$ and bending moments M_A, M_B of the beam shown in **Figure 1(a)**. [4]

e) State the parameters that influence the joint moment distribution factor. Formulate the equation to calculate moment distribution factors at joint B of the structure shown in **Figure 1(b)**. [2+2]

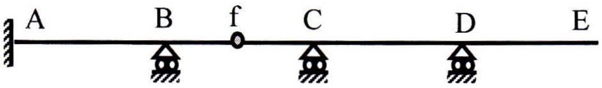


Figure 1(a)

f is Internal Hinge

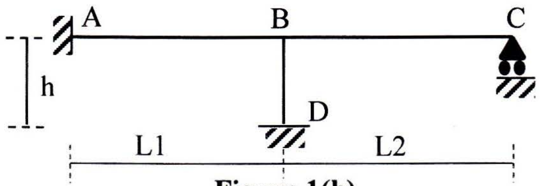


Figure 1(b)

QUESTION 2 [20 MARKS]

a) A frame of reinforced concrete building is shown in **Figure 2 (a)**. All beams of the frame are carrying 40 kN/m floor (vertical) load. Analyze the structure using approximate method to get bending moment diagram (BMD) of ground floor roof beams. [5]

b) The frame shown in **Figure 2(a)** is subjected to lateral load due to earthquake. In general, ground floor columns are more critical in bending moment compared to top floor columns. Justify the statement through analysis of the structure using Portal or Cantilever Method. The cross sections of all columns are same. [10]

c) A frame of portal mill of industry building is subjected to 48 kN lateral load as shown in **Figure 2(b)**. Analyze the frame for bending moment of columns. [5]

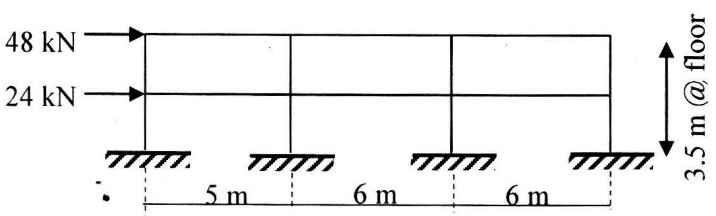


Figure 2(a): Frame of residential building

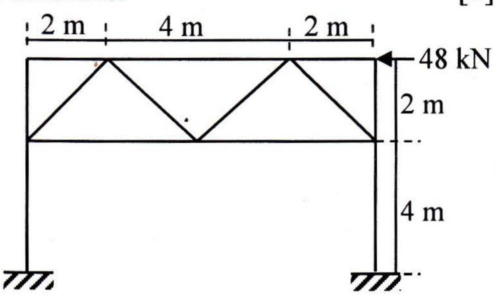


Figure 2(b): Frame of portal mill

QUESTION 3 [20 MARKS]

a) A steel floor truss of industry building is carrying vertical load as shown in **Figure 3(a)**. Apply Virtual Work Method to obtain maximum vertical deflection of the truss.
[Given: Cross-sections of members are 1200 mm^2, Modulus of elasticity of steel is 200 GPa]. [10]

b) A reinforced concrete slab ABC is carrying 15 kN/m floor load as shown in **Figure 3(b)**. The thickness of slab is 0.2 m and width is 1 m. Modulus of elasticity of concrete is 30,000 N/mm^2. Apply Virtual Work Method to calculate deflection at C. [10]

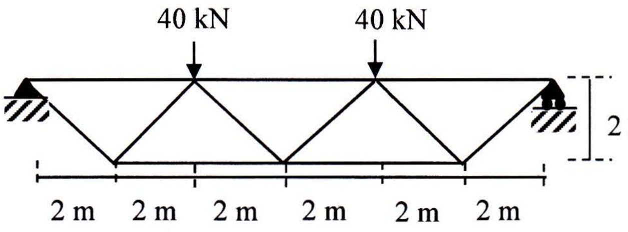


Figure 3(a): Floor truss

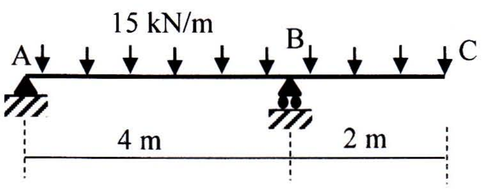


Figure 3(b): RC slab

QUESTION 4 [20 MARKS]

a) A bill board steel truss structure has joint forces due to wind as shown in **Figure 4(a)**. Analyze the truss using force method.
[Given: Cross section of all members is 1200 mm^2, Modulus of elasticity of steel is 200 GPa]. [10]

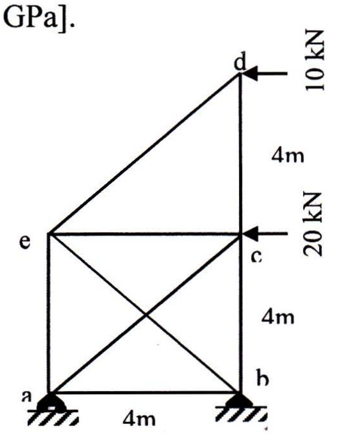


Figure 4(a): Truss of bill board

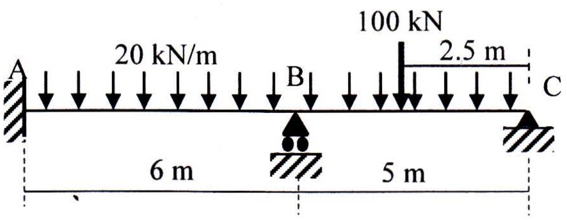


Figure 4(b): RC continuous beam

b) Analyze the reinforced concrete continuous beam ABC shown in **Figure 4(b)** for bending moment and shear force using Moment Distribution Method. EI is constant.
[Given: Fixed end moment for uniformly distributed load is wL^2/12, for concentrated load (at middle of beam) is PL/8] [10]

QUESTION 5 [20 MARKS]

a) A brick-reinforced concrete building structure is shown in **Figure 5(a)**. The beam ABC is carrying 40 kN/m design load (uniform). The size of the beam is 0.25 m x 0.8 m. The element BD could be RC column or brick wall. As a structural engineer select the appropriate structural system to have lower sagging bending moment of beam BC and justify your selection through comparative analysis of the structure using Moment Distribution Method. The size of BD RC column is 0.4 m x 0.4 m. Assume pin connection at beam-brick wall joint. [10]

b) A reinforced concrete frame of porch is carrying 10 kN lateral load due to wind as shown in **Figure 5(b)**. The maximum allowable lateral deflection at joint C is 10 mm. Select the appropriate size of column AB to maintain the maximum deflection at joint C and justify your selection through analysis of the frame using Virtual Work Method. Assume the section of beam BC is 0.25 m x 0.4 m. Modulus of elasticity of concrete is 30,000 N/mm^2. [10]

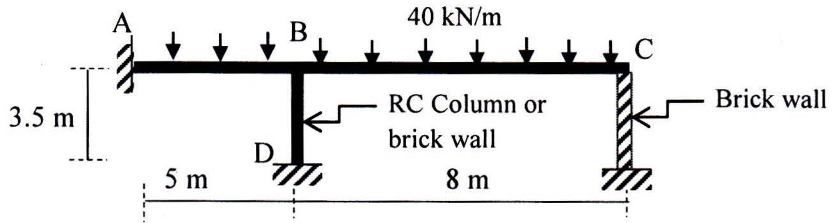


Figure 5(a): Frame of brick-concrete structure

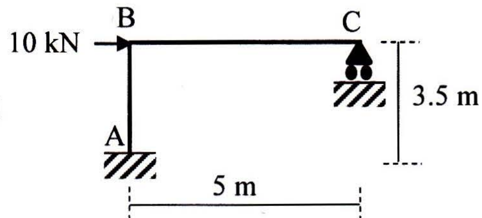


Figure 5(b): Prototype of porch

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
Program: B.Sc. in Civil Engineering

Course Title: Design of Concrete Structures II — Course Code: CE 317
Time: 3 (Three) hours — Full Marks: 100

Assume reasonable values for any missing data. Symbols used have their usual meanings.
[Use f_c' = 30 N/mm^2 (4 ksi) and f_y = 415 N/mm^2 (60 ksi) for all design]

QUESTION 1 [20 MARKS]

a. Explain why the factors ϕ and α are used for column design. [5]

b. Why are special reinforcements needed at the corners of a two way slab system? Discuss the possible special arrangements. [5]

c. State the critical parameters of punching shear to control the thickness of foundation. Show the layout of pile caps of 4 piles and 5 piles, diameter of friction pile is 400 mm. [3+2]

d. Discuss how to check stability of cantilever type reinforced concrete retaining wall. State the basic principles of methods of pre-stressing. [2+3]

QUESTION 2 [20 MARKS]

a. A beam-supported interior slab panel is carrying loads of 30 psf from floor finish and 50 psf from random wall. Calculated reinforcement (in USD) in short span was found to be #3 @8.25″ c/c (bottom), alt ckd + 2#3 extra top as shown in **Figure 1**. Thickness of the slab was found to be 4.5″. Calculate the live load that can be carried by the slab panel. Use Moment Co-efficient method. [10]

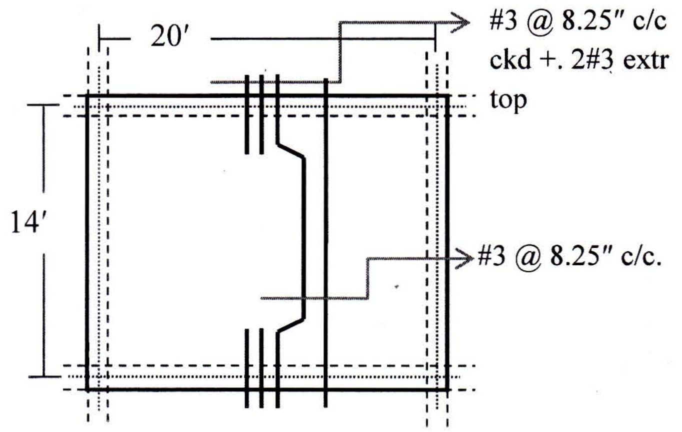


Figure 1: Details of slab

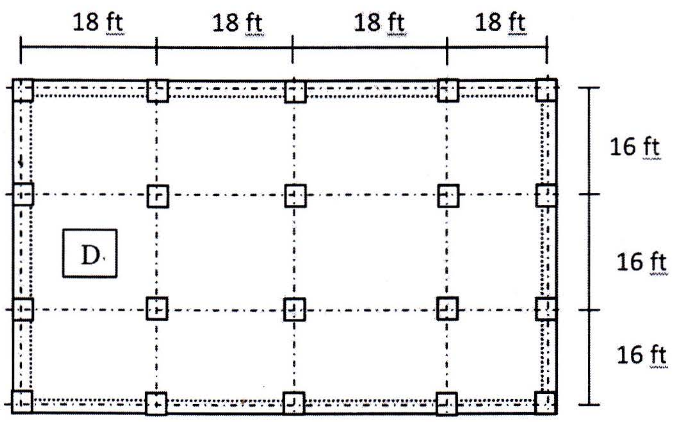


Figure 2: Details of flat slab

b. Calculate the design moments of the panel "D" of a flat slab (**Figure 2**) of size 18′×16′ c/c (supported on 12″×12″ edge beams), if it carries floor finish = 30 psf, random wall = 50 psf, live load = 60 psf. [10]

QUESTION 3 [20 MARKS]

a. Design a (i) round spiral and a (ii) square column to support an axial dead load of 200 k and live load of 300 k. Initially assume 2% longitudinal steel. [10]

b. A 12″ × 18″ column is reinforced with six #9 bars as shown in **Figure 3**. Determine,
   (i) the load P_b, Moment M_b and corresponding eccentricity e_b for balanced failure [5]
   (ii) the load and moment for a representative point in the compression failure region of the interaction diagram (with 2.5″ cover on all sides). [5]

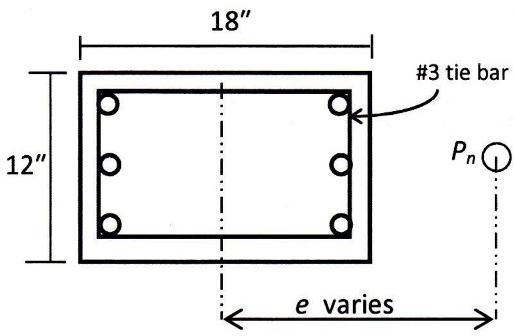


Figure 3: Section of column

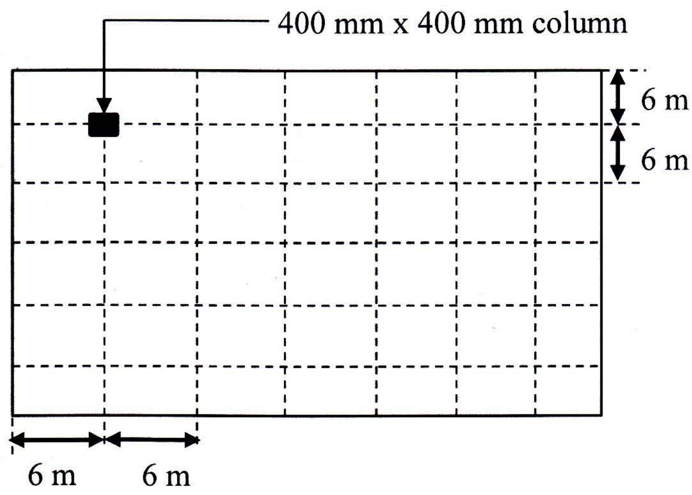


Figure 4: Layout plan of column

QUESTION 4 [20 MARKS]

a. The interior column (400 mm x 400 mm) as shown in **Figure 4** of 5-storeyed car park (flat slab structure) is supported by isolated footing. The thickness of flat slab is 250 mm and each floor height is 3.3 m. The live load of car park is 2.5 kN/m^2 and the bearing capacity of soil is 150 kN/m^2. Design the footing with optimal depth considering all critical parameters. Assume required data for design. Unit weight of concrete is 24 kN/m^3. [10]

b. An interior column (400 mm x 400 mm) of a 9 storeyed academic building is supported by bore pile foundation. The dead and live loads of the foundation are 2400 kN and 800 kN respectively. There is an option to select the piles i.e. 500 mm pile of 900 kN capacity or 400 mm pile of 750 kN capacity. Select the appropriate pile to have minimum depth of pile cap and justify your selection through checking of punching shear. Design the pile cap with your selected pile. Assume required data for design. [10]

QUESTION 5 [20 MARKS]

a. Two interior columns (400 mm x 400 mm) as shown in **Figure 5** of RC structure is supported by combined footing. The dead and live loads of each column are 1200 kN and 350 kN respectively. The bearing capacity of soil is 120 kN/m^2. Design the footing for long span bottom reinforcements only. Assume the effective depth of the footing is 500 mm. [5]

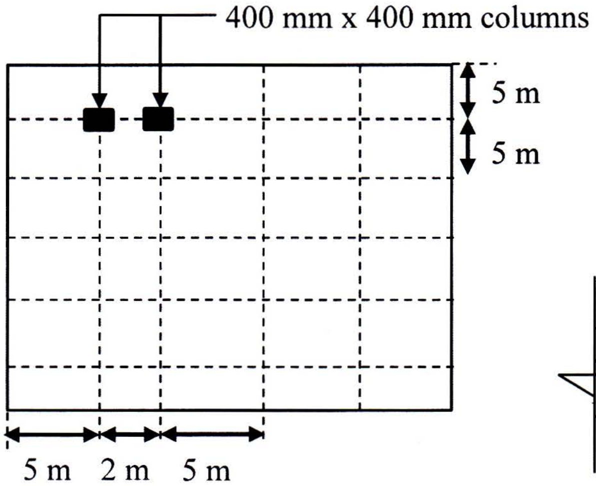


Figure 5: Layout of columns for combined footing

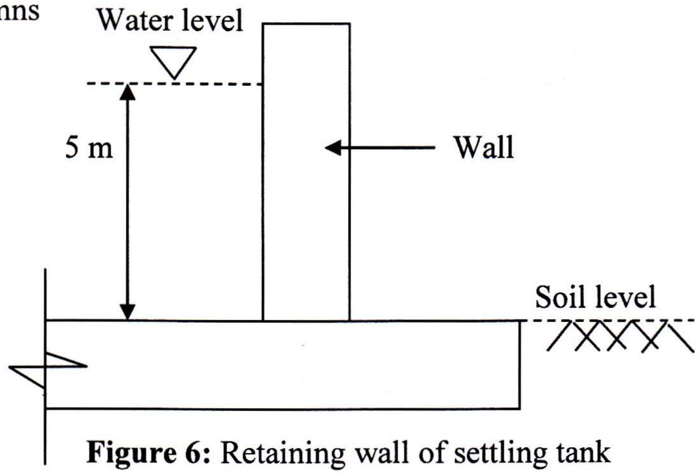


Figure 6: Retaining wall of settling tank

b. A settling tank of mini hydro power plant is constructed with retaining wall as shown in **Figure 6**. The density of water is 1000 kg/m^3. Design the wall for moment. Assume the required thickness of wall, cover is 75 mm and diameter of main reinforcement is 16 mm. As per ACI, the basic span depth ratio of cantilever slab is 10. [5]

c. A simply supported 8 meter span pre-stress concrete beam is carrying 15 kN/m live load. The section of the rectangular beam is 400 mm x 200 mm. A straight tendon is provided at an eccentricity of 75 mm below the centroid of the section. "The eccentricity of tendon reduces pre-stressing force and compressive stress on section", Justify the statement through analysis of the beam for maximum bending moment at mid-span. [10]

APPENDIX

Co-efficient Method:

$Ma = C_a w_u la^2$

$Mb = C_b w_u lb^2$

Thickness $h = P/180 \geq 3.5$, P = panel perimeter

Shear strength of the slab, $\varphi V_c = 2\sqrt{f_c'}bd$

$$d = \sqrt{\frac{M_u}{\phi \rho f_y (1 - 0.59\rho \frac{f_y}{f_c'})}} \qquad \text{Here } \rho = \rho_{max} = 0.75\rho_b = 0.75 * 0.85 * \beta_1 \frac{f_c'}{f_y} * \frac{87000}{87000 + f_y}$$

As $= (f_c/f_y)\, [1 - \sqrt{\{1 - 2\, M_n/(f_c\, bd^2)\}}]\, bd$

Direct Design Method:

Minimum thickness of Flat Slab

Exterior Panels without Edge Beams	Exterior Panels with Edge Beams	Interior Panels
$L_n/33$	$L_n/36$	$L_n/36$

For reinforcements with fy ≠ 40 ksi, the tabulated values are to be multiplied by (0.8 + fy/200).

$M_o = w_n L_2 L_n^2/8;\; M_u^{(-)} = 0.65M_o;\; M_u^{(+)} = 0.35M_o$

Distribution Factors applied to Static Moment M_0 for Positive and Negative Moments

Position of Moment	Ext Edge unrestrained (a)	Slab with beams between all supports (b)	No beam between interior supports		Exterior Edge fully restrained (e)
			Without edge beam (c)	With edge beam (d)	
Exterior $M^{(-)}$	0.00	0.16	0.26	0.30	0.65
Interior $M^{(-)}$	0.75	0.70	0.70	0.70	0.65
$M^{(+)}$	0.63	0.57	0.52	0.50	0.35

$\alpha = E_{cb}I_b/E_{cs}I_s \quad \beta_t = E_{cb}C/2E_{cs}I_s \quad C = \sum(1-0.63\, x/y)\, x^3y/3$

% of Exterior $M^{(-)}$ supported by Column Strip = $100 - 10\beta_t + 12\,\beta_t\,(\alpha_1\, L_2/L_1)\,(1-L_2/L_1)$

% of $M^{(+)}$ supported by Column Strip = $60 + 30\,(\alpha_1\, L_2/L_1)\,(1.5-L_2/L_1)$

% of Interior $M^{(-)}$ supported by Column Strip = $75 + 30\,(\alpha_1\, L_2/L_1)\,(1-L_2/L_1)$

For slabs without beams between supports ($\alpha_1 = 0$) and without edge beams ($\beta t = 0$), the portion of negative moments in column strip is simply 100% and 75% for exterior and interior supports, respectively, and portion of positive moment in column strip is simply 60%.

Punching shear capacity $V_c = 4\sqrt{f'_c}\, b_o d$

Short Column:

Axial Capacity $P_u = \alpha\, \phi A_g [0.85 f_c' + \rho_s (f_y - 0.85 f_c')]$

$$c = c_b = d\frac{\epsilon_u}{\epsilon_u + \epsilon_y} \qquad f_s = \epsilon_u E_s \frac{d-c}{c} \leq f_y \qquad f_s' = \epsilon_u E_s \frac{c - d'}{c} \leq f_y \qquad C = 0.85 f_c' ab$$

$$P_n = 0.85 f_c' ab + A_s' f_s' - A_s f_s$$

$$M_n = P_n e = 0.85 f_c' ab\left(\frac{h}{2} - \frac{a}{2}\right) + A_s' f_s'\left(\frac{h}{2} - d'\right) + A_s f_s\left(d - \frac{h}{2}\right)$$

$$K_n = \frac{P_u}{\phi f_c' A_g} \qquad R_n = \frac{M_u}{\phi f_c' A_g h}$$

CE 317 Formulae 2: In SI unit

Flexural shear capacity of normal concrete: $V_c = 0.17\sqrt{f_c'}b_w d$

Punching shear capacity of normal concrete: $V_p = 0.33\sqrt{f_c'}ud$

Minimum flexural reinforcement: $A_{s,min} = \frac{0.25\sqrt{f_c'}}{fy} b_w d \geq \frac{1.4 b_w d}{fy}$

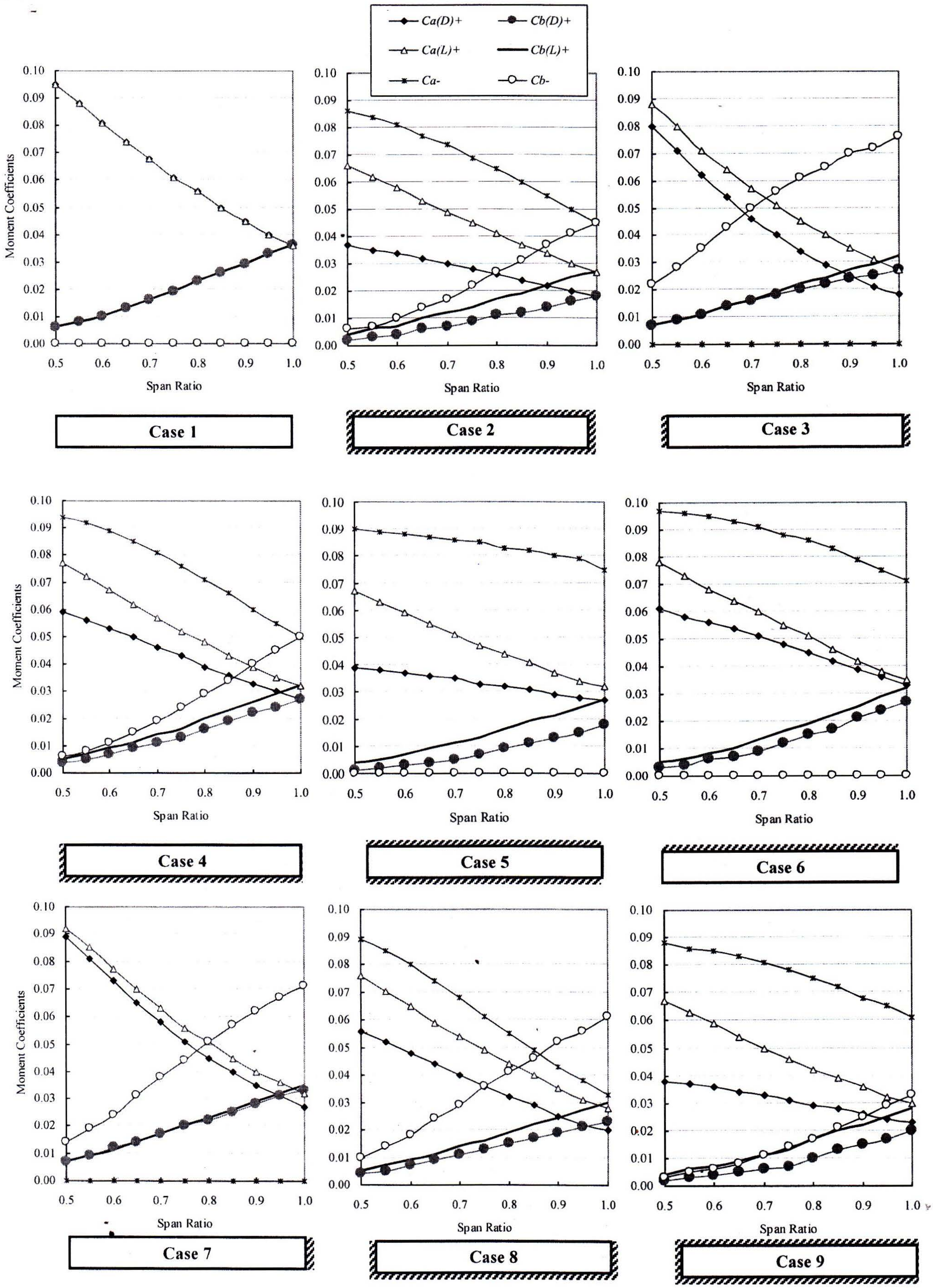


Fig. 1.5: Moment coefficients for different support conditions

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering II | Course Code: CE 333
Time: 3 hours | Full Marks: 100

There are six (6) questions. <u>Question no. 6 is compulsory</u>. Answer Question no. 6 and any four (4) from the rest. Assume any missing data.

1. (a) Differentiate between cistern flush and pour flush toilets. [3]
   (b) Explain the major pollutant removal mechanisms in a septic tank system. How water turbulence influences removal performance in a septic tank? [5]
   (c) How oil and grease are removed from wastewater? [5]
   (d) A settling analysis is run on a type 1 suspension. The column is 2m deep, and the data set are given below. Compute the removal efficiency in a settling basin with a load of 20 m/d. [7]

Time, min	0	60	80	100	130	200	240	420
Conc., mg/L	400	250	160	130	110	90	50	5

2. (a) With necessary assumptions derive the equation $L_t = L_0 e^{-kt}$ for quantifying BOD concentration of water/wastewater. [3]
   (b) Show schematic diagrams of a completely mixed reactor with: wasting of sludge from aeration tank and wasting from return sludge line. How MLSS and MLVSS are formed in an aeration tank? [5]
   (c) With engineering diagrams explain tapered aeration and pure oxygen activated sludge systems. [5]
   (d) Calculate: *(i) efficiency (ii) dimensions and (iii) sludge wasting flow* of aeration tanks employing the following data set. Use the provided equations if required. [7]

- Average design flow=$0.50 m^3/s$
- Influent BOD_5 concentration=450 mg/L
- Influent TSS concentration=250 mg/L
- Effluent BOD_5 concentration=20 mg/L
- Effluent TSS concentration=20 mg/L
- Sludge age, $\theta_c = 8$ d
- MLVSS=2000 mg/L
- VSS/TSS=0.7
- TSS concentration in RAS=10000 mg/L
- Y=0.5 mg VSS/mg BOD_5, k_d=0.06/d
- BOD_5=0.65 BOD_u
- BOD_5 removal in primary clarifiers=35%
- TSS removal in primary clarifiers=65%

- ➢ Specific gravity of primary sludge is 1.05, with solid content 4.4%
- ➢ Oxygen consumption is 1.42 mg per mg of cell oxidized

Equations: $V = \frac{\theta_c Q Y (S_o - S)}{X(1 + k_d \theta_c)}$ $\theta_c = \frac{VX}{Q_{wa}X + Q_e X_e}$

3. (a) Explain cell growth curve of bacteria. [5]
   (b) What is the main difference between CSTR and plug flow reactors? [5]
   (c) With necessary diagrams briefly describe operational principles of a rotating biological contactor reactor. [5]
   (d) The BOD_5 of a wastewater is 400 mg/L at 20°C. k at 20°C is 0.20 per day. Determine the BOD_8 of the sample at 10°C. [5]

4. (a) How sludge dewatering is achieved employing drying beds? [3]
   (b) Briefly explain ammonication, nitrification and denitrification processes that often control nitrogen removals in a biological reactor. [5]
   (c) Write short notes on: (i) Bardenpho system for nitrogen removals; (ii) Simultaneous phosphorus precipitation and (iii) The three stage Phoredox (A^2/O) system for phosphorus removal. [12]

5. (a) Enlist the advantages and disadvantages of stabilization ponds. [3]
   (b) How DO and pH concentration fluctuates with change of sunlight duration in a facultative pond? [5]
   (c) How effluent recirculation and aeration enhance pollutant removals in a vertical flow wetland? [6]
   (d) Explain pollutant removal differences between horizontal flow and floating treatment wetlands. [6]

6. As an environmental engineer you have been assigned to propose wastewater treatment plant diagrams for two industries. Effluent wastewater characteristics of these industries are summarized in the following table. Propose treatment flow diagrams for industry 1 which will include activated sludge process and stabilization pond/constructed wetland systems for industry 2. [20]

	Unit	Concentration value	
		Industry 1	*Industry 2*
pH	---	7.3	5
DO	mg/L	0.5	0.8
Solids		2000	·500
NH_4-N		15	120
NO_3-N		5	20
TN		30	180
P		0.7	12
BOD_5		4500	350
COD		9000	600

University of Asia pacific
Department of Civil Engineering
Final Examination Spring 2018
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering I (Transport and Traffic Design) — Course Code: CE 351
Time: 3 Hours — Full Marks: 150

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

1. a) Compile different types of problems caused by on-street parking in Dhaka city. 8
   b) Determine the AADT for the following data. Data collection was conducted on Tuesday in August. MEF for August is 0.578. 12

Hour	Volume
7:00-8:00 a.m.	1300
8:00-9:00 a.m.	1450
9:00-10:00 a.m.	1200
10:00-11:00 a.m.	990
11:00-12:00 p.m.	780

   c) Explain different types of vertical deflection measures for traffic calming. 10

2. a) Design a two-phase signal at an isolated cross-junction for the following data: 12
   Intergreen for N-S: 7 sec and E-W: 9 sec. Amber is 3 sec.
   Lost time for starting and end delays : 4 sec (N-S) and 3 sec (E-W)

	N	S	E	W
Flow(q), veh/hr	950	860	670	780
Saturation flow(s) veh/hr	2750	2500	1870	2250

   Assume any missing data. Draw bar diagram.

   b) Briefly summarize the contribution of transportation for Cultural development and Economic development in Bangladesh. 10
   c) A vehicle skids to a stop on a 5% upgrade initially traveling at 85 km/hr; taking 600 m to do so. Determine the coefficient of friction on this surface. 8

3. a) Explain the necessities of an effective bus terminal. 8
   b) An accident evaluator predicts that a bus collided with a bridge pier at a speed of 23mi/hr. determined by her assessment of damage. After examination to the accident location she detected skid marks of 70 ft on the bituminous pavement (f=0.425) and 40 ft on the earth shoulder (f=0.35). There is -2% grade. Determine the speed of the vehicle at the beginning of skid marks. 16
   c) Compile the benefits of shoulders for highway design. 6

4. a) A sag vertical curve is to be designed to join a -8% grade with a +6% grade at a section of a two-lane highway. The design speed of the highway is 75 mph. Determine the minimum length of the curve. Assume the stopping sight distance is 800 ft. 10
   b) A horizontal curve with a radius of 800 ft is designed for a two-lane highway having a design speed of 80 mph. If the section of highway have a 5% upgrade and coefficient of friction is 0.348, estimate the least possible distance of any object can be placed from the 14

centerline of the inside lane of the curve. Assume PR time 2.5.

c) Explain "Cone of vision" and "Depth perception". 6

5. a) Spot speeds (km/hr) of 50 vehicles navigating a section of an major road are as below: 24
43, 86, 54, 43, 67, 66, 36, 68, 67, 72, 69, 78, 57, 47, 63, 65, 49, 56, 58, 52, 55, 67, 63, 48, 77, 42, 83, 37, 55, 38, 55, 37, 39, 32, 57, 46, 73, 56, 43, 37, 47, 44, 68, 53, 67, 64, 66, 46, 49, 57.
Portray the design speed, average speed, safe speed, and median speed of speed. (Consider pace as **10-19, 20-29** and so on)

b) Outline the factors influencing highway design. 6

6. a) Formulate briefly the various elements of Passing Sight Distance for a two-lane highway with figure. 16

b) An urban primary road with 75 ft pavement width having a reflectance of 11% carries a maximum of 2250 vph at night-time. Design the lighting system considering Sodium source with mounting height of 60 ft and a maintenance factor of 0.78. Draw the lighting layout. 14

Necessary equations:

$$S<L: \quad L=\frac{AS^2}{100(\sqrt{2h_1}+\sqrt{2h_2})^2}$$

$$S>L: \quad L=2S-\frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A}$$

$$S<L: \quad L=\frac{AS^2}{200[2.0+S(\tan 1^\circ)]}$$

$$S>L: \quad L=2S-\frac{200[2.0+S(\tan 1^\circ)]}{A}$$

Table for Question 1 b)

Table 1 Hourly Expansion Factors for a Rural Primary Road

Hour	Vol.	HEF	Hour	Vol.	HEF
6:00-7:00 a.m.	294	42.01	6:00-7:00 p.m.	743	16.6
7:00-8:00 a.m.	426	28.99	7:00-8:00 p.m.	706	17.5
8:00-9:00 a.m.	560	22.05	8:00-9:00 p.m.	606	20.4
9:00-10:00 a.m.	657	18.8	9:00-10:00 p.m.	489	25.3
10:00-11:00 a.m.	722	17.11	10:00-11:00 p.m.	396	31.2
11:00-12:00 p.m.	667	18.52	11:00-12:00 a.m.	360	34.3
12:00-1:00 p.m.	660	18.71	12:00-1:00 a.m.	241	51.2
1:00-2:00 p.m.	739	16.71	1:00-2:00 a.m.	150	82.3
2:00-3:00 p.m.	832	14.84	2:00-3:00 a.m.	100	124
3:00-4:00 p.m.	836	14.77	3:00-4:00 a.m.	90	137
4:00-5:00 p.m.	961	12.85	4:00-5:00 a.m.	86	144
5:00-6:00 p.m.	892	13.85	5:00-6:00 a.m.	137	90.2
Total daily volume =		12350			

Table 2 Daily Expansion Factors for a Rural Primary Road

Day of Week	Volume	DEF
Sunday	7,895	9.515
Monday	10,714	7.012
Tuesday	9,722	7.727
Wednesday	11,413	6.582
Thusrday	10,714	7.012
Friday	13,125	5.724
Saturday	11,539	6.51
Total weekly volume =	75,122	

Table for Question 6 b)

TABLE 1 RECOMMENDED AVERAGE ILLUMINATION (LUMENS/FT²)

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

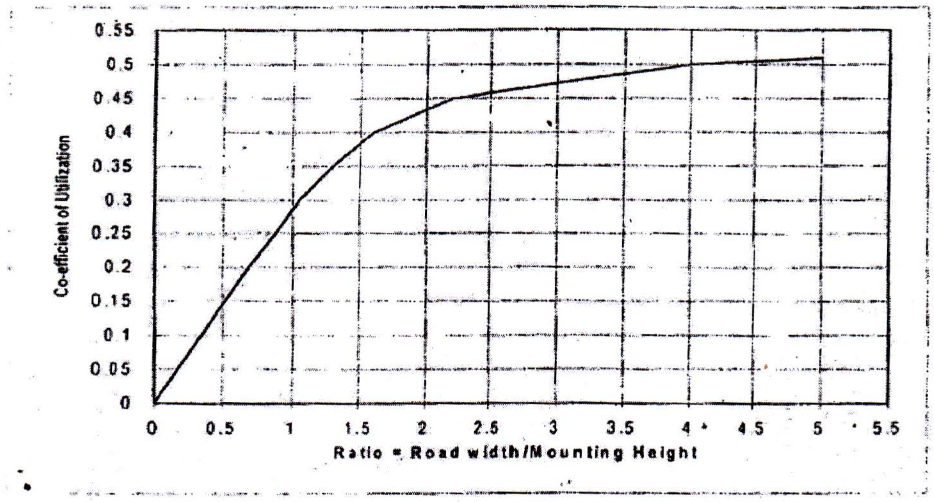
TABLE 3 LIGHTING SOURCE CHARACTERISTICS

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 Spring 2018
Program: B.Sc. Engineering (Civil)

Coarse Title: Engineering Hydrology — Course Code: CE 363
Time: 3:00 hours — Full marks: 100

Question **One** is **compulsory** and **answer** any **three** from questions **two to five (25+3*25=100).**
Assume any reasonable value, if not given.

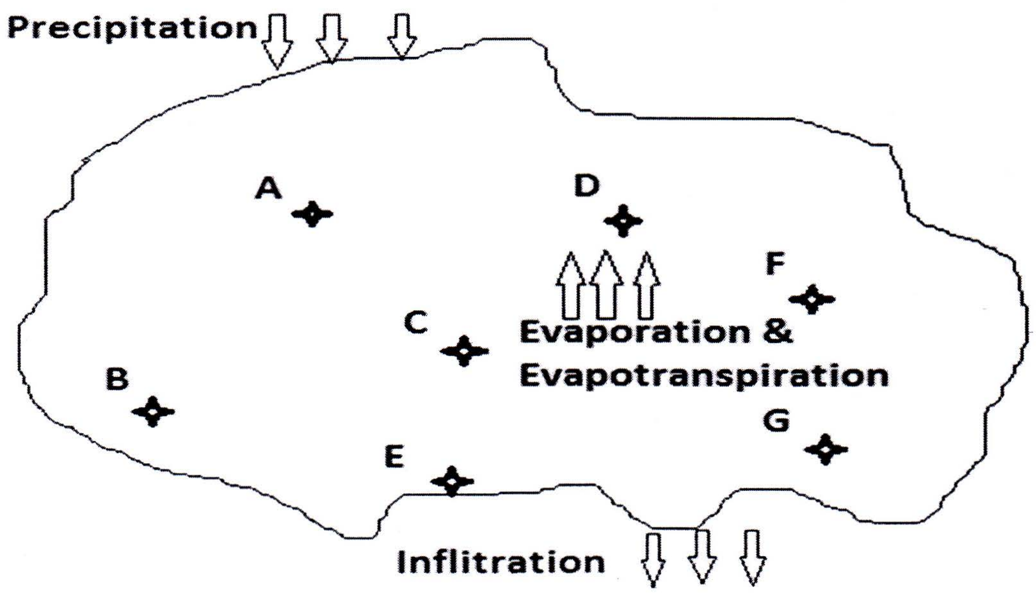


Figure No.: 1

1. A, B, C, D, E, F, and G are the rain gauge station (shown in figure-1) having catchment area of 70 hectares of which 40% is covered with water surface. The latitude and elevation of the catchment area are 32°4′ N and 230 m (above the sea level) from center of Bangladesh. Under catchment area, the water temperature is 25°C, humidity is 60% and wind velocity at 2 m above ground is 22 km/h. Data are collected about 12 h sunshine period. (25)

Stations	A	B	C	D	E	F	G
Observed precipitation(cm)	43.5	30.5	42.3	29.9	20	45	25
Area weighted factor	0.31	0.20	0.07	0.10	0.05	0.15	0.12

Calculate the following:
i. Average rainfall in the catchment;
ii. Monthly evaporation;
iii. Weekly evapotranspiration;
iv. Infiltration (40% of avg. rainfall);
v. Losses (consider only interception losses);
vi. Total runoff.

2(a) Write short notes on (any two): (5)

i. Application of Hydrology in civil engineering;
ii. Differentiate between convective and orographic storms;
iii. Form of precipitation;

2(b) In a diagram show (any two): (5)

i. Formation of frontal cycle;
ii. Different routes of runoff;
iii. Water-budget method of evaporation;

2(c) The total river area of the world is 148.8 M km^2 and has the water quantity $2.12*10^3$ km^3 . Assuming that all surface runoff to the oceans comes from rivers; calculate the average residence time of water in rivers. (5)

	Unit	Ocean	Land
Precipitation	Km^3/yr	478,000	225,000
Evaporation	Km^3/yr	596,000	725,000
Atmospheric moisture	Km^3/yr	458,00	125,00

2(d) Calculate the precipitable water in a saturated air column extending 2 km up of $1m^2$ ground surface. The surface pressure and air temperature are 101.3 kpa and 30°C respectively. The lapse rate is 6.5°C/km. (10)

3(a) Write all factors that affect flood hydrograph. (5)

3(b) The ordinates of a 6-h unit hydrograph of a catchment are given below: (12)

Time (h)	0	4	8	12	16	20	24	32	40	48	56	64
6-h UH	0	20	35	49	85	115	190	168	105	45	20	0

Derive the flood hydrograph in the catchment due to storm given below:

Time from start of storm (h)	0	4	8	12
Accumulated rainfall (cm)	0	3	10	15

The storm loss rate for the catchment is estimated as 0.25cm/h. The base flow can be assumed 20 m^3/s at the beginning and increasing by 2 m^3/s for every 12 hours till the end of direct runoff hydrograph.

3(c) Ordinates of a 4-h unit hydrograph are given below. Using given data derive the ordinates of a 2-h unit hydrograph for the same catchment. (8)

Time (h)	0	4	8	12	16	20	24	28	32	36	40	44
4-h UH	0	20	80	130	150	130	90	52	25	15	5	0

4(a) Graphically define the attenuation and time lag of flood hydrograph. (5)

4(b) The following inflow and outflow hydrographs were observed in a river reach. Estimate the value of K and x applicable to this reach for use in the Muskingum equation. (10)

Time (h)	0	4	8	12	16	20	24	28	32	36	40	44
Inflow (m^3/s)	5	18	45	45	30	20	15	10	8	7	6	6
Outflow(m^3/s)	5	6	12	29	38	35	29	23	17	13	9	7

4(c) A reservoir has the following elevation, discharge and storage relationships: (10)

Elevation (m)	100	100.50	101	101.50	102	102.50	102.75	300
Storage (10^6 m^3)	3.34	3.48	3.55	3.88	4.39	4.85	5.48	5.90
Discharge (m^3/s)	0	15	32	47	80	110	126	145

When the reservoir level was at 100.50 m, the following flood entered the reservoir.

Time (h)	0	6	12	18	24	30	36	42	48	54	60	66
Discharge (m^3/s)	12	24	54	82	76	56	45	32	40	21	15	13

Route the flood and obtain the outflow of the hydrograph.

5(a) What are the different methods to estimate the magnitude of a flood peak? (5)

5(b) Flood-frequency computations for the Padma river at Mawa ghat, by using Gumbel's method, yielded the following results: (10)

Returns period, T (years)	**Peak Flows (m^3/s)**
25	30,580
50	56,920
100	91,510

Estimate the flood magnitude in this river with a return period of 500 years.

5(c) Data covering a period of 95 years for the Jamuna river at Sirajgoaj yielded the mean and standard derivation of the annual flood series as 6450 m^3/s and 3125 m^3/s respectively. Using the Gumbel's method, estimate the flood discharge with a return period of 550 years. What are the (a) 95% and (b) 99% confidence limits for this estimate? (10)

Important equation and tables

$$H_n = H_a(1-r)\left(a+b\frac{n}{N}\right) - \sigma T_a^4\left(0.56-0.092\sqrt{e_a}\right)\left(0.10+0.90\frac{n}{N}\right)$$

Surface	range of r values
Close ground crops	0.15 - 0.25
Bare lands	0.05 - 0.45
Water surface	0.05
Snow	0.45 - 0.95

TABLE SATURATION VAPOUR PRESSURE OF WATER

Temperature (°C)	Saturation vapour pressure e_w (mm of Hg)	A (mm/°C)
0	4.58	0.30
5.0	6.54	0.45
7.5	7.78	0.54
10.0	9.21	0.60
12.5	10.87	0.71
15.0	12.79	0.80
17.5	15.00	0.95
20.0	17.54	1.05
22.5	20.44	1.24
25.0	23.76	1.40
27.5	27.54	1.61
30.0	31.82	1.85
32.5	36.68	2.07
35.0	42.81	2.35

TABLE MEAN MONTHLY SOLAR RADIATION AT TOP OF ATMOSPHERE, H_a IN mm OF EVAPORABLE WATER/DAY

North latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0°	14.5	15.0	15.2	14.7	13.9	13.4	13.5	14.2	14.9	15.0	14.6	14.3
10°	12.8	13.9	14.8	15.2	15.0	14.8	14.8	15.0	14.9	14.1	13.1	12.4
20°	10.8	12.3	13.9	15.2	15.7	15.8	15.7	15.3	14.4	12.9	11.2	10.3
30°	8.5	10.5	12.7	14.8	16.0	16.5	16.2	15.3	13.5	11.3	9.1	7.9
40°	6.0	8.3	11.0	13.9	15.9	16.7	16.3	14.8	12.2	9.3	6.7	5.4
50°	3.6	5.9	9.1	12.7	15.4	16.7	16.1	13.9	10.5	7.1	4.3	3.0

TABLE MEAN MONTHLY VALUES OF POSSIBLE SUNSHINE HOURS, N

North lati - tude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0°	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
10°	11.6	11.8	12.1	12.4	12.6	12.7	12.6	12.4	12.9	11.9	11.7	11.5
20°	11.1	11.5	12.0	12.6	13.1	13.3	13.2	12.8	12.3	11.7	11.2	10.9
30°	10.4	11.1	12.0	12.9	13.7	14.1	13.9	13.2	12.4	11.5	10.6	10.2
40°	9.6	10.7	11.9	13.2	14.4	15.0	14.7	13.8	12.5	11.2	10.0	9.4
50°	8.6	10.1	11.8	13.8	15.4	16.4	16.0	14.5	12.7	10.8	9.1	8.1

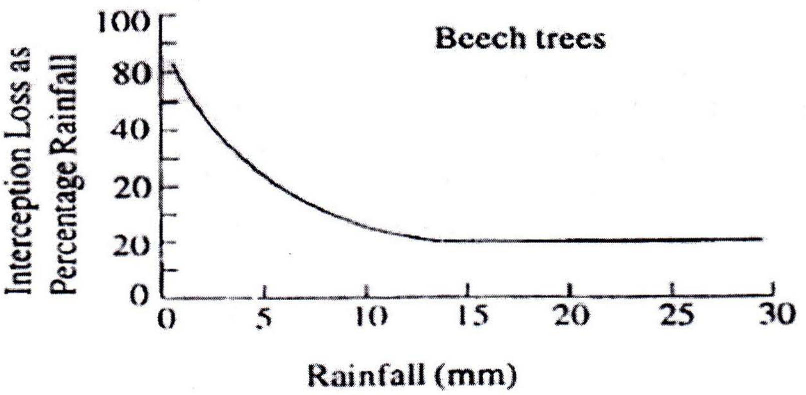


TABLE 7.3 REDUCED MEAN $\bar{y}_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTION

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									

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
Program: B.Sc in Civil Engineering

Course Title: Principles of Management | Course Code: IMG 301
Time: 2 hrs. | Full Marks: 100

(Answer any four of the following questions.)

1. (a) Write four actions that companies aiming for a blue ocean strategy should consider. 5
   (b) What is Delphi technique? Describe the process of Delphi technique. 10
   (c) Describe formal and informal organization. 10

2. Explain the bases of power and empowerment policy with examples. 25

3. Write about organization culture. 25

4. Describe personal characteristics that a manager should possess. 25

5. Evaluate Maslow's hierarchy of needs theory of motivation. 25