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University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2024
Program: B.Sc. in Engineering (Civil)

Course Title: Structural Engineering X | Course Code: CE 425
Time: 2 hours | Credit Hour: 2.00 | Full Marks: 70

QUESTION 1 [10 MARKS]

(a) Explain the pozzolanic reaction that takes place when pozzolans are added into concrete. **[4]**

(b) Explain the effect of fly ash on fresh and hardened properties of concrete. **[6]**

QUESTION 2 [10 MARKS]

Explain the factors influencing Carbonation-induced corrosion. **[10]**

QUESTION 3 [10 MARKS]

Write short note on segregation of concrete, explaining its cause, effects and control. **[10]**

QUESTION 4 [10 MARKS]

(a) State the purposes of non-destructive tests of concrete. **[4]**

(b) Ultrasonic Pulse Velocity Test is an effective NDT test for estimation of compressive strength of concrete – Do you agree or disagree? Justify your answer. **[6]**

QUESTION 5 [10 MARKS]

Explain how interfacial transition zone (ITZ) plays role in mechanical and durability properties of concrete. **[10]**

QUESTION 6 [20 MARKS]

A reinforced concrete wall needs to be constructed at a construction site. The following necessary data are provided for the wall and its formwork.

Cross sectional size of the wall: Thickness = 350 mm, Length = 10 m.

Height = 3 m

Concrete type: Blended cement containing 20% of fly ash with an accelerating admixture.

Form height = 3.5 m.

Density of concrete = 2400 kg/m^3.

Concrete temperature at placement = 30 °C.

Uniform volume supply rate = One 7 m^3 truck every 30 mins.

Table 1: Values of coefficients C1 and C2

Walls: C l = 1 .0	
Columns: C l = 1 .5	
Concrete:	**Value of C2**
Ordinary Portland Cement (OPC) without admixture	0.3
OPC with any admixture, except a retarder	0.3
OPC with a retarder	0.45
Blended cement containing less than 70% slag or 40% fly ash without admixture	0.45
Blended cement containing less than 70% slag or 40% fly ash with any admixture, except a retarder	0.45
Blended cement containing less than 70% slag or 40% fly ash with a retarder	0.6
Blended cement containing more than 70% slag or 40% fly ash	0.6

(a) Calculate the concrete lateral pressure and draw the pressure envelope as a function of height for form work design. **[12]**

(b) Explain the effect of workability of concrete on the lateral pressure of formwork. **[8]**

Formula:

$$P_{max} = D\left[C_1\sqrt{R} + C_2 K\sqrt{H - C_1\sqrt{R}}\right] \quad \text{and} \quad D \times h$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering VI | Course Code: CE 417
Time: 2 hours | Credit Hour: 2 | Full Marks: 100

QUESTION 1

A braced column is made up by a W steel section having $F_y = 36$ ksi (**Figure 1**). The top and bottom supports of the column are fixed and pinned, respectively. Along the strong axis direction, lateral pinned support is also provided as shown in the figure. Calculate the design compressive load carrying capacity (P) of the column. **[15]**

Geometrical Properties of the W Section:

D (in)	t_w (in)	b_f (in)	t_f (in)	A (in^2)	Z_x (in^3)	Z_y (in^3)	r_x (in)	r_y (in)	r_{ts} (in)
30.9	0.775	15.1	1.32	62.3	751	155	12.9	3.49	4.11

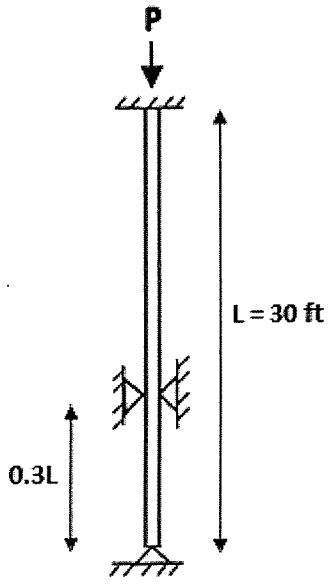


Figure 1

QUESTION 2

From engineering point of view, select the best and most economical W section (from **Table 1**) to carry a superimposed service dead load of 1.3 kip/ft and a service live load of 2.0 kip/ft on a simply supported beam. The length of the beam is 15 ft, and adequate lateral support is provided. Use A572 Grade 60 steel, and follow the **AISC-LRFD** approach. Note: Beam self-weight is not negligible and hence it must be accounted for. **[20]**

Table 1

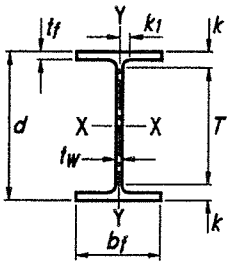
Shape	b_f (in)	t_f (in)	I_x (in^4)	I_y (in^4)	Z_x (in^3)	Z_y (in^3)
W 12x35	6.46	0.520	285	24.5	51.2	11.5
W 10x39	7.99	0.530	209	45.0	46.8	17.2
W 8x35	8.02	0.495	127	42.6	34.7	16.1
W 10x33	7.96	0.435	171	36.6	38.8	14.0
W 8x31	8.00	0.435	110	37.1	30.4	14.1

QUESTION 3

Determine the design moment capacity of W14×82 section of A572 Grade 50 steel for the beam shown in **Figure 2.** The beam has no lateral bracings in between support points A and D. Use the **AISC-LRFD** method. If intermediate lateral supports are provided along the beam to increase its moment capacity, determine the spacing of the lateral supports that will produce a most economical design. Calculate the allowable moment capacity of the beam for this case also. **[15+5+5]**

Section properties of W14x82:

D (in)	t_w (in)	b_f (in)	t_f (in)	S_x (in^3)	Z_x (in^3)	r_x (in)	r_y (in)	r_{ts} (in)	h_o (in)	T (in)	J (in^4)
14.3	0.51	10.1	0.85	123	139	6.05	2.48	2.85	13.4	10.88	5.07



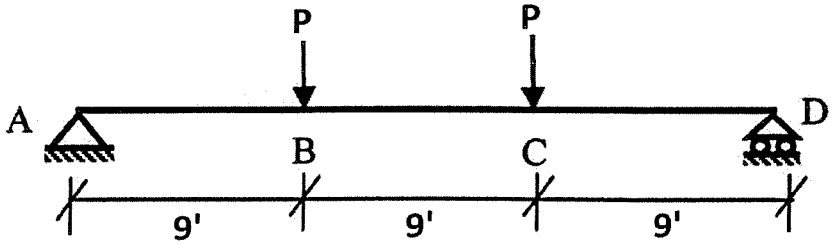


Figure 2

QUESTION 4

By following the elastic vector method, compute the required size of **E60XX** fillet weld for the weld configuration and loading condition shown in **Figure 3**. Assume the plate thickness does not affect the result. Use the **AISC-ASD** method for the calculation. **[15]**

Given: Service load, P = 35 kips

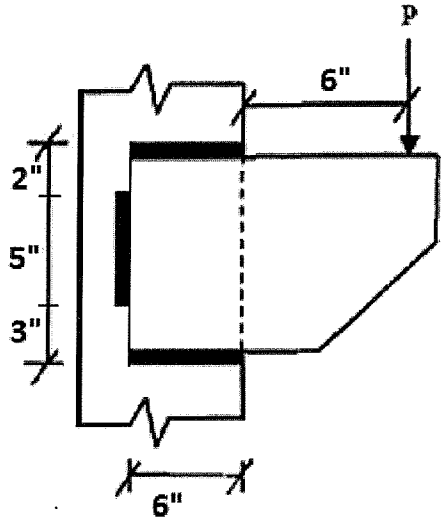


Figure 3

QUESTION 5

(a) Using a neat sketch, distinguish between stiffened and unstiffened element of steel section. **[6]**

(b) For a compression steel member, about which axis (between the major and minor axes) buckling is easier? Explain. Describe a way of increasing the buckling capacity of a compression steel member without changing the steel section. **[5+2]**

(c) Explain all of the welding symbols (location, size, length, type and any other specification of welding) shown in **Figure 4**. **[12]**

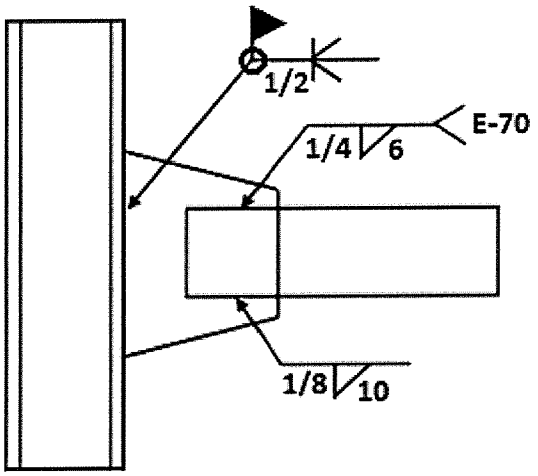


Figure 4

Table: Minimum size of fillet welds

Material Thickness of Thinner Part Joined, in. (mm)	Minimum Size of Fillet Weld, [a] in. (mm)
To 1/4 (6) inclusive	1/8 (3)
Over 1/4 (6) to 1/2 (13)	3/16 (5)
Over 1/2 (13) to 3/4 (19)	1/4 (6)
Over 3/4 (19)	5/16 (8)

Formula

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right]F_y \quad \text{For } \frac{KL}{r} \le 4.71\sqrt{\frac{E}{F_y}} \qquad F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$

$$F_{cr} = 0.877F_e \qquad \text{For } \frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}} \qquad P_n = F_{cr}A_g$$

$$C_b = \frac{12.5M_{max}}{2.5M_{max} + 3M_A + 4M_B + 3M_C}R_m \le 3.0 \qquad L_p = 1.76r_y\sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95r_{ts}\frac{E}{0.7F_y}\sqrt{\frac{Jc}{S_x h_o}}\sqrt{1+\sqrt{1+6.76\left(\frac{0.7F_y S_x h_o}{E \quad Jc}\right)^2}}$$

$$M_n = C_b\left[M_p - (M_p - 0.7F_y S_x)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \le M_p$$

$$M_n = M_p - (M_p - 0.7F_y S_x)\left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right) \qquad F_{cr} = \frac{C_b\pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1 + 0.078\frac{Jc}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2}$$

$$k_c = \frac{4}{\sqrt{h/t_w}}, \text{ where } 0.35 \le k_c \le 0.763 \qquad M_n = F_{cr}S_x \le M_p$$

$$\lambda_r = 0.56\sqrt{\frac{E}{F_y}} \qquad \lambda_r = 1.49\sqrt{\frac{E}{F_y}} \qquad \lambda_{pf} = 0.38\sqrt{\frac{E}{F_y}} \qquad \lambda_{rf} = 1.0\sqrt{\frac{E}{F_y}}$$

$$f'_x = \frac{P_x}{A} \qquad f'_y = \frac{P_y}{A} \qquad M_n = \frac{0.9Ek_c S_x}{\lambda^2}$$

$$f''_x = \frac{Ty}{I_p} \qquad f''_y = \frac{Tx}{I_p}$$

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Environmental Engineering V | Course Code: CE 435
Time: 2 hours | Credit Hour: 2.0 | Full Marks: 60

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1 a. Name three major environmental issues related to development projects. [2]

b. Calculate the MPI for a hypothetical region using given indicators. [6]

Indicator	Household		
	1	2	3
Household size	7	4	5
Health			
At least one member is undernourished	1	0	1
One or more children have died	0	1	0
Education			
No one has completed six years of schooling	0	0	0
At least one school-age child not enrolled in school	1	0	0
Standard of living			
No electricity	0	0	1
No access to improved sanitation	0	1	1
No access to an improved source of drinking water	0	0	1
House built with inadequate materials	0	0	0
Household cooks with dung, wood, charcoal or coal	0	1	1
Household does not own a car or truck and does not own more than one of the following assets: radio, television, computer, animal cart, bicycle, motorbike or refrigerator	0	0	0

c. Explain the relationship between human poverty and development. [4]

2 a. State the purpose of environmental quality standards. [3]

b. Design a sustainable development plan for a rural community, incorporating environmental and poverty indicators. [15]

3. Evaluate the case study of the following development project to determine its adherence to sustainable development principles. [15]
Case Study – Hilltop Resort Development Project

Project Overview:
The Hilltop Resort Development project is a luxury tourism initiative designed to attract visitors to a remote mountainous region. The project aims to create 200 high-end villas, a golf course, and a spa. Key features of the project include:

Location: The resort is built on a steep slope in a biodiversity-rich mountainous area. The construction requires extensive deforestation and terracing.
Materials: Imported luxury materials like exotic hardwoods and marble are used, with no emphasis on locally sourced or sustainable alternatives.
Water Usage: The golf course irrigation system relies on natural springs, significantly reducing the water supply for nearby villages.
Waste Management: Proper sewage treatment plant is planned, no untreated wastewater is set to be discharged into nearby rivers.
Energy Usage: The resort is powered mostly by diesel generators, and some renewable energy systems are included.
Community Impact: The project displaced indigenous communities living on the slope, providing minimal compensation. Promises for local employment remain unfulfilled.

4. Apply the characteristics of environmentally sound projects to suggest changes to the following urban infrastructure plan. [15]

Project Description:
A new urban commercial complex is proposed in a densely populated city. Key features of the project:
Location: Built on reclaimed wetland, which serves as a natural flood control system.
Design: Energy-intensive HVAC systems, natural ventilation is included in limited capacity, and some provisions for renewable energy sources.
Waste Management: No segregation of waste, and waste disposal is planned through landfill dumping.
Transport Accessibility: Parking spaces prioritized over public transportation access, encouraging private vehicle usage.
Community Consideration: The project displaces small local businesses without providing alternatives.
Environmental Impacts During Construction:
Air Pollution: Heavy construction equipment and machinery cause significant dust and emissions.
Sound Pollution: Construction noise disrupts nearby residential and commercial areas.
Deforestation and Habitat Loss: Clearing of nearby forests impacts biodiversity and displaces wildlife.

University of Asia Pacific
Department of Civil Engineering
Final Examination (Spring 2024)
Program: B. Sc. Engineering (Civil)

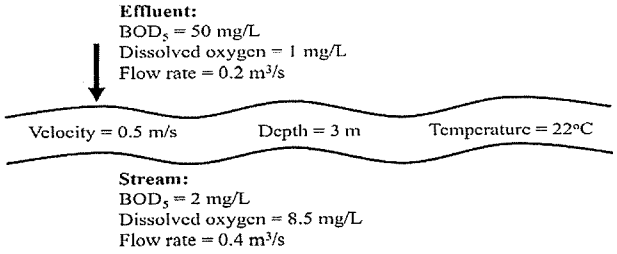
Course Title: Environmental Engineering IV | Course Code: CE 433
Time: 2 hours | Credit Hours: 2.00 | Full Marks: 100

[You must answer all the **THREE** questions (**50+26+24**)]

1. a) A municipal wastewater treatment plant discharges treated effluent into the nearby stream. The characteristics of the wastewater effluent and stream have been shown in the figure below. Assume that the mixing of the effluent is complete and instantaneous into the stream. ***Calculate*** the following using **Streeter-Phelps model**. **[20+5]**

i. The **critical distance downstream** at which dissolved oxygen is minimum. [Given, the deoxygenation rate constant is 0.2 /day at 20°C.]

ii. The **minimum dissolved oxygen**.



b) You are an environmental engineer tasked with assessing pollution potential from a factory **emitting SO_2** through a **smokestack** located in a suburban area. The smokestack has an effective height of 70 m, and the factory consumes 300 tons of coals (containing 5 % sulfur). [Assume that 10 % of the sulfur is emitted as SO_2.] **[5+10+10]**

As part of your analysis, you need to determine the pollutant concentration at different downwind locations under varying atmospheric conditions. Surface wind speed measurements have been taken, and the atmospheric conditions are described below:

- **Surface wind speed at 10 m height:** 3.5 m/s
- **Atmospheric description:** It is a clear summer day with the sun approximately 50° above the horizon.
- The maximum surface temperature is **30 degrees Celsius**.

Calculate the following using **Gaussian Plume model**.

i. The emission rate of SO_2 in g/s.

ii. The SO_2 concentration at a point 1.5 km downwind and 0.3 km off the downwind axis at 10 m height.

iii. The point where SO_2 will be maximum and the maximum SO_2 concentration. [***Attach the necessary chart with the question paper.***]

2. a) The AQI of Dhaka city is found to be 255 on 28th October 2024 and the critical pollutants were $PM_{2.5}$ and PM_{10}. It is generally known that the hazard posed by the particulates depends on their chemical composition and where they deposit within our respiratory system. ***Explain*** how the detected critical pollutants in the atmosphere of Dhaka city **enter the various regions of human respiratory system**. **[15]**

b) A **settling chamber** is designed under the following conditions to remove **PM_{10}** from polluted gas emission from an industry. **[4+2]**

- **Air:**
  - Horizontal velocity: 0.25 m/s
  - Temperature: 80°F
  - Viscosity of air: 1.7×10^{-5} kg/m.s
- **Particle:** Specific Gravity = 2.0
- **Chamber:** Length = 10 m, Height = 2 m

i. ***Calculate*** the **minimum size of particle** that will be removed with 100% theoretical efficiency from a settling chamber

ii. ***Justify*** whether the settling chamber will be suitable for the removal of PM_{10} or not.

c) ***Discuss*** how groundwater can be protected from pollution. **[5]**

3. a) A nitric acid plant has been established near a small town in 2015. After a few years of operation of the plant, the air quality started to decrease. Increased level of smog in the town has been reported, with peak ozone concentrations during sunny days. Several reports of rubber cracking were also found in automobile tires and seals exposed to outdoor conditions. Besides, visible damage to vegetation in nearby rural areas has also been observed. **[10+4]**

Investigate the situation and ***outline*** **the process** how the problem occurred due to the **operation of nitric acid plant**. *[Show necessary chemical reactions to justify your answer.]*

Examine why the **peak ozone concentrations** have been reported only **during sunny days.**

b) ***Discuss*** how subsidence temperature inversion occurs in an atmosphere. **[4]**

c) ***Show*** the graphical representation of the plume behavior under the following conditions. **[2+2+2]**

i. Adiabatic lapse rate is greater than ambient lapse rate

ii. The height of the inversion layer is 20 m and the height of smokestack is 15 m.

iii. The atmosphere is adiabatic.

Necessary equations

1. $DO_{Sat} = 14.62 - 0.394T + 0.007714T^2 - 0.0000646T^3$
2. $t_c = \frac{1}{k_r - k_d} ln\left\{\frac{k_r}{k_d}\left[1 - \frac{D_o(k_r - k_d)}{k_d L_o}\right]\right\}$
3. $D_c = \frac{k_d}{k_r} L_o e^{-k_d t_c}$
4. $c(x,y,z) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left(\frac{-y^2}{2\sigma_y^2}\right)\left(\exp\left(\frac{-(z-h)^2}{2\sigma_z^2}\right) + \exp\left(\frac{-(z+h)^2}{2\sigma_z^2}\right)\right)$
5. $c(x,y,z) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left(\frac{-y^2}{2\sigma_y^2}\right)\left(\exp\left(\frac{-(z-h)^2}{2\sigma_z^2}\right)\right)$
6. $\bar{u}(z) = \bar{u}_o\ (z/z_o)^p$
7. $\sigma_y = a.x^{0.894}$
8. $\sigma_z = c.\ x^d + f$

TABLE 7.8 ATMOSPHERIC STABILITY CLASSIFICATIONS

Surface wind speed[a] (m/s)	Day solar insolation			Night cloudiness[e]	
	Strong[b]	Moderate[c]	Slight[d]	Cloudy (≥4/8)	Clear (≤3/8)
<2	A	A–B[f]	B	E	F
2–3	A–B	B	C	E	F
3–5	B	B–C	C	D	E
5–6	C	C–D	D	D	D
>6	C	D	D	D	D

[a] Surface wind speed is measured at 10 m above the ground
[b] Corresponds to clear summer day with sun higher than 60° above the horizon
[c] Corresponds to a summer day with a few broken clouds, of a clear day with sun 35-60° above horizon
[d] Corresponds to a fall afternoon, or a cloudy summer day, or a clear summer day with sun 15-35° above horizon
[e] Cloudiness is defined as the fraction of sky covered by clouds
[f] For A-B, B-C, or C-D conditions, average the values obtained for each

Source: Turner (1970)

[You must submit this page with your answer script]

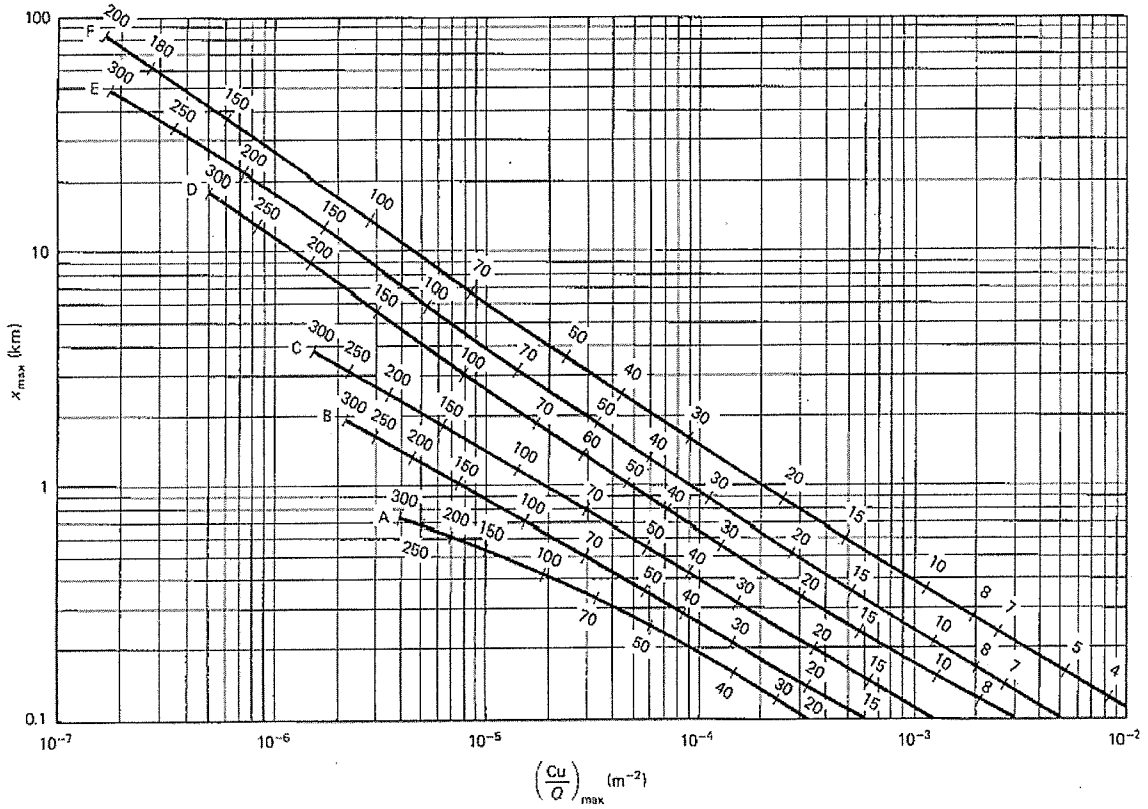
TABLE 7.7 WIND PROFILE EXPONENT p FOR ROUGH TERRAIN[a]

Stability class	Description	Exponent, p
A	Very unstable	0.15
B	Moderately unstable	0.15
C	Slightly unstable	0.20
D	Neutral	0.25
E	Slightly stable	0.40
F	Stable	0.60

[a] For smooth terrain, multiply p by 0.6; see Table 7.8 for further descriptions of the stability classifications used here.

Table 4. Constants in empirical relationships for σ_y and σ_z

		$x \leq 1$ km			$x \geq 1$ km		
Stability class	a	c	d	f	c	d	f
A	213	440.8	1.941	9.27	459.7	2.094	-9.6
B	156	106.6	1.149	3.3	108.2	1.098	2.0
C	104	61	0.911	0	61	0.911	0
D	68	33.2	0.725	-1.7	44.5	0.516	-13.0
E	50.5	22.8	0.678	-1.3	55.4	0.305	-34.0
F	34	14.35	0.740	0.35	62.6	0.180	-48.6



University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Project Planning and Management | Course Code: CE 401
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 50

1. (a) A project team consists of the following stakeholders: Project Manager, 5 Team Members, 2 Clients, 3 Consultants, 1 Executive Sponsor. How many communication channels exist within this project team? [3]

   (b) A project team starts with 8 members, and the total communication channels are calculated. Later, 4 additional members join the team. How many additional communication channels are created when the 4 members join? [4]

   (c) Describe a real-world example of an interactive communication method and explain its advantages over one-way methods like push and pull. [3]

2. (a) What are the five team development stages that a team passes through based on Tuckman's team development model. [2]

   (b) Based on Maslow's Hierarchy of needs model, how many levels are there. Explain each level with at least one example. [2]

   (c) You are managing a project with a BAC of $93,000, EV of $51,840, PV of $64,800, and AC of $43,200. What is the CPI? [2]

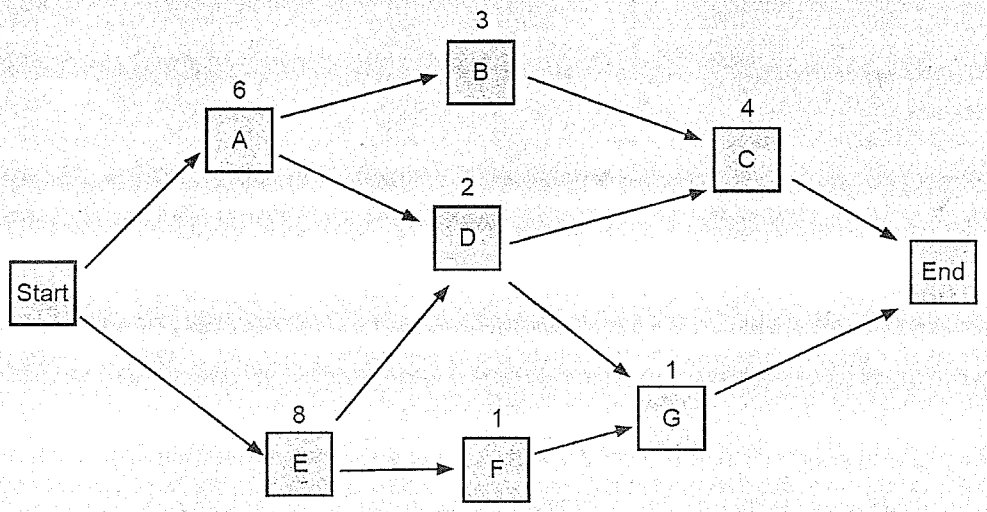
   (d) Your project has a BAC of $4,522 and is 13% complete. What is the earned value (EV)? [2]

   (e) You are working on a project with a PV of $56,733 and an SPI of 1.2. What's the earned value of your project? [2]

3. (a) Your project has a total budget of $300,000. You check your records and find that you've spent $175,000 so far. The team has completed 40% of the project work, but when you check the schedule, it says that they should have completed 50% of the work. Calculate BAC, PV, AC, EV, SV, CV, CPI and SPI for the project. [6]

   (b) It's nine months into one of your projects. The total budget for your project is $4,200,000. You've spent $1,650,000 so far, and you've got a CPI of 0.875. Use the earned value management formulas EAC, ETC and VAC for forecasting to figure out where things stand. [4]

4. Given the network diagram below, what is the critical path? Use forward and backward pass for all the calculation. For that same network diagram below, what's the float for activity A? For that same network diagram below, what's the float for activity E? [10]



5. (a) As part of a project manager's due diligence, he reviews the schedule, focusing on each activity as its start time approaches. He also monitors activities as they progress. He is currently looking at an activity that has an early start (ES) of day 3, a late start (LS) of day 13, an early finish (EF) of day 9, and a late finish (LF) of day 19. What is the float of the activity? Is it on critical path? [4]

(b) You're managing a project to build a new project management information system. You work with the team to come up with an estimate of 27 weeks (Most Likely). In the best case, this could be shortened by two weeks because you can reuse a previous component. But there's a risk that a vendor delay could cause the project to be delayed by five weeks. Use PERT to calculate a three-point estimate for this project. [3]

(c) An activity in a project network has the following characteristics: ES = 8, EF = 14, and LF = 18. Therefore, LS = ____. Draw the activity with ES, EF, LS and LF. What is the float of the activity? [3]