pUniversity of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2023
Program: B.Sc. Engineering (Civil)

2-2

Course Title: Fluid Mechanics | Course Code: CE 221
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 100

There are 4 questions with 25 marks for each. Please answer them accordingly.

[Assume reasonable data if and when required]

1. a) Define three energy heads used in fluid mechanics. **5**

   b) Draw energy grade line and hydraulic grade line for real and ideal fluid in a conduit section. **10**

   c) State the impulse momentum formula used to calculate force on a hydraulic structure. Discuss the characteristics of laminar and turbulent flow. **10**

2. a) State and derive Bernoulli's energy equation for incompressible fluid **10**

   b) Derive the Darcy-Weisbach equation for a circular pipe **15**

3. a) An airplane wing of 3-ft is to move at 90 mph in air. A model of 3 inch is to be tested in a wind tunnel. What must be the velocity in the tunnel to achieve same Reynold's number? **5**

   b) Water is flowing in all pipes shown in Figure:1. The tank surface is 84 ft above the free outlet D. given that, total outlet discharge, $Q=0.890\ ft^3/s$. Pipe parameters: pipe AB (L = 800 ft, dia = 6-inch, f = 0.02); pipe u (L=500 ft, dia = 6-inch, f = 0.02), pipe l (L = 700 ft, dia = 2-inch, f = 0.04), pipe CD (L = 300ft, dia = 4-inch, f = 0.02) **20**

   Compute the following:

   i) head losses in pipe u and l
   ii) outlet velocity
   iii) Discharge through pipe, u.
   iv) Total head loss occurred in all pipes (neglect minor losses).

4. a) If 140 L/s of water flows through the system shown in Figure:2, calculate total head loss between 2 and 3. Ignore minor losses. Point 2 lies on datum. **10**

   b) Determine the magnitude and direction of the resultant force exerted on the double nozzle shown in Figure: 3. The axis of the pipe and both nozzle lies in a horizontal plane. Use discharge, $Q = 0.20\ m^3/s$ and $\gamma = 9.81\ kN/m^3$. Neglect friction. **8**

c) Find the discharge through the pipeline (ϵ/D= 0.00173 and kinematic viscosity $1.02*10^{-6}$ m^2/s) shown in Figure:4, for H=10m. Use minor loss coefficient for entrance, elbows and globe valve of 0.50, 0.90 (each) and 10, respectively. (Hint: you have to consider both major and minor losses and give only 1 trial of friction factor). Use the Moody diagram attached with the question. 7

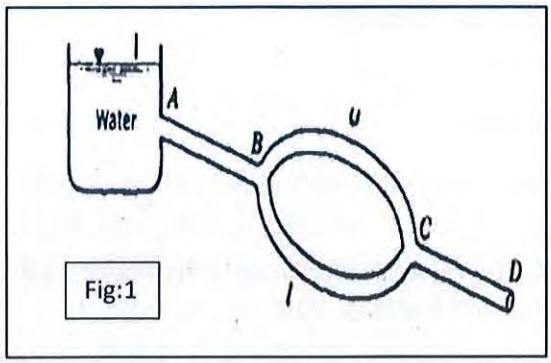


Fig:1

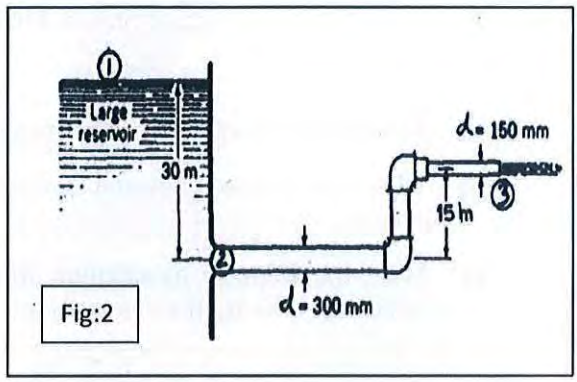


Fig:2

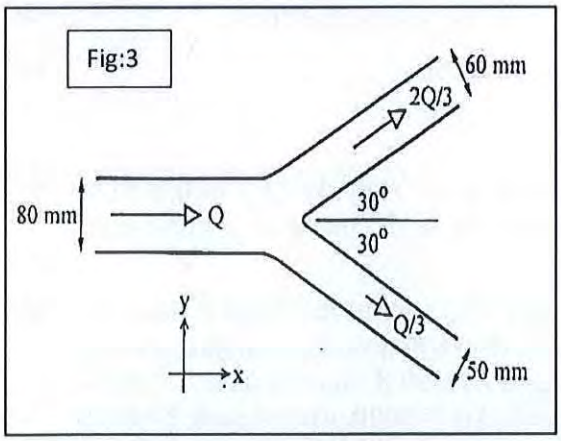


Fig:3

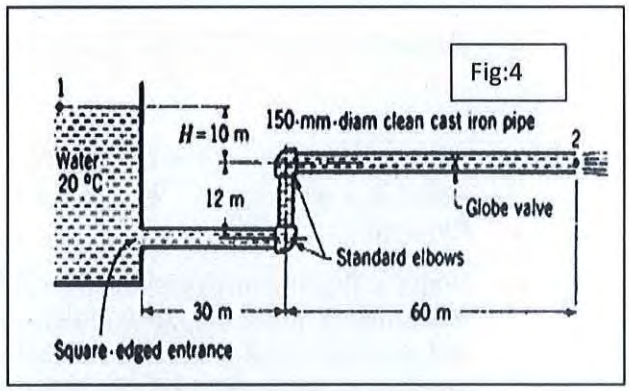
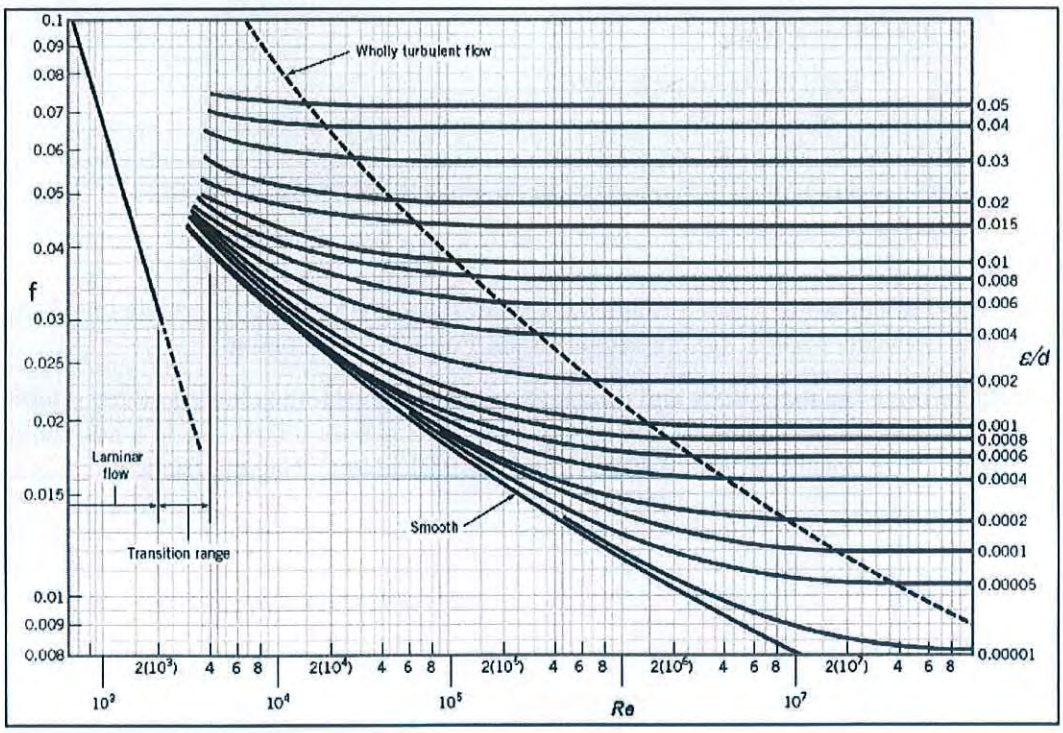


Fig:4



Moody Diagram

University of Asia Pacific
Department of Basic Sciences and Humanities
Final Examination, Fall 2023
Program: B.Sc. in Civil Engineering

Course Title: Principles of Economics | Course Code: ECN 201
Time: 2 hours | Credit Hour: 2.00 | Full Marks: 100

There are **six** questions. Answer any **four including Q-1 and Q-2.** All questions are of equal value. Figures in the right margin indicate marks.

1.	a)	$U = X_1^2 X_2^2$. Price of X_1 is 4 tk, price of X_2 is 8 tk and income is 100 tk. Calculate the optimal value of X_1, X_2 and maximum utility.	15
	b)	Explain Law of Diminishing Marginal Utility.	10
2.		Analyze the impact of Padma Bridge on Bangladesh Economy.	25
3.		Explain different methods of calculating GDP.	25
		OR	
4.		Explain the difference between perfect competition and monopoly market.	25
5.		Explain different types of price elasticity of demand with the help of appropriate graph.	25
		OR	
6.		Explain different types of price elasticity of supply with the help of appropriate graph.	25

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2023
Program: B. Sc. Engineering (Civil)

Course # : CE-203 | Course Title: Engineering Geology & Geomorphology
Full Marks: 120 | Time: 3 hours

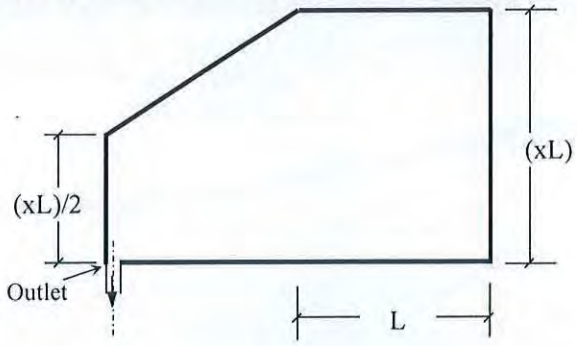
Answer to all questions

1. (a) Discuss metamorphic rock. Giving examples distinguish between igneous and sedimentary rocks. 11
   (b) Distinguish among different geomorphic processes based on origin. 6
   (c) Mention (no description is required) a few major physical and chemical weathering processes. 3

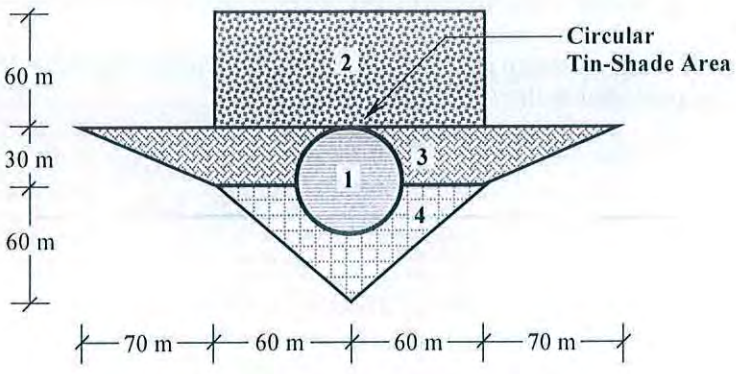
2. (a) Draw neat sketch of a typical fold geometry showing its major features. 3
   (b) Write short notes on folds, faults, joints and rock cleavages. 8
   (c) What is mineral? Distinguish between Ferromagnesian and Non-Ferromagnesian mineral. 5
   (d) Draw neat sketches of Oblique fault and Graben. 4

3. (a) Classify (mention names only) folds and discuss any two types showing neat sketches. 6
   (b) Discuss liquefaction phenomenon in the light of its mechanism and aftermaths. 9
   (c) Distinguish between epicenter and focus. Also distinguish between epicentral and hypocentral distance. 5

4. (a) Mention a few factors affecting runoff. No description is required. 4
   (b) For the following basin, x is a constant factor. For what value of x, the flow rate (Q) will be the maximum for the basin? Find the FF of the basin for maximum runoff. 8



   (c) For the drainage area shown below, calculate peak runoff in ft3/s. Use C2 = (C3 + C4 - 0.3), C3 = (C4 - 0.2) and C4 = 0.6 and I = 0.05 in/min. 8

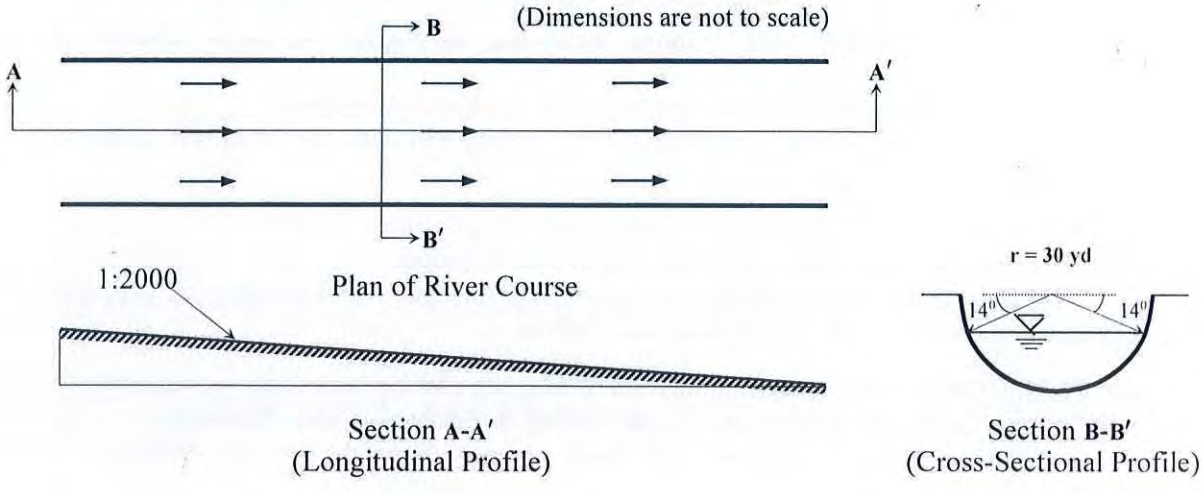


5. (a) Define river transportation. Write short notes on various types of loads of a river. 5

(b) Prove that $\tau = \gamma_w R_H s$; where symbols carry their usual meanings. 4

(c) Velocity of flow of one river (R-1) is five times the velocity of flow of another river (R-2). Derive a correlation between the two rivers in terms of their ability of transporting maximum size of sediments. 3

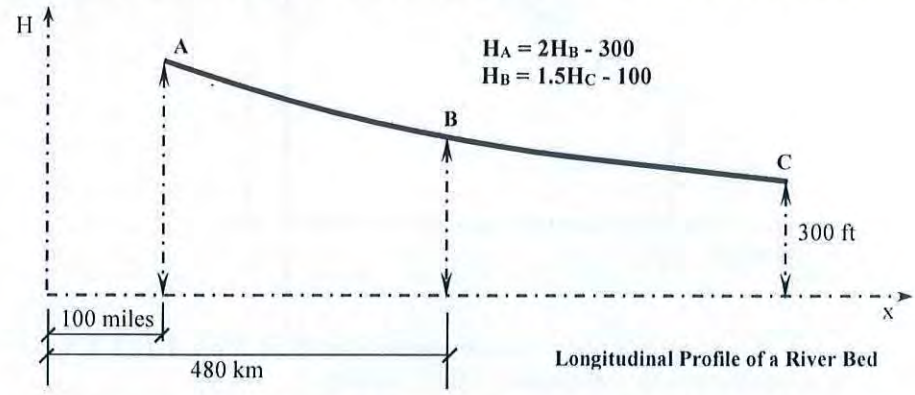
(d) Consider the following river having the longitudinal and cross-sectional profiles as follows. Calculate traction pressure in Pa (Pascal). 8



6. (a) For a stream having triangular x-section and T <<<<< D, prove that $\tau \alpha T$ 3

Where symbols carry their usual meaning. am

(b) Using the figure shown below, calculate the horizontal distance between B and C. 5



(c) Mention three factors affecting drainage pattern. Discuss, in brief, the ways valleys are widened. 5

(d) Calculate Drainage Density (DD) of a catchment area (having SF = 0.005/Km^2) from the information provided in the table below. 7

Stream Rank	No. of Streams (N_{Si})	BR	ABR	Mean Length (Lm_i, Km)	LR	ALR
1	---	---		---	3.0	
2	7			---		
3	---	1.75	2.583	---	---	2.5
4	---	---		375	2.5	

University of Asia Pacific
Department of Basic Sciences and Humanities
Final Examination, Fall 2023
Program: B.Sc. in Civil Engineering

Course Title: Mathematics-IV | Course Code: MTH 203
Time: 3.00 Hours | Credit Hour: 3.00 | Full Marks: 150

There are **eight (8) questions**. Answer **six (6) including Q-1, Q-2, Q-3, and Q4**. Figures given in the right margin indicate the marks of the respective questions.

1. a. Write down the first shifting property. Evaluate $\mathcal{L}\{t^3e^{-5t}\}$ and $\mathcal{L}\{e^{3t}(2\cos 3t - 3\sin 2t\}$ by using the first shifting property. **15**

b. Using the Laplace transform prove that $\int_0^\infty \frac{e^{-at}-e^{-bt}}{t}dt = \log\frac{b}{a}$. **10**

2. a. A linear time-invariant continuous system is in zero state. Its response $y(t)$ is described by the DE $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} - 3y = \frac{df}{dt} + f(t)$. Derive the transfer function of the system. If the input is given by $f(t) = e^{-2t}$, find the total response of the system. **20**

b. Evaluate $\mathcal{L}\{\cos at\}$ by using the change of scale property. **05**

3. a. Evaluate $i)\ \mathcal{L}^{-1}\left\{\frac{3}{s^2(s+2)}\right\}$ and $ii)\ \mathcal{L}^{-1}\left\{\frac{1}{s^2(s^2+4)}\right\}$ with the help of the convolution theorem. **15**

b. Solve the differential equation $y'' - 9y = e^t$ subject to $y(0) = 1,\ y'(0) = 0$ by using Laplace transform. **10**

4. a. Solve the equation $(D^3 - 2D^2 - 5D + 6)y = e^{3x}$. **15**

b. Verify whether the differential equation $x(x^2 + y^2 - a^2)dx + y(x^2 - y^2 - b^2)dy = 0$ is exact or not, and find its solution. **10**

5. a. Identify and solve the equation $x^3\frac{d^3y}{dx^3}+2x^2\frac{d^2y}{dx^2}-x\frac{dy}{dx}+y=\frac{1}{x}$. **15**

b. Solve the equation $(D^2+D+1)y=0$. **10**

OR

6. a. Identify and solve the equation $x^2\frac{d^2y}{dx^2}-x\frac{dy}{dx}-3y=x^2\log x$. **15**

b. Solve the equation $(D^3+D^2+D+1)y=0$. **10**

7. a. Obtain the Fourier series of the function $f(x)=\begin{cases}0\,;\ -\pi\le x\le 0\\ 1\,;\ 0\le x\le\pi\end{cases}$. **15**

b. Obtain the Fourier transform of $f(x)=\begin{cases}1-x^2;\ |x|<1\\ 0;\ |x|>1\end{cases}$. **10**

OR

8. a. Find the Fourier Series of the function $f(x)$ in the interval **15**
$-\pi<x<\pi$, where $f(x)=\begin{cases}0\ ;\ -\pi<x<0\\ \frac{\pi x}{4}\ ;\ 0<x<\pi\end{cases}$.

b. Obtain the Fourier transform of $f(x)=e^{-|x|}$, where x belongs to $(-\infty,\infty)$. **10**

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2023
Program: B.Sc. in Engineering (Civil)

Course Title: Numerical Analysis and Computer Programming | Course Code: CE 205
Time: 3 hour | Credit Hour: 3.00 | Full Marks: 50

(Answer All the questions)

1. In environmental engineering, the equation used to compute the oxygen level C (in mg/L) in a river upstream from a sewage discharge is expressed by

$$C = 10+20(e^{-0.15x} - e^{-0.5x})$$

Where x is the distance upstream in kilometers. Now, use Bisection Method to calculate the distance x where the concentration of oxygen level C falls to a reading of 0 mg/L. As an initial guess, assume that your solution lies within x=0 km and x= -2 km. Perform 7 iterations to find the solution. [7]

2. Following is a differential equation:

$$\frac{dy}{dx} - y^2 = x \quad ; \qquad \text{where } y(0)=1$$

a) Solve the equation using Euler's method to get y (0.2) [Use step size h=0.2] [2]

b) Solve the equation using Mid-point method to get y (0.2) [Use step size h=0.2] [2]

c) Solve the equation using Fourth Order Runge Kutta method to get y (0.2) [Use step size h=0.2] [3]

d) Compare the results to state which one is the more efficient method. [1]

3. Suppose, you are the owner of the construction company "Court of Owls". You want to track the weekly payable bill for your ongoing projects. You have total 4 ongoing projects. You hire construction laborers on weekly basis and distribute them to 4 projects. Each labor works at the rate of 130tk/hr. If the weekly payable bills of all the workers exceed 1,50,000 tk, then only 75% of the total payable amounts are given to the workers. The rest will be paid the next week. Now, create a code using C++ language that will show the total amount of bill payable by you on a certain week. Assume each labor works for 8hr/day and 5 days/week. [7]

4. Imagine, a construction company has developed a model which determines the C: FA: CA ratio for concrete mixture to be used in a day. On a certain day, the ratio needs to be determined by the following system of linear equations:

$$27FA + 6CA - C = 85$$
$$FA + CA + 54C = 110$$
$$6FA + 15\,CA + 2C = 72$$

Now, determine the C: FA: CA ratio using Gauss Seidel method. [7]

5. For the cantilever beam, calculate the upward reaction force (for **middle one-third** of the span load) using the following equation: $y = 3x^2 + 2e^x + 5$, where, x is the distance from the left and y is the reaction (shown in Fig.1). Use the following methods:

a) Using Simpson's rule with 6 panels. [2]

b) Gauss Quadrature with 4 points or n=4. [4]

c) Compare the results to state which one gives a more accurate result. [1]

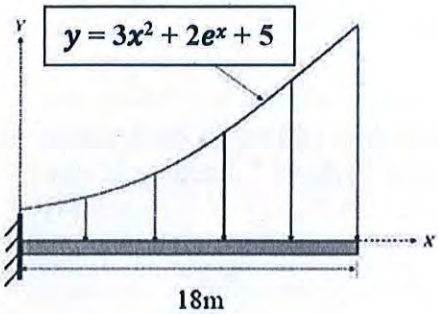


Fig. 1

Table 1: Gauss points and weight factors for integration.

n	x_i	w_i
4	X_1= +0.86114	0.34785
	X_2= +0.33998	0.65215
	X_3= -0.33998	0.65215
	X_4= -0.86114	0.34785

6. Analyze the data provided in the following table and:

a) form a polynomial equation using Lagrange interpolating polynomial formula. [6]

b) determine velocity (v) when time (t) is 25s. [2]

Time, t (s)	1	2	5	9
Velocity v (m/s)	1	3	6	10

7. Calculate Local truncation error of Taylor series for the following differential equation:

Use step size, h= 0.5

$$\frac{dy}{dx} = -2x^3 + 12x^2 - 20x + 8.5$$ [6]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2023
Program: B.Sc. in Civil Engineering

Course Title: Mechanics of Solids II | Course Code: CE 213
Time: 3 hours | Credit Hour: 3 | Full Marks: 100 (12.5 x 8)

1. A shear wall in a reinforced concrete building is subjected to a vertical uniform load of intensity q and a horizontal force H, as shown in the first part of the Fig.1. As a consequence of these loads, the stresses at point A on the surface of the wall have the values shown in the second part of the figure. Determine
(a) the principal stresses
(b) the maximum shear stresses and associated normal stresses. Show the results for both cases by using Mohr's circle.

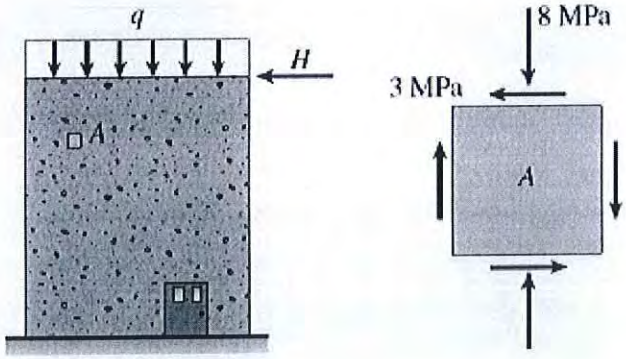


Fig. 1

2. Determine the allowable axial load for a 20-ft W 14 X 159 steel column (r = 4 in, A = 46.7 sq.in) with yield strength of 50 ksi, using AISC ASD formulas when the columns has one end pinned and other end fixed.
Given that:

$$C_c = \sqrt{2\pi^2 E/\sigma_{yp}}$$

For long columns, $(L_e/r) > C_c$: $\sigma_{allow} = \dfrac{12\pi^2 E}{23(L_e/r)^2}$

For intermediate columns, $L_e/r \leq C_c$: $\sigma_{allow} = \dfrac{\left[1-(L_e/r)^2/2C_c^2\right]\sigma_{yp}}{\text{F.S.}}$

where F.S., the factor of safety, is defined as: $\text{F.S.} = \dfrac{5}{3} + \dfrac{3(L_e/r)}{8C_c} - \dfrac{(L_e/r)^3}{8C_c^3}$

3. The overhanging steel beam (Fig. 2) ABC carries a concentrated load **P** at end C. For the portion AB of the beam
(a) Derive the equation of the elastic curve
(b) Determine the maximum deflection (Use Moment integration Method)

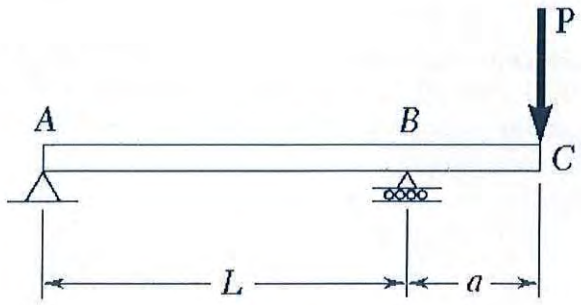


Fig. 2

4. For the prismatic beam and loading shown in Fig.3 determine
(a) the equation of the elastic curve
(b) the slope at A
(c) the maximum deflection. (Use Moment Integration Method)

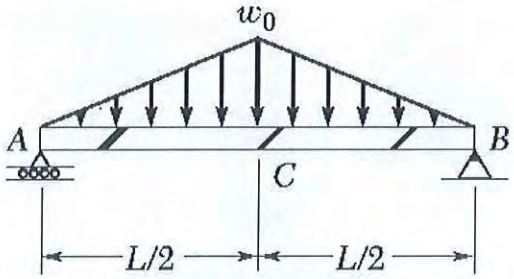


Fig. 3

5. The prismatic rods AD and DB are welded together to form the cantilever beam ADB loaded as shown in Fig.4. Knowing that the flexural rigidity is EI in portion AD of the beam and 2EI in portion DB, determine for the slope and deflection at end A. (Use Moment Area Method)

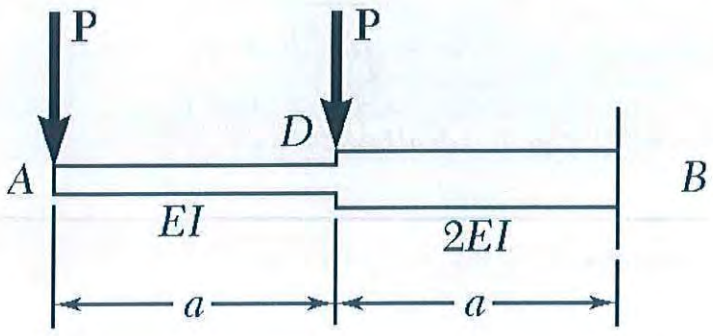


Fig. 4

6. A 75 by 100 mm, 1.5 m long elastic bar of negligible weight is loaded as shown in Fig.5.
(a) Determine the maximum tensile and compressive stresses acting normal to the section
(b) Draw the Stress distribution diagram.

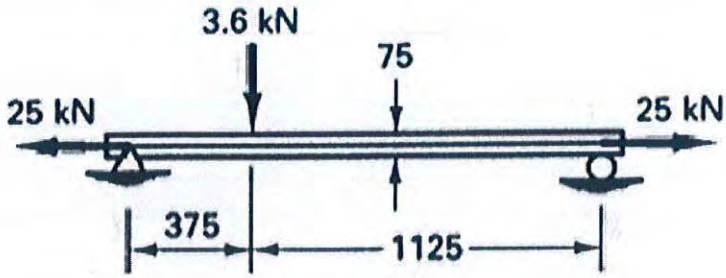


Fig. 5

7. A 2 m long pin-ended column of a square cross-section is to be made of wood.
Determine the size of the cross-section if the column is to safely support
(a) a 100-kN load (b) a 200-kN load.
Assume $E = 13\text{GPa}$, $\sigma_{all}=12$ MPa, and use a factor of safety of 2.5 in computing Euler's critical load for buckling,
Use the following formula:

$$P_{cr} = \frac{\pi^2 EI}{(KL)^2} = \frac{\pi^2 EI}{L_e^2}$$

8. For the state of plane stress shown in Fig.6, determine (a) the principal planes (b) the principal stresses (c) the maximum shearing stress and the corresponding normal stress. Show the results on a properly oriented element.

$$\sigma_{max,\,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \qquad \tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

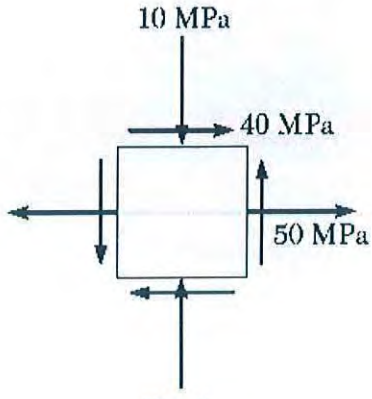


Fig. 6

6. A 75 by 100 mm, 1.5 m long elastic bar of negligible weight is loaded as shown in Fig.5.
(a) Determine the maximum tensile and compressive stresses acting normal to the section
(b) Draw the Stress distribution diagram.

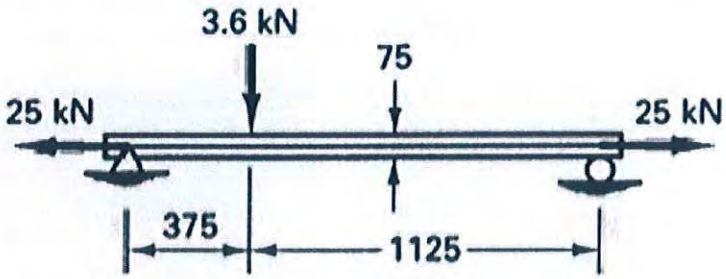


Fig. 5

7. A 2 m long pin-ended column of a square cross-section is to be made of wood.
Determine the size of the cross-section if the column is to safely support
(a) a 100-kN load (b) a 200-kN load.
Assume $E = 13\text{GPa}$, $\sigma_{all}=12$ MPa, and use a factor of safety of 2.5 in computing Euler's critical load for buckling,
Use the following formula:

$$P_{cr} = \frac{\pi^2 EI}{(KL)^2} = \frac{\pi^2 EI}{L_e^2}$$

8. For the state of plane stress shown in Fig.6, determine (a) the principal planes (b) the principal stresses (c) the maximum shearing stress and the corresponding normal stress. Show the results on a properly oriented element.

$$\sigma_{max,\,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \qquad \tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

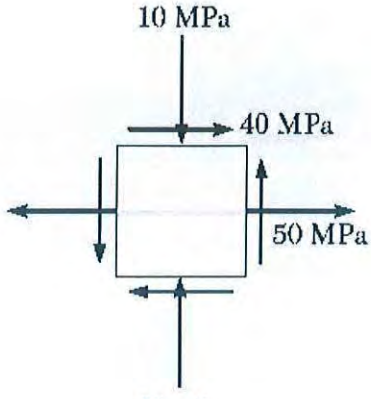


Fig. 6