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

2-2

Course Title: Engineering Economics | Course Code: ECN 201
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 150

There are **EIGHT** questions. Answer any **SIX** questions where questions **1 and 2** are compulsory. All the questions are of equal value. Figures in the right margin indicate marks.

1. Describe different types of elasticity of demand and derive the formula for measuring the elasticity of demand. The demand function for mobile data is given by 25

   $Qdx = 2024 - 45\,Px + 0.008\,Y$

   Where, price of per unit mobile data, Px = Tk. 25 and consumer income, Y = Tk. 60000.

   Calculate the price elasticity and income elasticity of mobile data.

2. Describe the major macroeconomic policy goals with special emphasis on the business cycle. Explain the differences between Gross Domestic Product (GDP), Gross National Product (GNP) and Net National Product (NNP). 25

3. Define an indifference curve and describe its properties. Explain the concepts of marginal rate of substitution (MRS) with the help of an indifference curve. 25

4. a) Clarify the concepts of 'short-run' and 'long-run' in the theory of production and illustrate the law of diminishing marginal returns. 12

   b) Define fixed cost and variable cost. Sketch different types of short-run cost curves from hypothetical cost data. 13

5. a) Mathematically derive the condition for profit maximization and illustrate the short-run profit maximization of a firm using a graph. 12

   b) The Total Revenue (TR) and Average Cost (AC) functions of a firm are given respectively: 13

   $TR = 4000Q - 33Q^2$ and $AC = 2Q^2 - 3Q + 400 + 5000/Q$

Find the maximum profit-giving level of production and maximum profit

6. a) Given, the price of Pears, Pp = tk. 40, price of Orange, Po =Tk. 50 and budget (income) of the consumer, M = Tk. 1800. Draw the consumer's budget line and calculate its slope. What will happen to the budget line for 'a change in budget' and 'a change in price'? 12

b) Sketch an indifference map from three indifference sets. Graphically show the optimal consumption point of a consumer and explain the optimal (equilibrium) conditions. 13

7. a) Explain the reasons of taking inflation into consideration when measuring GDP with an example. 12

b) Explain Consumer Price Index (CPI). From the following table calculate the rate of inflation. 13

Category	Price index for each category		
	Weight	Year 2021	Year 2023
Food and drinks	0.2	300	320
Housing	0.35	5000	6500
Transportation	0.18	200	207
Medical	0.013	150	130
Others	0.257	1200	1245
	1.00		

8. Write Short Notes on any THREE of the following 25

i) Circular flow of income and expenditure

ii) Methods of measuring national income

iii) Returns to scale of production (RTS)

iv) Principles of taxation.

University of Asia Pacific
Department of Civil Engineering
Semester Final Examination Spring-2024 (Self-Study)
Program: B.Sc. in 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 any six (6) questions. Figures given in the right margin indicate the marks of the respective questions.

1. a) Make the non-exact differential equation then solve 15

$$(x^2 + y^2 + x)dx + xy\,dy = 0.$$

b) Check the exactness and solve $(x^2 + y^2 + 1)dx - 2xy\,dy = 0$. 10

2. Solve the following linear equations: 25

(i) $(1 - x^2)\frac{dy}{dx} - xy = 1$

(ii) $x\frac{dy}{dx} + 2y = x^2 \log x$

3. Solve the followings: 25

(i) $\frac{dy}{dx} = e^{x-y} + x^2e^{-y}$ (Using Variable separation)

(ii) $\frac{dy}{dx} = (x + y)^2$ (Using Reducible Variable separation)

4. Solve the following Homogeneous differential equation 25

(i) $x^2ydx - (x^3 + y^3)dy = 0$

(ii) $(x^2 + y^2)dx + 2xydy = 0$

5. Solve the following Bernoulli's equations 25

(i) $x^2\frac{dy}{dx} - 2xy = 3y^4$

(ii) $\frac{dy}{dx} + xsin2y = x^3cos^2y$

6 Solve the following higher order differential equations 25

(i) $\frac{d^3y}{dx^3} - 13\frac{dy}{dx} - 12y = 0$

(ii) $\frac{d^4y}{dx^4} - \frac{d^3y}{dx^3} - 9\frac{d^2y}{dx^2} - 11\frac{dy}{dx} - 4y = 0$

(iii) $(D^4 + 5D^2 + 6)y = 0$

7 Using convolution theorem find $\mathcal{L}^1\left\{\frac{3}{s^2(s+2)}\right\}$. 25

8 Solve the following differential equation using Laplace transformation 25

$$y' + 2y = e^t;\ y(0) = 1.$$

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

Course Title: Engineering Geology and Geomorphology (OBE) Credit Hour: 3.00 Course Code: CE 203
Time: 3 hours Full Marks: 100

(There are SIX questions in total. You must answer all)

1. a) Derive the equation of a longitudinal bed profile. (4)

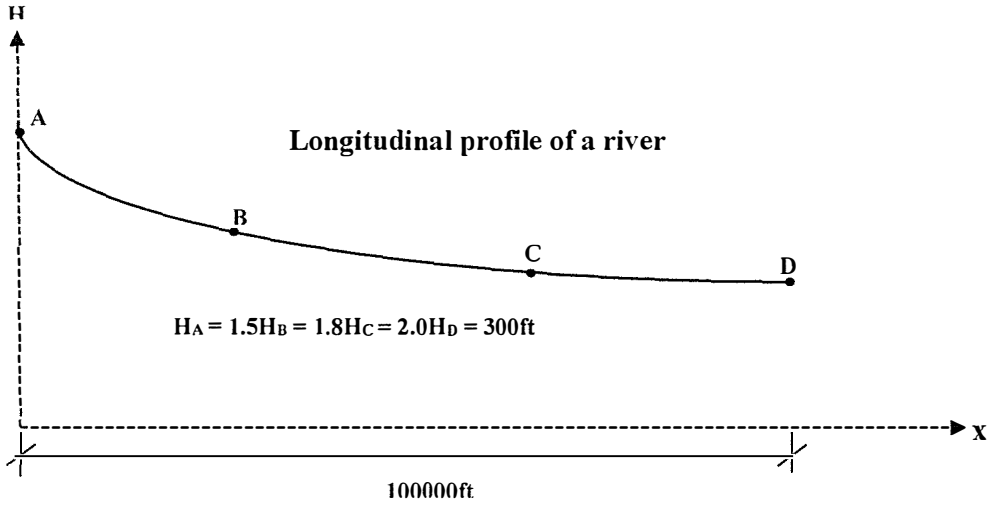
   b) Describe the processes by which bed load is transported along the direction of the flow. (4)

   c) Rainfall with mild intensity can cause significant surface runoff if it persists for a long duration. Discuss. (4)

2. From the following figure (5+5)

   i. Calculate the horizontal distance between locations B and D

   ii. Compute the erosional tendency at locations A, B, C, and D.

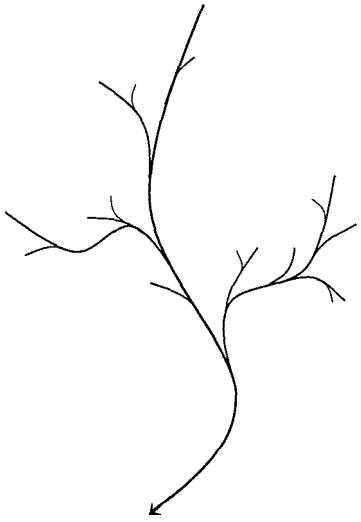


3. a) Discuss typical changes of the following stream channel characteristics along its length with the help of a graph. (8)
   i) bed material grain size ii) channel width iii) channel depth iv) relative volume of stored alluvium

   b) Explain why the maximum stage and maximum discharge occur at different times and draw the stage-discharge curve. (6)

   c) Discuss the importance of the seismic hazard map of Bangladesh updated in BNBC-2020. (4)

4. a) Rank the streams of the following drainage basin having a drainage density of 0.12/km. The results of the survey are summarized in the table below. (5+10)



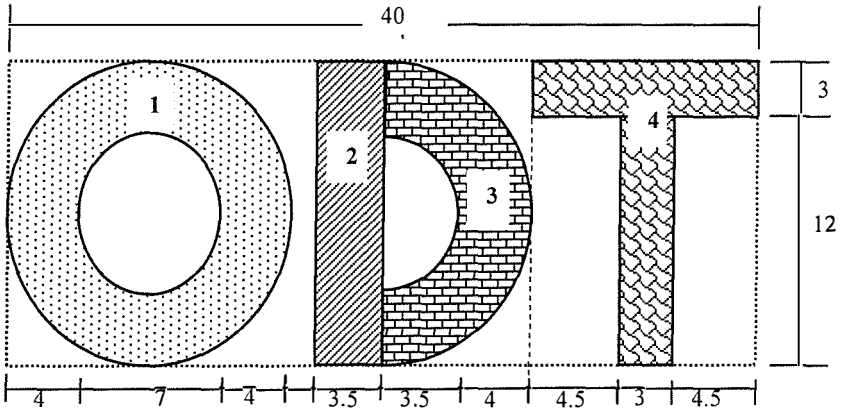
Steam Rank	Average Length (km)
1	5.9
2	18.3
3	40.4
4	98.2

Hence, or otherwise, calculate the following parameters:

a. Average Bifurcation Ratio (ABR)
b. Average Length Ratio (ALR)
c. Length of overland flow
d. Stream Frequency (SF)

b) Using the following figure, calculate the rainfall intensity in inches/hr for the catchment area where the peak runoff is 120 ft^3/hr. [All units are in the yard.1 yard = 3 feet] (10)

Area	Run-off coefficient
1	0.70
2	0.50
3	0.45
4	0.35



5. a) Discuss the concept of graded stream according to Mackin and explain how slope controls the equilibrium of the stream. (5)

b) Compare between infiltration and percolation. (5)

6. a) The magnitude of an earthquake in Richter scale is 6.0. If the maximum trace amplitude of a seismograph is measured to be 10000 mm. Find out the distance of the epicenter from the station. (6)

b) An urban area of 5 km^2 experiences a rainfall event with an intensity of 10 mm/h lasting for 2 hours. The runoff coefficient of the area is 0.5, and evaporation and transpiration losses are estimated to be 2 mm. Calculate the total volume of infiltration into the soil using the given data. Assume the total rainfall volume is distributed between runoff, evaporation-transpiration, and infiltration. (6)

c) A city is designing a stormwater drainage system for a 0.5 km^2 urban area. The runoff coefficient of the area is 0.75. The system is being designed for a critical storm duration of 30 minutes. Estimate the peak runoff if the estimated design period is 10 years. Evaluate whether increasing the design period to 25 years would significantly affect the peak runoff. (13)

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

Course Title: Numerical Analysis and Computer Programming (OBE) Course Code: CE 205
Time: 3 hours Credit Hour: 3.00 Full Marks: 100

(Answer ALL the questions)

1. In transportation engineering, these equations used to compute the travel demand (in number of persons) are expressed by

$$-18= -2X_1 - 2X_2 - 4X_3$$

$$-14= - X_1 - 2X_2 - 3X_3$$

$$2= X_1 - X_2 + X_3$$

Where X_1, X_2 and X_3 are the travel distance, travel time and travel cost, respectively. Now, apply **Gauss-Jordan Elimination Method** to calculate the value of travel distance (X_1), travel time (X_2), and travel cost (X_3).
[15]

2. In Hydrology lab, an experiment named "Flow through a Venturi Meter" is done to collect Discharge vs Time data provided in the following table. Develop an equation to determine the discharge (Q) using **Lagrange interpolating polynomial formula.** **[15]**

Time, t (s)	0	3	4	6
Discharge, Q (m^3/s)	0	1	2	3

3. In Solid Mechanics lab, an equation, $\mathbf{y= x^3+3e^x+7}$ is found to determine the reaction force for a **6 m** long cantilever beam where, x is the distance from the left and y is the reaction force (shown in **Fig.1**). Calculate the upward reaction force **y** **[5x4=20]**

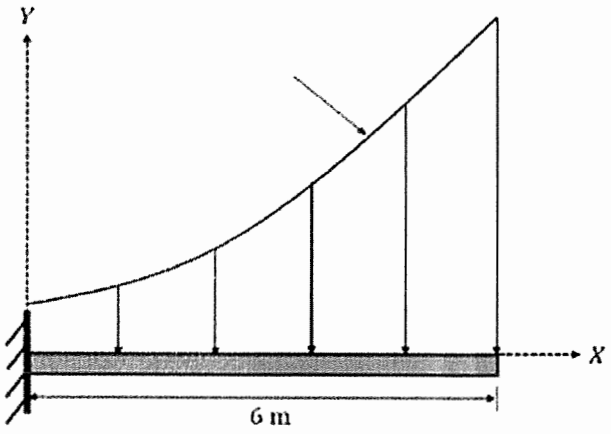


Fig. 1.

a) Using Trapezoidal Rule where n=10

b) Using Simpson Rule where n=10

c) Using Gauss Quadrature formula where n=1

d) Compare the results found in a, b and c with Analytical Solution

4. Following is a differential equation which is found in Geotechnical lab in UAP while performing an experiment **[15+5+5=25]**

$$2\frac{dy}{dx} - \frac{x^2-10x+25}{y} = 0 \qquad \text{where } y(0)=1$$

a) Determine the value of y when **x=2** using **Second order Runge Kutta** Method [Use step size h=0.5]

b) Determine the **Analytical Solution**

c) Determine **Absolute, Relative and Percentage Error**

5. The rate of cooling can be expressed using the following equation: **[6+3+3+3=15]**

$$\frac{dT}{dt} = -k(T - 20)$$

t	0	5	10	15	20	25
T	80	44.5	30	19.1	21.7	20.7

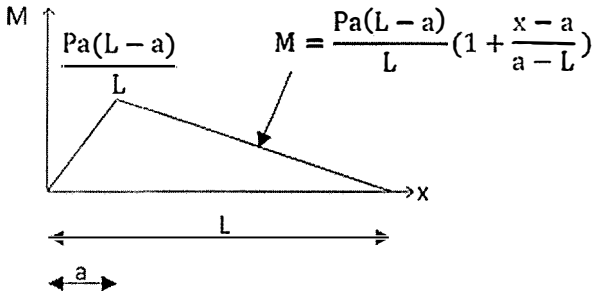
a) Develop a **program using MATLAB** to plot the specified points, adding axis names and a title "Rate of cooling" to the plot.

b) Develop a **program using MATLAB** to find the area under the curve using trapezoidal integration.

c) Develop a **program using MATLAB** to find the value of $\frac{dT}{dt}$ for the points mentioned above.

d) Develop a **program using MATLAB** to find the values of k at the specified points.

6. Develop a **program using MATLAB** to make a function that computes the bending moment in a simply supported beam subjected to a point load as shown in the figure below. **[10]**



Relevant Formulae:

1. $\int_{-1}^{1} f(p)dp = f\left(\frac{-1}{\sqrt{3}}\right) + f\left(\frac{1}{\sqrt{3}}\right)$
2. $Y_n = Y_{n+1} + \frac{1}{2}(k_1 + k_2)$

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Final Examination, Spring 2024
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Course Title: Mechanics of Solids II **Course Code:** CE 213
Time: 3 hours **Credit Hour:** 3 **Full Marks:** 100

(Answer all the questions)

1. An aluminum extrusion has the cross section shown in **Fig.1**. If torque T = 400 N.m is applied. All dimensions in mm.
   (a) Determine the maximum shear stresses that would develop in the three different parts of the member.
   (b) Calculate the torsional stiffness of the member. (Neglecting stress concentrations.) **[6+6]**

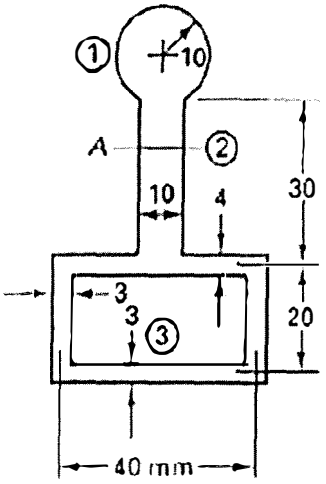


Fig:1

2. 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.2**. 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.
   (a) Determine
      (i) the principal stresses
      (ii) the maximum shear stresses and associated normal stresses.
   (b) Show the results for both cases by using **Mohr's circle**. **[7+7]**

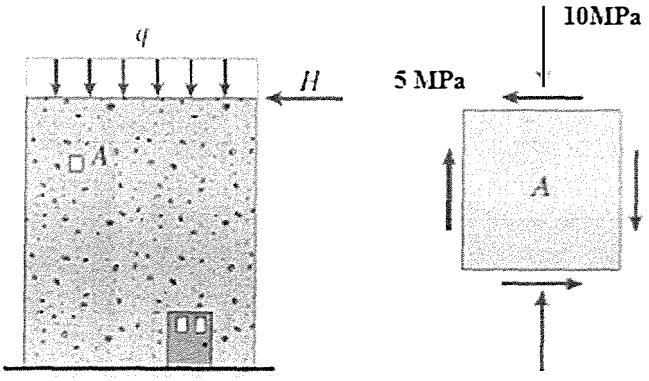


Fig:2

3. Calculate the maximum compressive stress acting on section **a-a** caused by the applied load for the structure shown in **Fig.3**. The cross section at a-a is that of a solid circular bar of 2-in diameter. **[16]**

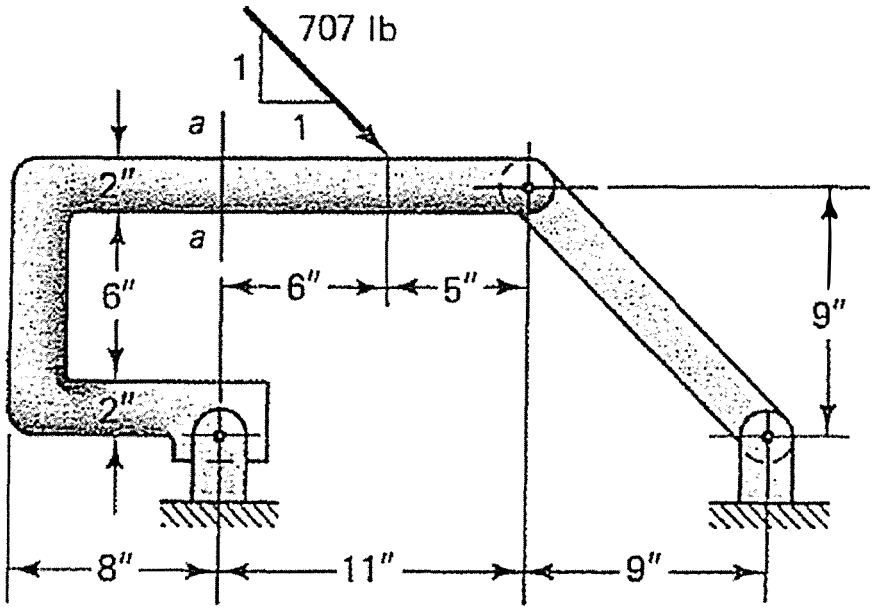


Fig:3

4. A thin bar of stainless steel is axially pre-compressed 100 N between two plates that are fixed at a constant distance of 150 mm apart (see **Fig.4**). This assembly is made at 30°C. How high can the temperature of the bar rise, so as to have a factor of safety of 2 with respect to buckling? Assume E = 200 GPa and α=17 x 10^{-5} per °C. **[10]**

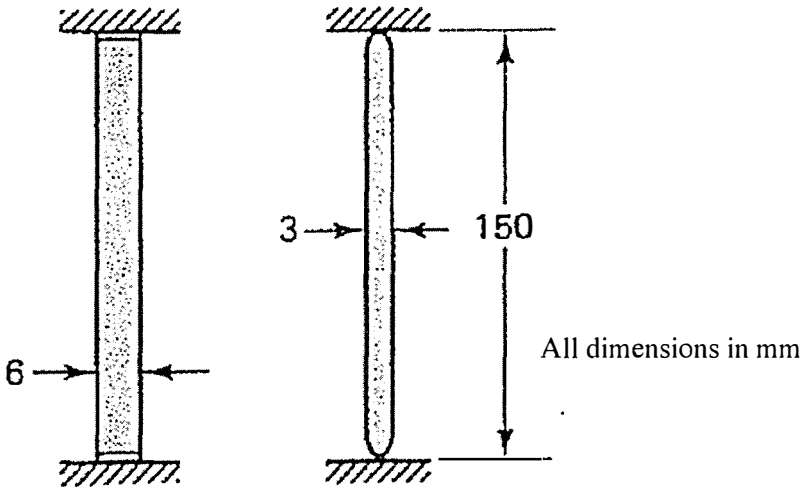


Fig:4

5. The overhanging steel beam ABC carries a concentrated load **P** at end C (as shown in **Fig. 5**) .
For the portion AB of the beam,
(a) Derive the equation of the elastic curve
(b) Determine the maximum deflection (Using **Direct integration** Method)
. **[6+6]**

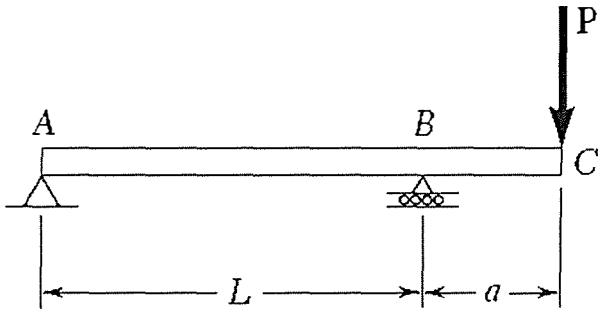


Fig:5

6. For the prismatic beam and loading shown in **Fig.6**, determine
(a) the equation of the elastic curve
(b) the slope at A
(c) the maximum deflection. (Using **Direct Integration** Method)
. **[4+4+4]**

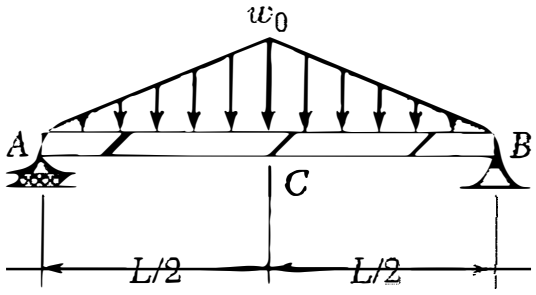


Fig:6

7. The prismatic rods AD and DB are welded together to form the cantilever beam ADB loaded as shown in **Fig.7**.
Knowing that the flexural rigidity is EI in portion AD of the beam and 2EI in portion DB, determine the slope and deflection at end A. (Using **Moment Area** Method) .
[12]

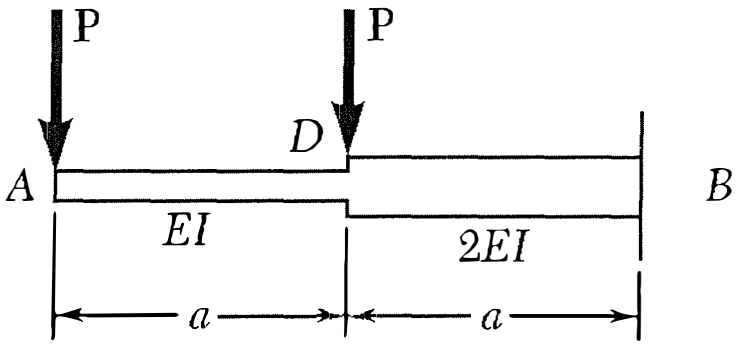


Fig:7

8. **(a)** Derive the formula to calculate the critical load for buckling in a column with both ends pinned.
(b) Develop the formula to determine the critical buckling load for a column with one end fixed and the other end pinned.
[6+6]

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

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

Please answer all questions.

[Assume reasonable data if and when required]

1. **a)** Define dynamic viscosity. Describe relationship between unit weight and density of fluid. **5**
   b) Define volume flow rate. State the condition for flow lines to satisfy continuity equation. **5**

2. **a)** Define hydraulic radius in fluid mechanics. **5**
   b) Derive the Darcy-Weisbach equation for a circular pipe flow. **15**

3. **a)** A 2000 ft pipeline is designed to flow crude oil (s.g = 0.86, υ= 0.00003 ft^2/s) with a discharge of 1.0 ft^3/s through a 6-inch diameter Cast-iron pipe (Roughness height: 0.0004 ft). Compute the head loss in the flow. [Use the Moody diagram attached] **10**

   b) Water is flowing from reservoir A to B though a series of pipe as shown in ***Figure:1***. If the head loss is 5m, find the discharge from A to B. Use equivalent length method. Pipe information and relevant formula are attached with the figure. **10**

4. Determine flow in each pipe as shown in ***Figure:2*** using **Hardy-Cross** method. Give 2 trials. **10**

5. **a)** State Bernoulli's energy equation and express the limitations of it. **10**
   b) Explain geometric similarity in fluid mechanics. **5**
   c) Explain which fluids are appropriate to use in a manometer **5**

6. **a)** Find the hydrostatic force acting on the 200-ft long concrete dam as shown in the ***Figure:3*** **5**
   b) A ship whose hull length is 460 ft is to travel at 25.0 ft/s. Find the velocity at which a model (1:30) should be driven in water (water characteristics of the model is same as the prototype). **5**
   c) A jet of oil (s.g=0.85) flowing through a **90° bend** attached to a 24-inch diameter pipe as shown in ***Figure: 4.*** The flow has discharge of 31.4 ft^3/s and pressure at the entrance and exit is 42.5 psi. Find the force on the **bend** by the oil jet. Draw the free body diagram. **10**

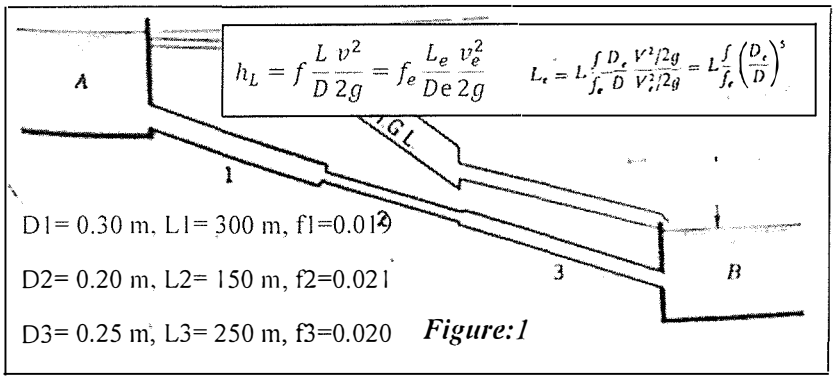


Figure:1

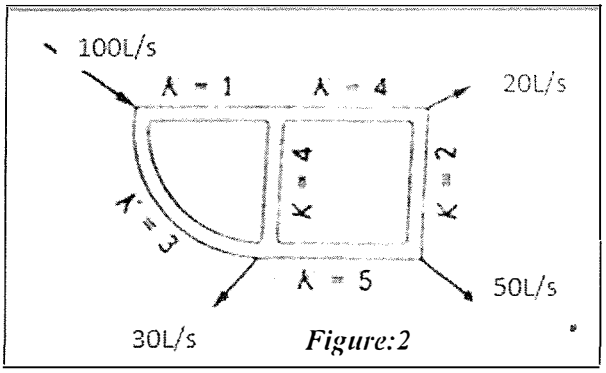


Figure:2

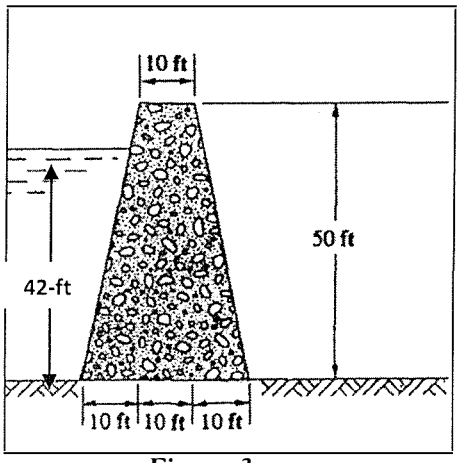


Figure:3

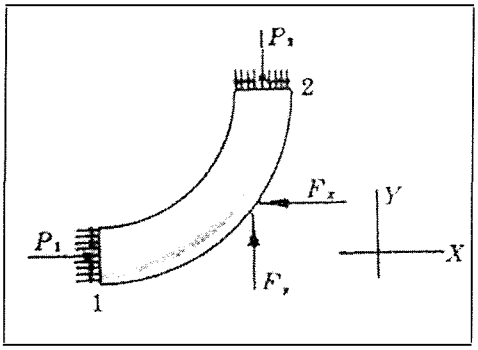
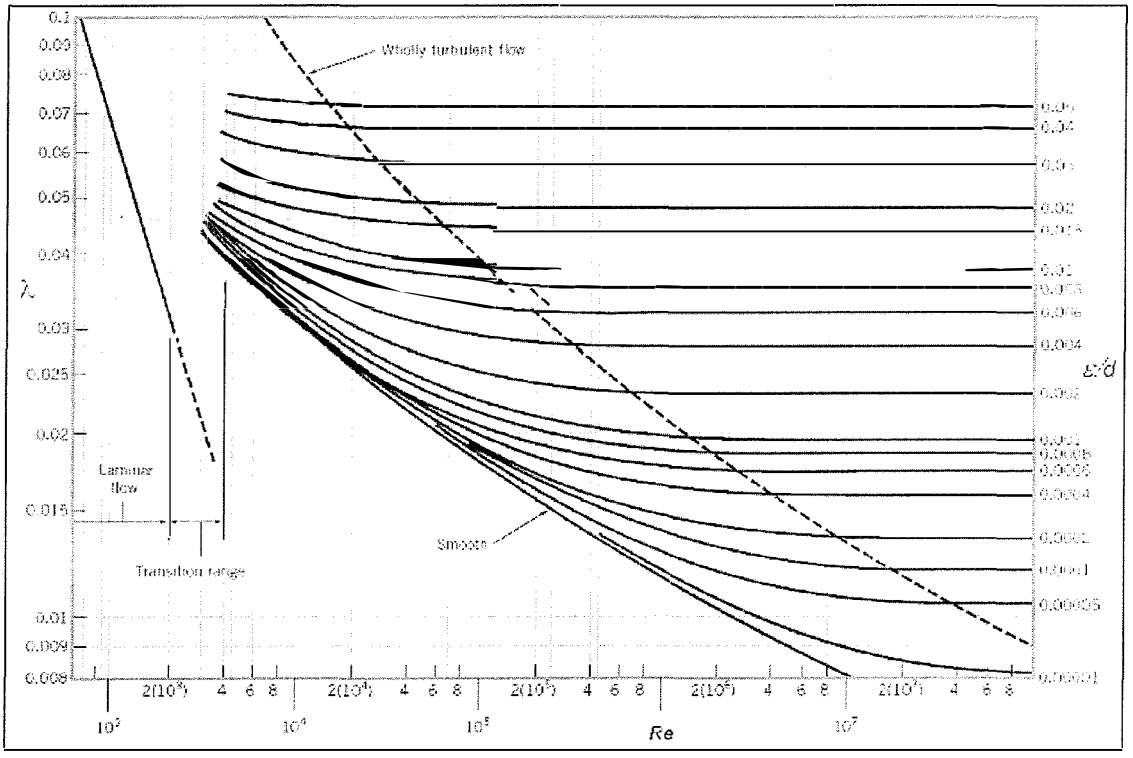


Figure:4



Moody Diagram