2-2

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall-2015
Program: B. Sc Engineering 2nd Year 2nd Semester)

Course Title: Principles of Economics Course No: ECN 201 Credit: 2.00
Time: 2.00 Hours. Full marks: 100

Instructions:

There are **Seven (7)** Questions. Answer any **Five (5)**. All questions are of equal value. Part marks are shown in the right margins.

1. An island castaway spends eight hours each day acquiring two items- coconuts and fish based on the following production possibilities schedule. 20

Production Scenario	Coconuts	Fish
A	24	0
B	20	1
C	12	2
D	0	3

   a. From a starting point of production (scenario A), what is the castaway's opportunity of catching the first fish (scenario B), the second fish (scenario C) and the third fish (scenario D)?
   b. Do these results conform to the law of increasing opportunity costs?
   c. If you drew a graph showing the castaway's production possibilities curve, what shape would it have?
   d. What assumptions must be met for the castaway to operate on his production possibilities curve?
   e. What happens to the castaway's production possibilities curve if he works for 12 hours instead of eight hours, each day?

2. (a) What is price elasticity of demand? Explain the classification of price elasticity of demand. 10
   (b) Explain the factors that affect price elasticity of demand. 10

3. (a) A rise in the price of wheat from $110 to $135 per tonne increases the amount supplied by wheat farmers from 8 million to 9 million. Calculate the appropriate elasticity coefficient. 05
   (b) Explain the role of government in controlling the price of the agricultural products and show a list identifying the winners and losers of the agricultural price supports program of the government. 15

4. (a) Write down the advantages and disadvantages of fiscal and monetary policy. 10
   (b) Explain the role of government in controlling the production or consumption of products where spill over costs are associated with it. 10

5. (a) Explain different types of competition in the marketplace. 10
   (b) What are the advantages and disadvantages of monopoly business? 10

6. (a) What are the different types of entry barriers faced by companies in monopoly or oligopoly market? 10
   (b) Briefly explain five types of inflation found in the economy of a country. 10

7. The short-run costs for a parking lot are shown in the table below: 20

L	△L	TP	△TP	MP	FC	VC	TC	△TC	MC	AFC	AVC	ATC
0		0			60	0						
1		120			60	180						
2		280			60	360						
3		410			60	540						
4		520			60	720						
5		580			60	900						

   (a) Copy and complete the table.
   (b) At which employment level does marginal product begin to fall? How is this point related to the behaviour of marginal cost?
   (c) On one graph draw the marginal product curve for this business. On another graph, draw the curve for marginal cost.

NB: Here L=Labour, TP= Total Product, MP=Marginal Product, FC=Fixed Cost, VC=Variable Cost, TC=Total Cost, MC=Marginal Cost, AFC= Average Fixed Cost, AVC=Average Variable Cost, ATC=Average Total Cost.

"Wish You Good Luck"

University of Asia Pacific

Department of Basic Sciences and Humanities

Final Examination, Fall- 2015

Program: B. Sc Engineering (Civil)

(2^{nd} Year/ 2^{nd} Semester)

Course Title: Mathematics-IV | Course Code. MTH 203

Time: 3.00 Hours | Full Mark:150

N.B: There are **Eight** questions. Answer any **Six (6)** of the following:

1. (a) Define Cauchy-Euler equation and Solve the differential equation **13**

$$(x^2D^2 - 6xD + 6)y = 0$$

(b) Solve: $(D^3 + 3D^2 + 3D + 1)y = e^{-x}$ **12**

2. (a) Define Bernoulli's equation and Solve **15**

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

(b) Solve: $p^2 - px - 2py + 2xy = 0$ **10**

3. (a) Define Integrating factor and Solve the differential equation **13**

$$cosx\frac{dy}{dx} + ysinx = 1$$

(b) Solve: $(x^2 - 4xy - 2y^2)dx + (y^2 - 4xy - 2x^2)dy = 0$ **12**

4. (a) Using Heaviside's expansion theorem evaluate **13**

$$\mathcal{L}^{-1}\left\{\frac{2s^2 - 4}{(s+1)(s-2)(s-3)}\right\}$$

(b) By applying first shifting theorem prove that **12**

(i) $\mathcal{L}\{tsinat\} = \frac{2as}{(s^2+a^2)^2}$

(ii) $\mathcal{L}\{tcosat\} = \frac{s^2-a^2}{(s^2+a^2)^2}$

5 (a) Write down the Convolution theorem. Evaluate $\mathcal{L}^{-1}\left\{\frac{1}{s^2(s^2+4)}\right\}$ by using Convolution theorem. **15**

(b) Find $\mathcal{L}\{\int_0^t \frac{Sint}{t} dt\}$ **10**

6 (a) Graph the function **15**

$$F(t) = \begin{cases} Sint & , \ 0 \leq t < \pi \\ 0 & , \ \pi \leq t < 2\pi \end{cases}$$

Extended periodically with period 2π and then find $\mathcal{L}\{F(t)\}$.

(b) Solve the Differential equation $Y' + 2Y = e^t$; $Y(0) = 1$ by using Laplace transformation. **10**

7 (a) Define Finite Fourier Sine and Cosine transforms. Find the (a) finite Fourier Sine transform, (b) finite Fourier Cosine transform of the function **15**

$$F(x) = 2x \ , \quad 0 < x < 4$$

(b) Write down the relation between Fourier and Laplace transforms. **10**

8 (a) Define Fourier Series. Obtain the Fourier Series of the function **15**

$$f(x) = \begin{cases} 0 & , -\pi \leq x \leq 0 \\ 1 & , \ 0 \leq x \leq \pi \end{cases}$$

(b) Show that $\int_0^\infty \frac{cosux}{u^2+1} du = \frac{\pi}{2} e^{-x}$ $(x > 0)$, when $f(x) = e^{-x}$ is an even function. **10**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2015
Program: B. Sc. Engineering (Civil)

Course Title : Engineering Geology & Geomorphology — Course Code : CE 203
Time: 3 hours — Full Marks: 120 (6 X 20 = 120)

Section A

There are **four (4)** questions in this section, answer **any three (3)**

1. (a) Draw a schematic diagram of the rock cycle and discuss (with at least two examples of each) about igneous, sedimentary and metamorphic rocks according to the cycle. **14**

(b) Mention (names only) the principal zones of the earth from geologic point of view and show thicknesses of different parts of lithosphere/geosphere. **6**

2. (a) Discuss, in brief, various types of chemical weathering processes. **4**

(b) Classify fold (mention names only) based on geometry and draw neat sketches of syncline and dome **6**

(c) Classify and discuss briefly (with neat sketches) various types of faults according to the direction of movement and net slip. **10**

3. (a) Define earthquake. Mention the causes of earthquake. Define the major earthquake parameters (geometric) with neat sketches. **8**

(b) Discuss liquefaction phenomenon (with basic mechanism) due to earthquake. **7**

(c) Tabulate Modified Mercalli intensity scales of earthquake (VIII to XII). **5**

4. Briefly discuss, mention or draw sketches, as asked for, on **any four** of the following topics:- **5 X 4 = 20**

(i) Different geomorphic processes (no description required) based on origin
(ii) Neat sketches of anticline and basin
(iii) Surface waves of earthquake (no sketch required)
(iv) Typical geometry of a fold (with neat sketch)
(v) Distinction between physical and chemical weathering processes

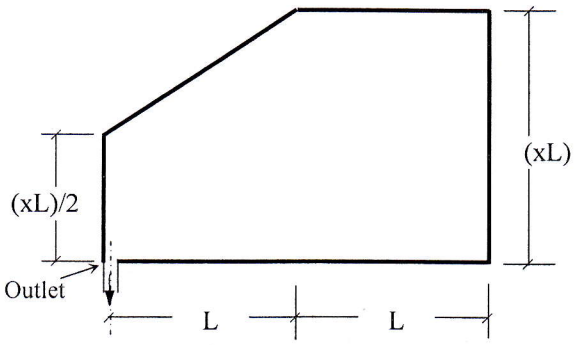
Section B

There are **four (4)** questions in this section, answer **any three (3)**

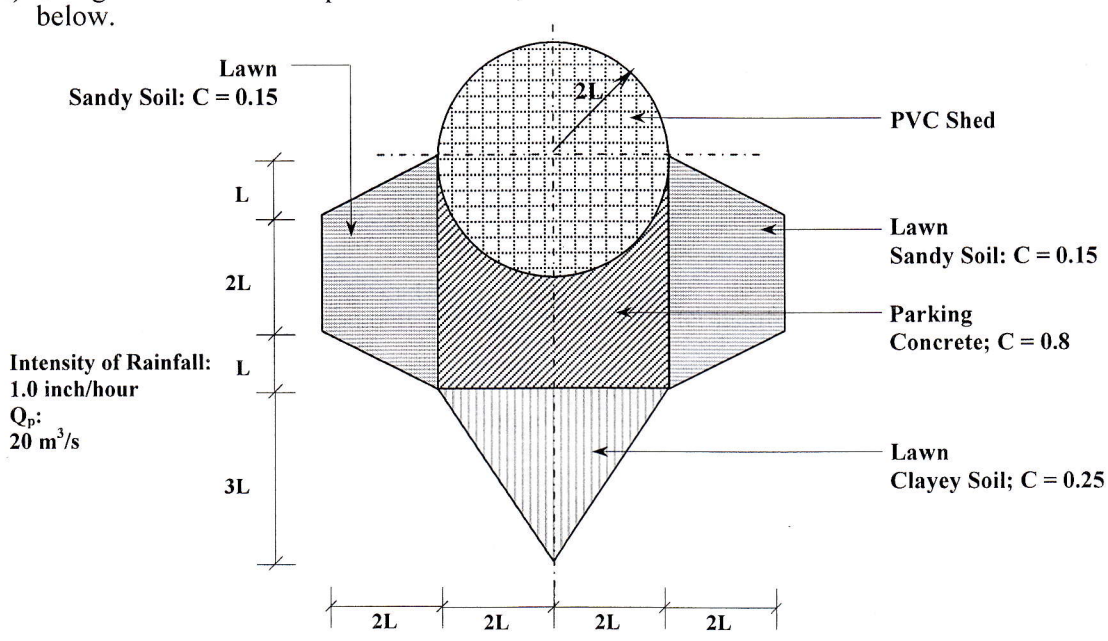
5. (a) Define infiltration and percolation. **2**

(b) Define with sketch: (1) Axial length (2) Time of Concentration. **3**

(c) 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 and CC of the basin for maximum runoff. **7**



(d) Using the information provided below, calculate L for the catchment area as shown below. 8



6. (a) Prove that $\tau = \gamma_w R_H S$; where symbols carry their usual meanings. 5

(b) For a stream having triangular X-section and D <<<<< T, prove that $\tau \propto D$ 4

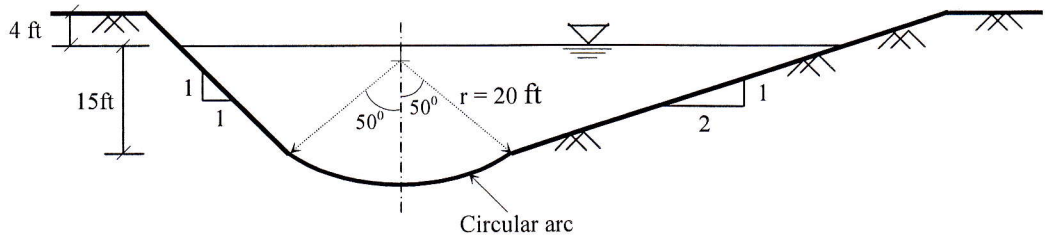
where

τ = tractive pressure along the stream T = Top width of stream

D = depth of stream

(c) Velocity of flow of one river (R-1) is four 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. 4

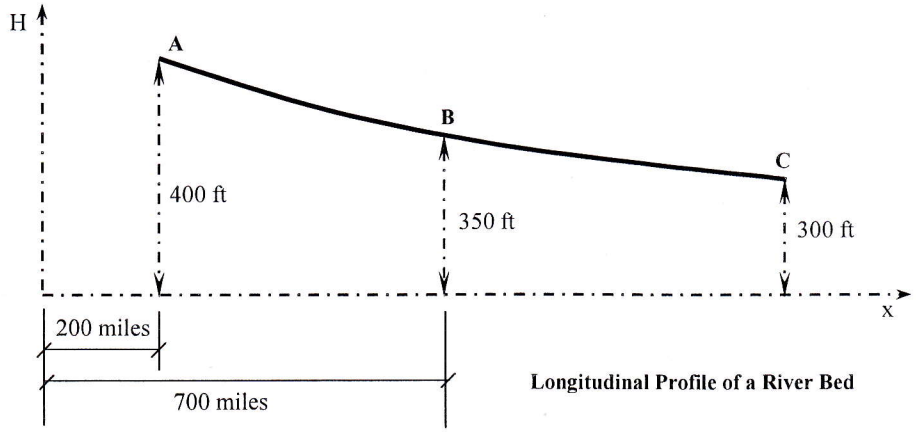
(d) Cross-sectional profile of a channel is shown below. The gradient of the channel bed is 4.33×10^{-4}. Calculate the tractive pressure along the channel. 7



X-Sectional Profile of Channel Course

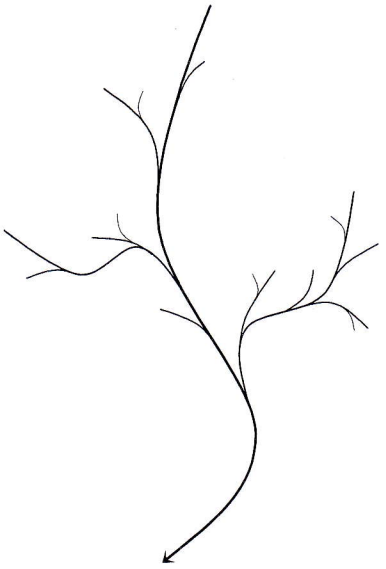
7. (a) Prove that $H = ae^{-bx}$; where symbols carry their usual meanings. 6

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



Longitudinal Profile of a River Bed

(c) Rank the streams of the following drainage basin having a total catchment area of 10,000 square kilometer. The results of the survey are summarized in the table below. 9



Steam Rank	Average Length (km)
1	7.0
2	18.9
3	44.8
4	99.9

Calculate the following parameters:
(i) Average Bifurcation Ratio (ABR)
(ii) Average Length Ratio (ALR)
(iii) Stream Frequency

8. (a) Write short notes on various types of loads of a river. **4.5**

(b) Write down four major factors affecting drainage pattern. Draw neat sketches of any two types of drainage patterns. 7

(c) What is a river valley? Sketch a typical cross-section of a river/stream valley. Classify (mention names only) valley according to the stage, genesis and controlling structures. 4

(d) Discuss, in brief, the ways valleys are widened. **4.5**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2015
Program: B. Sc. Engineering (Civil)

Course Title: Numerical Analysis & Computer Programming — Course Code: CE 205
Time: 3 hours — Full Marks: 150

PART–A

Answer **any 10 (TEN)** of the following questions

1. Find the root of the equation $3x^2 - 5x - 1 = 0$ using the Bisection method between the interval [1, 2] with the accuracy of 0.0001. (12)

2. Find the root of the equation $x^3 - 2x^2 + 4x - 6 = 0$ by the Newton-Raphson method using the initial approximation of $x_0 = 1$. Use the accuracy of 0.0001. (12)

3. Solve the following system of linear equations using the Gauss-Seidel method corrected upto four decimal places. Assume the initial values are $x = 0$, $y = 0$ and $z = 0$. (12)

$$\begin{aligned} 4x + 2y + z &= 6 \\ x + 5y - 2z &= 6 \\ 3x - y - 6z &= -2 \end{aligned}$$

4. Fit a Lagrange polynomial to the following data. Also find y when $x = 3.5$. (12)

x	1	2	3	5
y	0	1	26	124

5. Fit a second degree curve of regression or Parabola ($y = a + bx + cx^2$) to the following data. (12)

x	1	2	3	4	5
y	1	10	23	40	61

6. Evaluate numerically the following using the Trapezoidal rule with 10 panels or $n = 10$. Also compare the result with the actual solution. (12)

$$I = \int_0^5 \left(\frac{24}{x+1}\right) dx$$

7. Evaluate numerically the following using the Simpson's rule with 10 panels or $n = 10$. (12)

$$I = \int_0^5 \left(\frac{6x}{\sqrt{x^2 + 2x + 1}}\right) dx$$

8. Solve the following differential equation to get $y(1)$ by the Euler's method which has an initial value $y(0) = 1$. Use the step length, $h = 0.2$. (12)

$$\frac{dy}{dx} = \frac{x^2 + 5}{y}$$

9. Find $y(1)$ by solving the following differential equation using the fourth-order Runge-Kutta method which has an initial value $y(0) = 1$. Use the step length, $h = 0.5$. (12)

$$4\frac{dy}{dx} = \frac{3x^3}{y}$$

10. Solve the following boundary value problem to estimate $y(0.5)$ by the Finite Difference method with step length, $h = 0.5$. (12)

$$\frac{d^2y}{dx^2} - 8y + 12 = 0$$

Given that,

$$y(0) = 0$$
$$y(1) = 4$$

11. Using the Milne's method find $y(0.8)$ by solving the following differential equation. (12)

$$\frac{dy}{dx} = x - y^2$$

Given that,

$$y(0) = 0$$
$$y(0.2) = 0.02$$
$$y(0.4) = 0.0795$$
$$y(0.6) = 0.1762$$

12. Evaluate numerically the following using the 4 point Gauss Quadrature. (12)

$$I = \int_0^{10} \left(e^{0.5x} + x^2 + 20\right) dx$$

Table: 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

PART–B

Answer **any 3 (THREE)** of the following questions

13. Write an algorithm to find the real root of a quadratic equation ($ax^2 + bx + c = 0$). (10)

14. Write a C++ program to calculate the summation of the following series. (10)

$$1^2 + 3^2 + 5^2 + 7^2 + \ldots\ldots + n^2$$

15. Write an algorithm to determine the greatest of given three numbers. (10)

16. Write the output of the following *for* loop. The first two are done for you. (10)

```
int main ()
{
   int count = 0;
   for (int i = 1; i < 5; i++)
   {
     for (int j = i; j < 5; j++)
     {
     count + = i * j;
     cout<<"i = "<<i<<""<<"j = "<<j<<""<<"count = "<<count<<endl;
     }
   }
}
```

Sample output:

```
i = 1     j = 1     count = 1
i = 1     j = 2     count = 3
```

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2015 (Set 1)
Program: B. Sc. Engineering (Civil)

Course Title: Mechanics of Solids II — Course Code: CE 213
Time: 3 hours — Full Marks: 100 (= 10 × 10)

[Answer **any 10 (ten)** of the following 14 questions]

1. Calculate the equivalent polar moments of inertia (J_{eq}) for the three cross-sections shown in Fig. 1(a)~(c) by centerline dimensions [Given: Wall thickness = 0.10″ throughout].

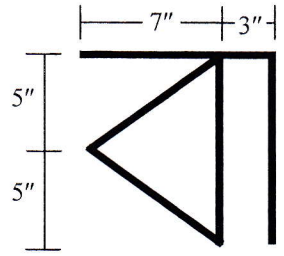


Fig. 1(a)

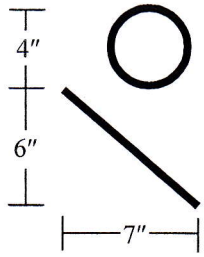


Fig. 1(b)

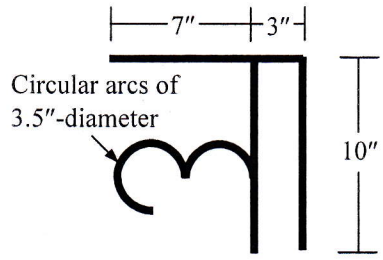


Fig. 1(c)

2. A (10′× 6′) flag is supported by a 20′-high post *abc* (4″-dia circular section, weighing 100 lb), shown in Fig. 2, and subjected to horizontal pressure (in *z*-direction) 20 lb/ft^2 over area A_1 and 30 lb/ft^2 over A_2.

   Draw torque diagram of *abc* and calculate its maximum torsional rotation [Given: $G_{abc} = 1.0 \times 10^6$ psi].

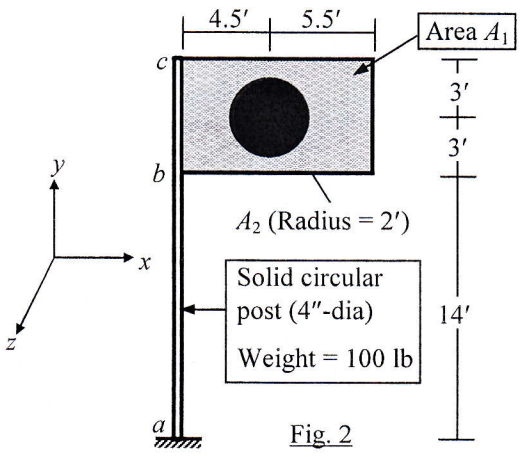


Fig. 2

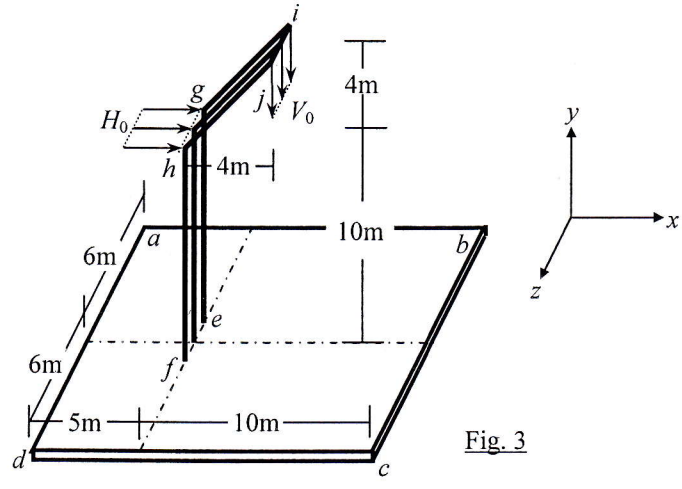


Fig. 3

3. For the weight and forces mentioned in Question 2 on the flag shown in Fig. 2
   (i) Calculate combined normal stress (σ_{yy}) and shear stress (τ_{xy}) at center of section *a* of the post *abc*,
   (ii) Draw the Mohr's circle showing the stresses calculated in (i).

4. Frame *efghij* is supported on footing *abcd* as shown in Fig. 3. Calculate the vertical force V_0 and horizontal force H_0 required to avoid overturning of the footing *abcd* as well as to ensure the maximum pressure underneath the footing does not exceed 100 kN/m^2.

5. Fig. 4 shows the σ_1 vs. σ_2 (both in MPa) graph including the 'No yield zone', for a material following Von Mises yield criterion.

   Instead, if the material follows the yield criteria of
   (i) St. Venant, (ii) Tresca [Given: Poisson's ratio = 0.25]
   Determine the equations relating σ_1 and σ_2, and plot the corresponding graphs.

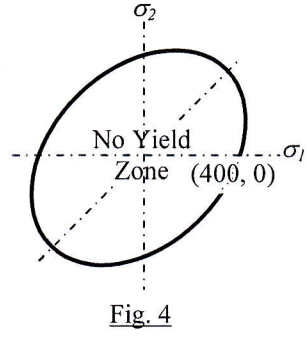
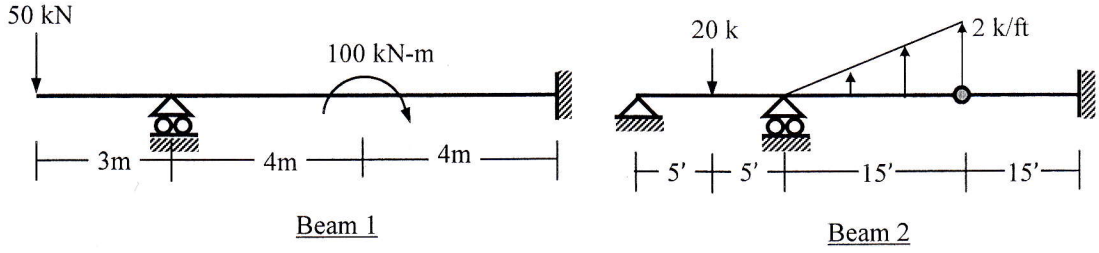


Fig. 4

6. For the beams (Beam 1 and Beam 2) shown in Fig. 5
   (a) Write down the equations for load $w(x)$ using singularity functions.
   (b) Write down the boundary conditions.
   (c) Determine whether the beams are statically determinate or indeterminate.
   (d) Drawn the qualitative deflected shapes of the beams under the given loads.



Beam 1 Beam 2

Fig. 5

7. Using Singularity function, calculate the deflection at D and rotation at A of the beam $ABCD$ shown in Fig. 6 [$EI = 15 \times 10^6$ kN-m^2].

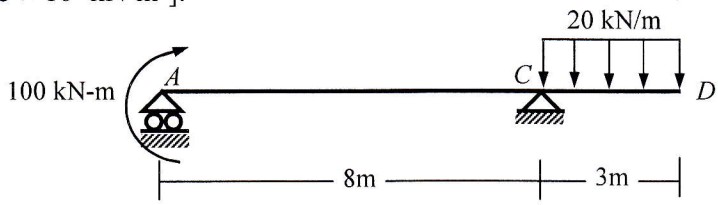


Fig. 6

8. Using Moment Area Theorem, calculate the rotation at A and deflection at B of the beam ABC shown in Fig. 7 [$EI = 40 \times 10^3$ k-ft^2].

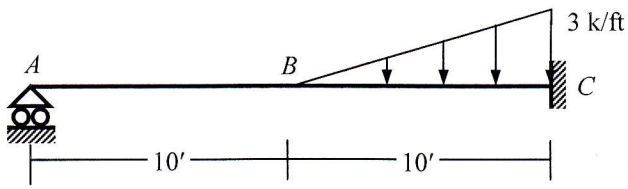


Fig. 7

9. Using Conjugate Beam Method, calculate the rotation at the left and right of C of the beam $ABCD$ shown in Fig. 8 [Given: $EI_{ABC} = 50 \times 10^3$ k-ft^2, $EI_{ABC} = 2EI_{CD}$].

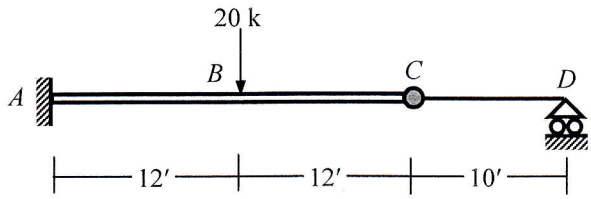


Fig. 8

10. Calculate support reactions and draw shear force and bending moment diagram the beam ABC shown in Fig. 9 [Given: $EI = 40 \times 10^3$ k-ft^2].

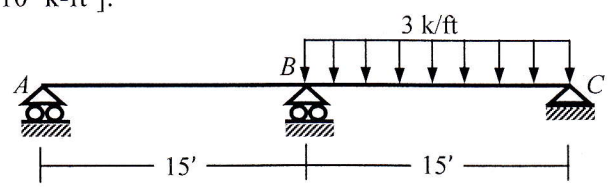


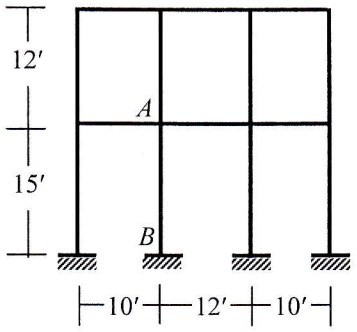
Fig. 9

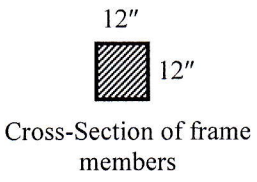
11. Calculate the critical load (P_{cr}) for column AB of the frame structure shown in Fig. 10.

Consider the frame is made of a nonlinear material with stress-strain relationship given by

$\sigma = 5\ Sin(\pi\varepsilon)$,

where σ is the stress (ksi) and ε is the strain.





Cross-Section of frame members

Fig. 10

12. Use the AISC-ASD criteria to check adequacy of the member DF in the truss shown in Fig. 11
[Given: The truss members are circular hollow tubes of 10 cm outside and 7.5 cm inside diameter, $E = 200$ GPa, $f_y = 500$ MPa for all members].

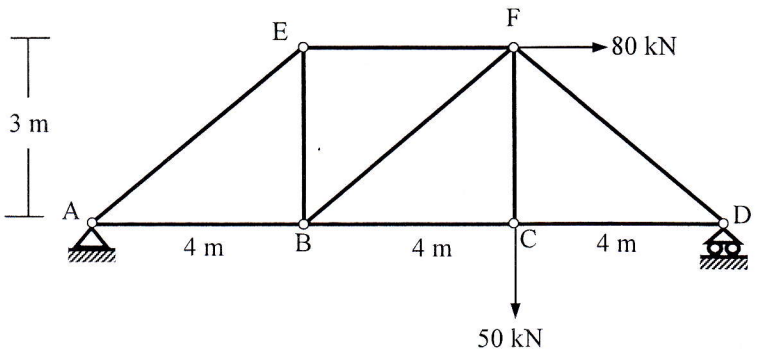


Fig. 11

13. For the column AB of the frame $ADBC$ shown in Fig. 12, calculate the
(i) Allowable value of load P using the AISC-ASD method,
(ii) Moment magnification factor and bending moment at the mid-span D when $P = 50$ kips
[Given: $E = 29000$ ksi, $f_y = 40$ ksi, $A = 9\text{in}^2$, $I_{min} = 25\ \text{in}^4$].

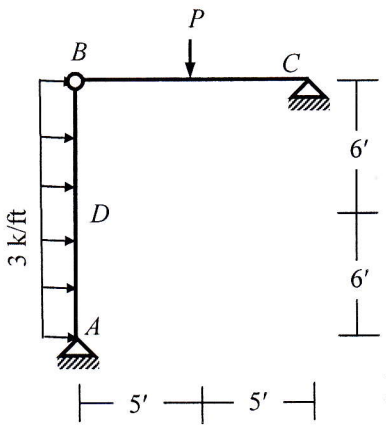


Fig. 12

14. The beam ABC shown in Fig. 13 is subjected to compressive forces (P) applied at both ends at an eccentricity of 'e'.

If deflection at B for $P = 150$ kips is 2″, calculate the

(i) Eccentricity 'e', and

(ii) Deflection at B for $P = 250$ kips

[Given: $EI = 30 \times 10^3$ k-ft^2].

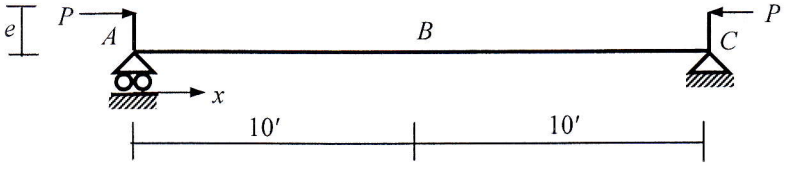


Fig. 13

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2015 (Set 2)
Program: B. Sc. Engineering (Civil)

Course Title: Mechanics of Solids II | Credit Hours: 3.0 | Course Code: CE 213
Time: 3 hours | Full Marks: 100 (= 10 × 10)

[Answer **any 10 (ten)** of the following 14 questions]

1. In Fig. 1, a simply supported beam EF is subjected to a triangular distributed load and supported at E on a spring support.

   Calculate the
   (i) Combined shear stress in the spring connected to top corner '*a*' of the column *abcd*
   (ii) Vertical deflection of the beam at E

   [Mean radius of radius = 6″, Coil dia = 1″, Number of coils = 6, G = 12000 ksi]

2. Fig. 1 shows a 15-ft long column *abcda′b′c′d′* supported on a rectangular footing ABCD and subjected to triangular distributed load.

   Calculate the combined normal stress at the corners B and D of the footing

   (Note: Footing center coincides with the center of column section).

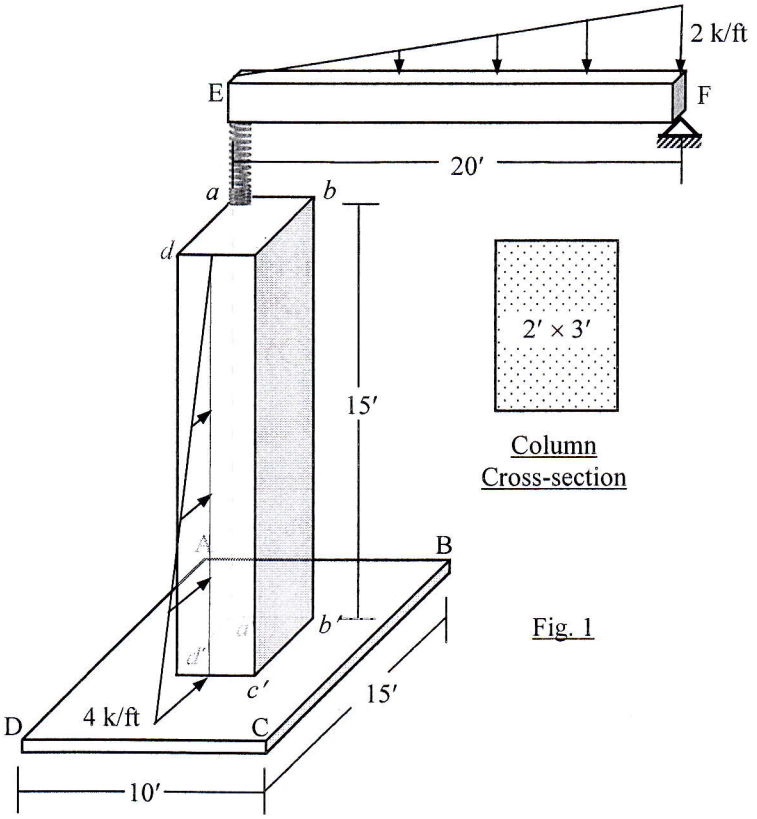


Fig. 1

3. Fig. 2 shows a Mohr's circle of stress (ksi). Vertical axis τ_{xy} intersect the circle at A (0, 4). Calculate the
   (a) Principal stresses
   (b) σ_{xx} and τ_{xy} if σ_{yy} = 4 ksi
   (c) Normal and shear stress (σ_{xx}', τ_{xy}') on a plane defined by θ = –30°.

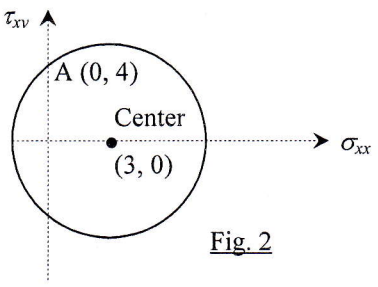


Fig. 2

4. Considering the statically indeterminate torsional problem shown in Fig. 3, calculate the maximum torsional stress and torsional rotation.

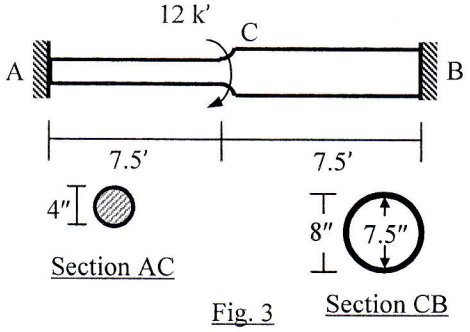


Fig. 3

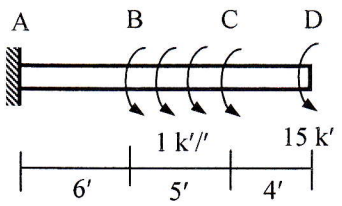
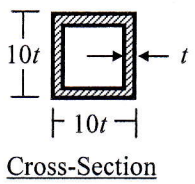


Fig. 4



5. Calculate the required thickness (t) of the closed thin-walled section shown in Fig. 4 if the allowable angle of twist is 2° [Given: G = 12000 ksi].

6. For the beam *abc* loaded as shown in Fig. 5, use *Singularity Functions* to calculate the vertical deflection and rotation at *c*, if the deflection and rotation at *b* are zero

   [Given: EI = constant = 100×10^3 kN-m^2].

7. Answer Question 6 using the *Moment-Area Theorems*.

8. Answer Question 6 using the *Conjugate Beam Method*.

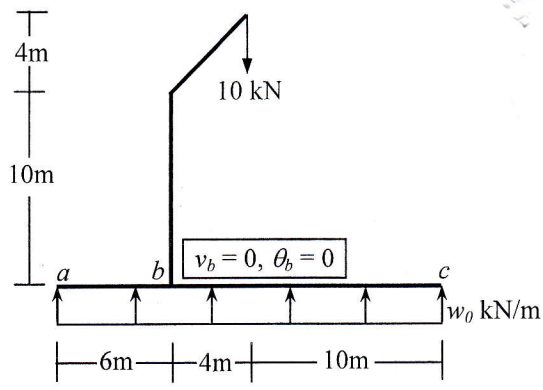


Fig. 5

9. For the beam *abc* loaded as shown in Fig. 6, calculate the
   (i) Vertical reaction and deflection at spring *a*
   (ii) Vertical deflection at *b*
   (iii) Rotation just at the right of *b*

   [Given: k_a = Stiffness of spring *a* = 100 k/ft, EI = constant = 80×10^3 k-ft^2].

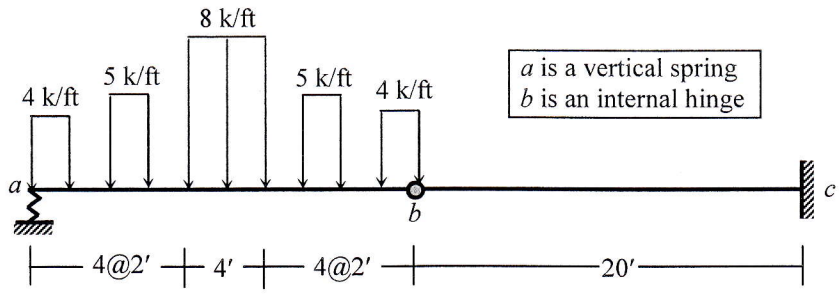
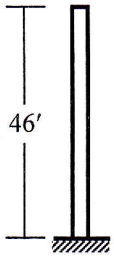


Fig. 6

10. Briefly answer the following questions
    (i) Draw the qualitative deflected shapes of the beams loaded as shown in Fig. 5 and Fig. 6.
    (ii) Explain why hinged support within a beam is converted to internal hinge in a conjugate beam.
    (iii) Draw the axial force vs. transverse deflection graph of a column using Euler's formulation, and also show the modifications due to column imperfection and material nonlinearity.
    (iv) Explain the necessity of using factor of safety for the AISC-ASD column design curve.

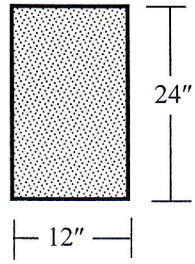
11. A 46′ high cantilever column [shown in Fig. 7(a)] has a cross-section shown in Fig. 7(b) and is made of a material whose stress-strain relationship is $\sigma = 100(\varepsilon)^{0.5}$, where σ is the stress (ksi), and ε is the strain.

    Calculate the critical load for the column.



Cantilever Column

Fig. 7(a)



Cross-section

Fig. 7(b)

12. Figs. 8(i) and 8(ii) show uniformly distributed load w_0 (= 100 kN/m) acting on member *ab* supported on column *bc*.

Calculate the

(i) Exact Moment Magnification Factor for column *bc* in Fig. 8(i)

(ii) AISC Moment Magnification Factor for column *bc* in Fig. 8(ii)

(iii) Bending moment at *b* for both columns

[Given: EI_{abc} = constant = 20×10^3 kN-m^2].

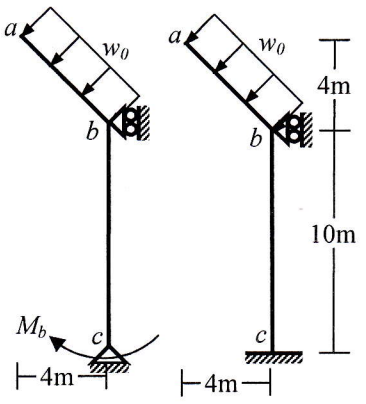


Fig. 8(i) Fig. 8(ii)

13. To resist the vertical force *F* applied at joint *b*, truss *abcdef* [shown in Fig. 9(i)] is modified to truss *abcdghef* by adding the joints *g* and *h* [shown in Fig. 9(ii)].

Use the AISC-ASD criteria to calculate the allowable value of *F* to avoid buckling of any member of

(i) Truss *abcdef* (ii) Truss *abcdefgh* [Given: E = 200,000 MPa, f_y = 400 MPa].

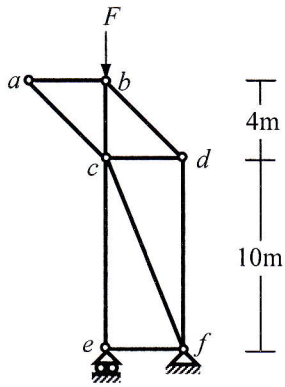


Fig. 9(i)

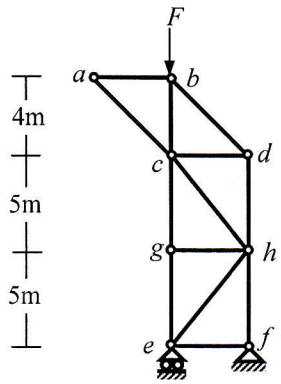
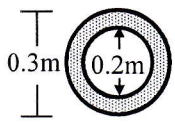


Fig. 9(ii)



Member Section

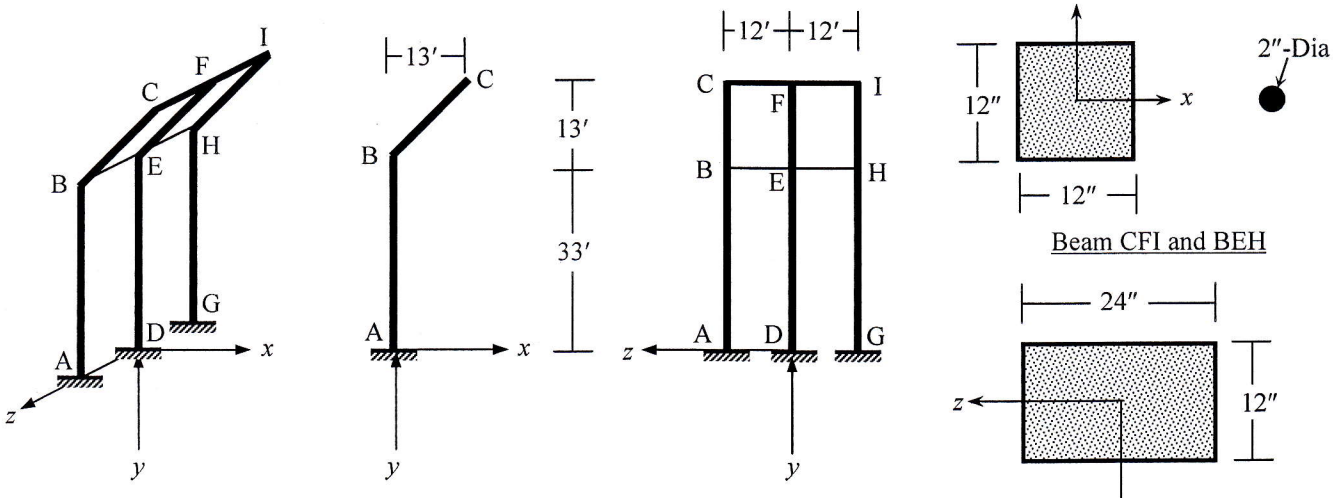
14. In the frame ABCDEFGHI shown in Fig. 10, calculate the

(i) Effective length factor, (ii) Critical buckling load

of the column DE about both *x*- and *z*-axis

[Given: E = 3000 ksi for all members (made of concrete) except BEH

E_{BEH} = 29000 ksi for the member BEH (made of steel)].



Beam CFI and BEH

Column Section

Fig. 10

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2015
Program: B.Sc. Engineering (Civil)

Course Title: Fluid Mechanics | Course Code: CE 221

Time: 3 hours | **Section: A** | Full Marks: 150(=25×6)

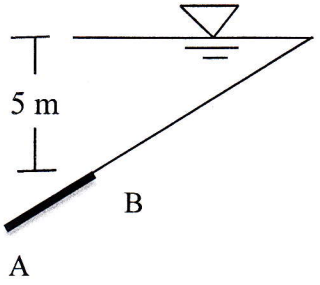
Part A

*There are **three (03)** questions in this part. Answer any **two (02)** of them.*
Assume any missing data reasonably.

1. (a) Prove that center of pressure of a submerged plane surface is same for all liquids. (10)

   (b) Why center of pressure of submerged plane surface act below the center of gravity? (3)

   (c) A square plate AB of 2m each side is immersed in water as shown in figure below. The plane of the plate is inclined at 30° with the free surface of water. Find the total pressure force on the plate and position of the center of pressure. (12)



Formula:

$F = h_C \gamma A$

$h_P = h_C + (I_C/Ah_C) Sin^2 \theta$

2. (a) Derive hydrostatic law of variation of pressure. (12)

   (b) Why mercury is usually used as a liquid in barometers? (3)

   (c) Calculate the capillary rise/drop in mm in a glass tube of 6 mm diameter when immersed in mercury at 20°C. The surface tension of mercury at 20° is 0.52 N/m, the contact angle for mercury is 130° and density of mercury at 20°C is 13500 kg/m^3. (10)

3. (a) Derive Newton's equation of viscosity. (8)

   (b) Differentiate between (5)
   i) Compressible and Incompressible flow
   ii) Steady and Uniform flow

   (c) Write down the characteristics of streamlines. (5)

   (d) From a flow net diagram it was found that the distance between two consecutive stream lines at two successive sections are 10 mm and 5 mm respectively. If the velocity at the first section is 2 m/sec, find velocity at the other section and discharge between the two stream lines. (7)

Part B

*There are **five (05)** questions in this part. Answer any **four (04)** of them.*
Assume any missing data reasonably.

4. (a) Derive Continuity Equation for steady incompressible flow. (10)

   (b) A pump is 2.0 m above the water level in the sump and has a pressure of -3.0 m of water at the suction side. The suction pipe is of 30 cm diameter and the delivery pipe is a short 35 cm dia pipe ending in a nozzle of 10 cm dia. If the nozzle is directly vertically upwards at an elevation of 5.0 m above the sump water level, determine (i) the discharge, (ii) power input into the flow by the pump, (iii) the elevation, above the sump water level, to which the jet would reach. Neglect losses. (15)

5. (a) What is energy correction factor? Why is it needed? Derive an equation for energy correction factor. (10)

   (b) Calculate the momentum correction factor for the following velocity distribution in a circular pipe of 1.5 m diameter. (15)

   $u = 0.50(1-\frac{r^2}{0.5625})$, where u=velocity (m/s) and r = radius (m).

6. (a) Briefly explain Reynolds Experiment. How can you determine characteristics of flow from Reynolds Experiment? (10)

   (b) Find the horizontal thrust on water by each meter of width of the sluice gate as shown in **Figure 1**. Neglect friction. (15)

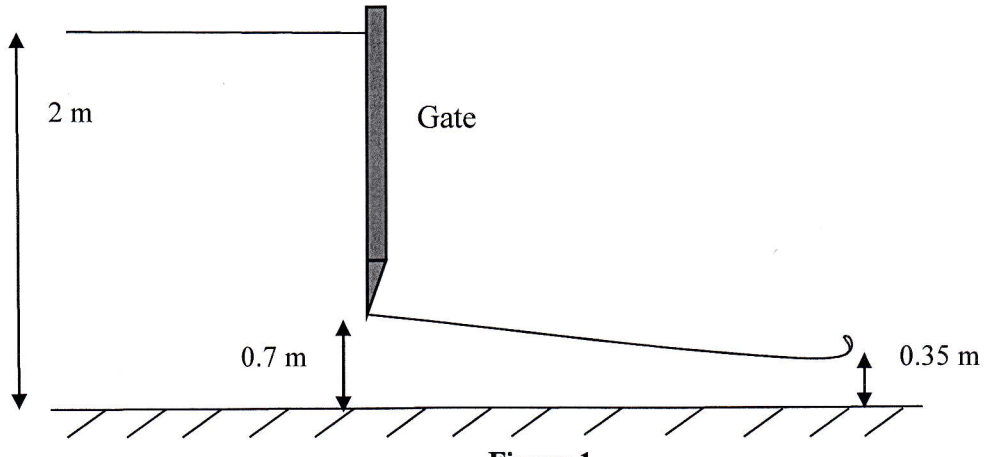


Figure 1

7. (a) Derive general equation for conduit friction (Darcy-Weisbach Equation). (10)

   (b) If the flows into and out of a two-loop pipe system are as shown in **Figure 2,** determine the flow in each pipe. The k-values for each pipe are given in the figure. Use Hardy Cross method. (15)

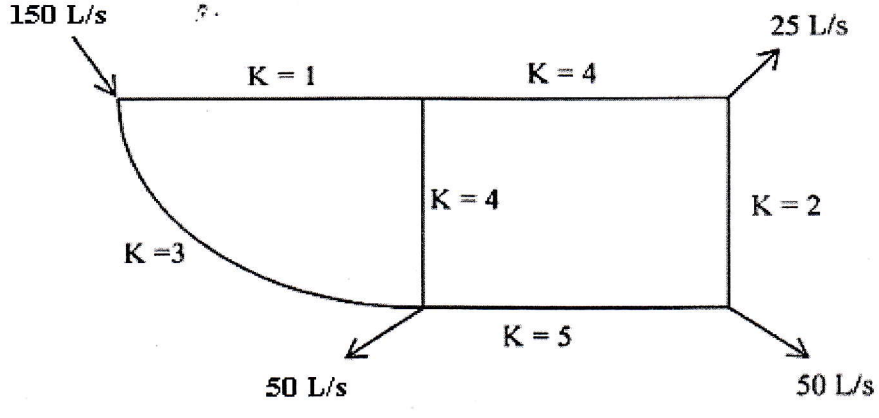


Figure 2

8. A fluid is flowing through a series of pipes which is shown in **Figure 3**. Determine the rate of flow from A to B when total head loss is 12 m and the kinematic viscosity of the fluid is 1.14×10^{-6}. Use Moody diagram shown in **Figure 4** to determine friction factor. Neglect minor losses. Pipe properties are given in following table. (25)

Table

Pipe No	Diameter (mm)	Length (km)	Equivalent Roughness(e), mm
1	350	0.30	0.25
2	200	0.20	0.30
3	300	0.25	0.275

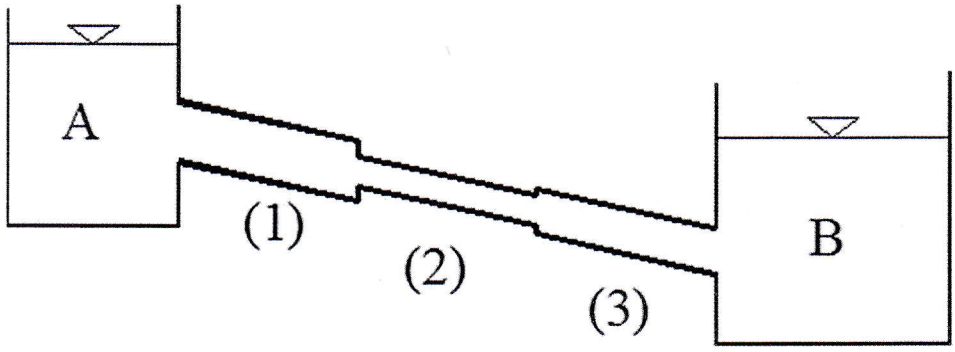


Figure 3

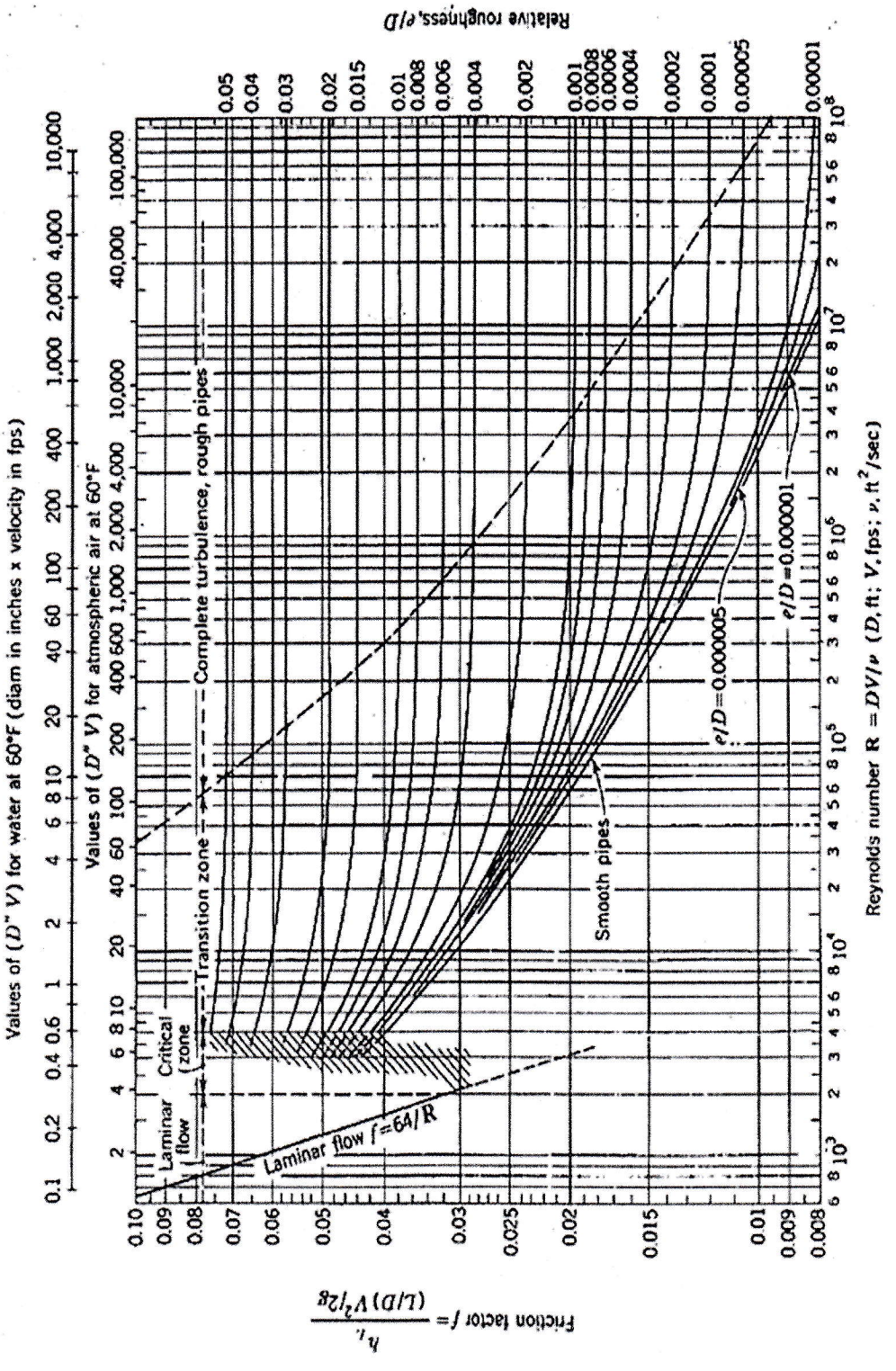

Relative roughness, e/D
0.05
0.04
0.03
0.02
0.015
0.01
0.008
0.006
0.004
0.002
0.001
0.0008
0.0006
0.0004
0.0002
0.0001
0.00005
0.00001
Values of (D" V) for water at 60°F (diam in inches x velocity in fps)
0.1 0.2 0.4 0.6 1 2 4 6 8 10 20 40 60 100 200 400 1,000 2,000 4,000 10,000
Values of (D" V) for atmospheric air at 60°F
2 4 6 8 10 20 40 60 100 200 400 600 1,000 2,000 4,000 10,000 40,000 100,000
Laminar flow
Critical zone
Transition zone
Complete turbulence, rough pipes
Laminar flow f=64/R
Smooth pipes
e/D=0.000005
e/D=0.000001
Friction factor f = h_L / (L/D) V²/2g
0.10 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.025 0.02 0.015 0.01 0.009 0.008
Reynolds number R = DV/ν (D, ft; V, fps; ν, ft²/sec)
6 8 10³ 2 3 4 5 6 8 10⁴ 2 3 4 5 6 8 10⁵ 2 3 4 5 6 8 10⁶ 2 3 4 5 6 8 10⁷ 2 3 4 5 6 8 10⁸

Figure 4

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2015
Program: B.Sc. Engineering (Civil)

Course Title: Fluid Mechanics | Course Code: CE 221

Time: 3 hours | **Section: B** | Full Marks: 150(=25×6)

Part A

[*There are **Three (03)** questions in this part. Answer any **Two (02)** of them. Assume any reasonable missing data*]

1. (a) What do you mean by fluid mechanics? Classify fluid mechanics. Differentiate between hydrodynamics and hydraulics. (10)

   (b) Define and classify viscosity. Derive Newton's Law of Viscosity. (10)

   (c) Two liquids A and B have same mass but volume of B is 2.5 times of volume of A. Which liquid has greater unit weight? (05)

2. (a) Prove that center of pressure of a submerged plane surface is independent of unit weight of the liquid. (10)

   (b) The gate is 60 cm wide normal to the sketch. It is pivoted at O. The gate weighs 2224 N. Its center of gravity is 36 cm to the right and 27 cm above O. For what values of water depth x above O will the gate remained closed? Neglect friction at the pivot and neglect thickness of the gate. (15)

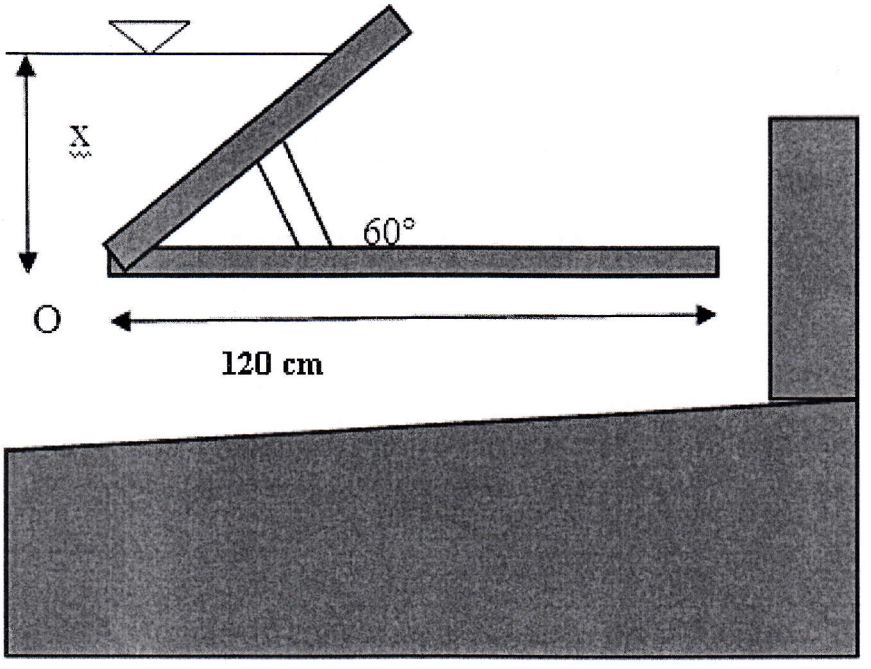


Figure 1

3. (a) What is flow net? Draw a typical flow net diagram. (07)

   (b) Define and differentiate between (06)
   i) Laminar and Turbulent flow
   ii) Steady and Unsteady flow
   iii) Compressible and Incompressible flow

(c) Find the pressure difference between point A and B shown in following **Figure 2**. (12)

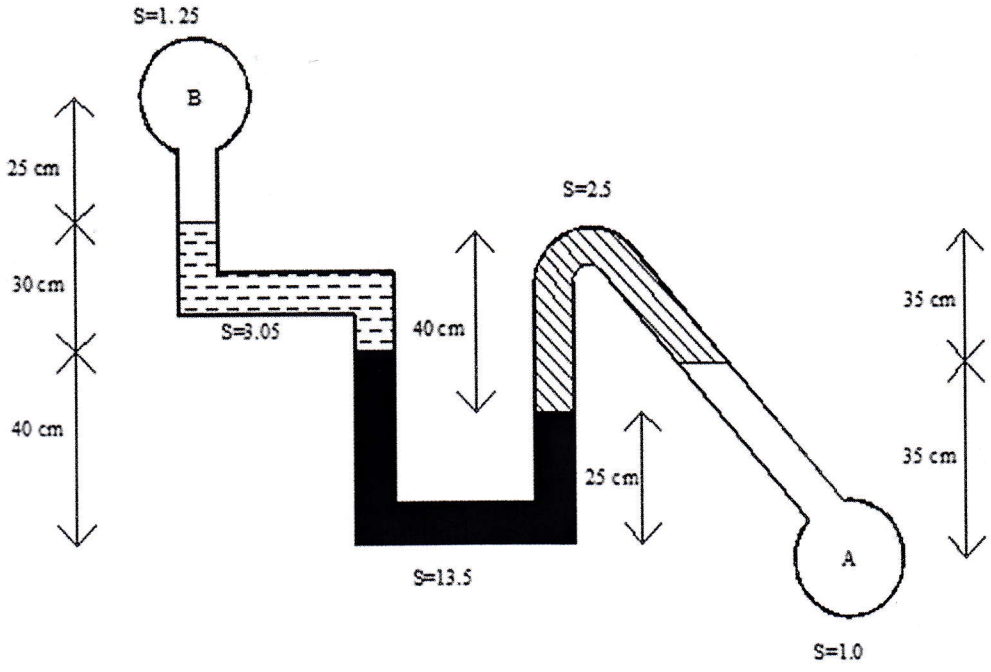


Figure 2

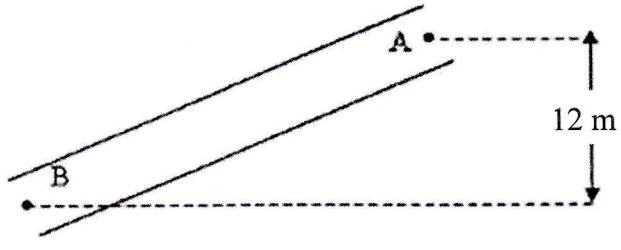
Part B

*[There are **Five (05)** questions in this section. Answer any **Four (04)** of them. Assume any reasonable missing data]*

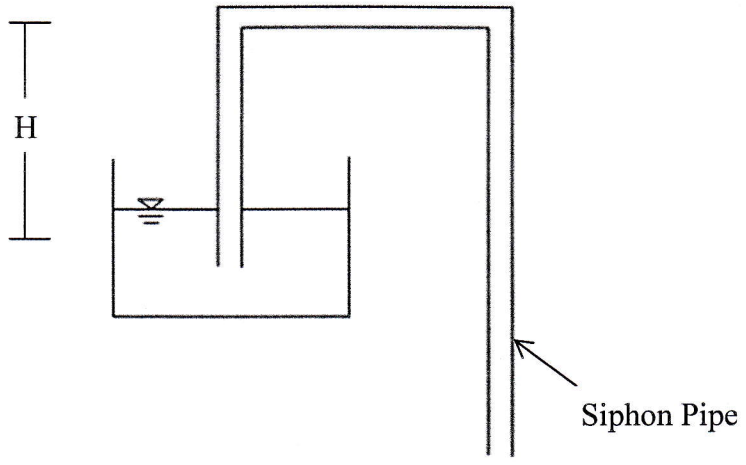
4. (a) Define cavitation? What are the effects of cavitation? (5)

   (b) Write the statement along with limitations corresponding to Bernoulli's equation. (5)

   (c) For a uniform diameter pipe with P_A=200 kN/m^2, P_B=150 kN/m^2, a crude oil (S=0.85) is flowing as shown in figure below. Find the direction of flow and head loss. (8)

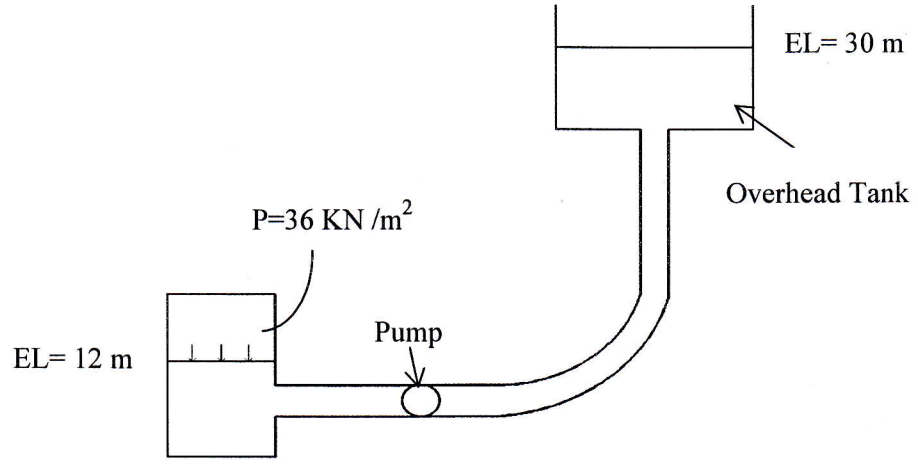


(d) In a siphon pipe installed in a tank shown in figure below the velocity of flow in the pipe is 6 m/sec. Neglecting friction and other losses calculate the maximum value of H for which siphon action will not be disrupted. Consider atmospheric pressure head and vapor pressure head is 10.34 m (abs) and 0.2 m (abs) respectively. (7)



5. (a) Derive the general equation of continuity for fluid flow through regions with fixed boundaries. Reduce the equation for steady incompressible flow. (10)

(b) A 12 HP pump working with 75% efficiency discharging crude oil (S=0.85) to the overhead tank as shown in figure. If losses in the whole system are 2.5m of the flowing fluid, find the discharge. (10)

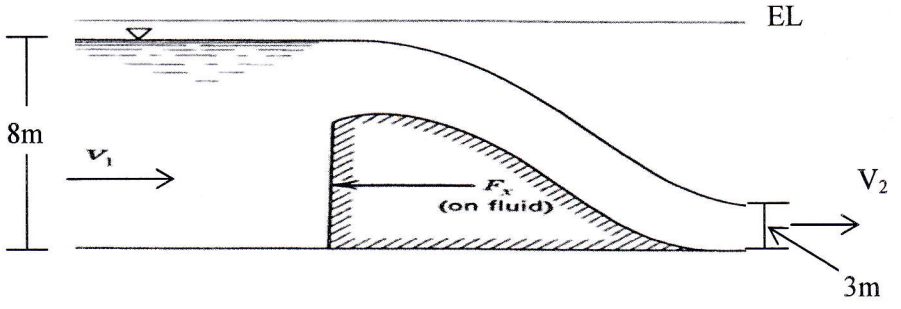


(c) Water is flowing through a pipe 100 mm in diameter under a gauge pressure of 5 kg/cm^2 with a mean velocity of 3 m/sec. Neglecting friction, determine the total head if the pipe centerline is considered as datum line. (5)

6. (a) Write a short note on momentum correction factor and energy correction factor. (7)

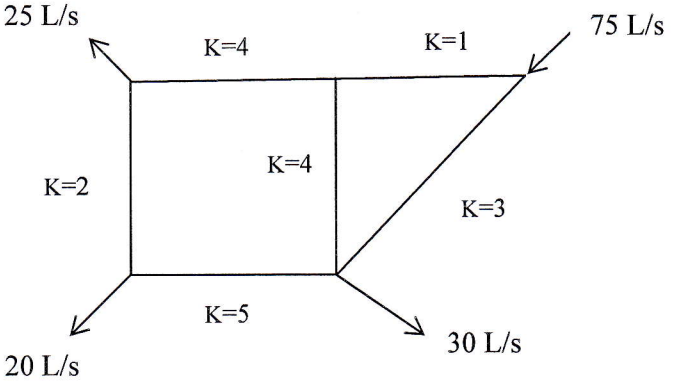
(b) State the impulse momentum principle for steady flow. (3)

(c) An overflow structure produces the flow field as shown in figure below. Assuming the fluid as frictionless calculate the magnitude and direction of the horizontal component of force on the structure. (15)



7. (a) Write down the basic relations of continuity and energy corresponding to flow in any pipe network. (4)

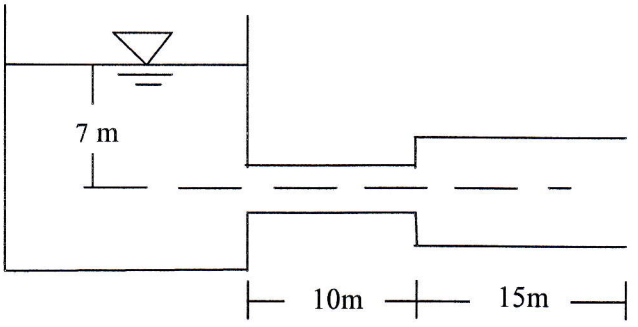
(b) If the flows into and out of a two loop pipe system are as shown in figure below, determine the flow in each pipe. The K-values for each pipe is given in the figure. Use Hardy Cross Method. (15)



(c) Describe with proper diagram the velocity distribution along a pipe with laminar flow. (6)

8. (a) Write short note on (6)
i) Hydraulic radius
ii) Relative roughness
iii) Viscous sub layer

(b) A pipeline 25m long as shown in figure below is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the 1st 10m of its length from the tank, the pipe is 15 cm in diameter and its diameter suddenly enlarges to 30 cm. Considering major and minor losses determine the rate of flow. Assume f = 0.02 for both the pipes. (14)



(c) From Darcy-Weisbach equation for circular pipe prove that $\tau_o = f\ \rho V^2/8$. Each term has their usual meaning. (5)