

31

**University of Asia Pacific**  
**Department of Civil**  
**Final Examination (Fall 2012)**  
**Program: B.Sc. Engg ((3rd year 1st semester)**

Course Title : Principles of Accounting  
 Full marks : 50

Credit Hours: 2.0

Course : ACN 301  
 Time : 2 hrs

(Answer any two from each part. Total number of ques. answered should be four)

**Part-A**

Q.1. At the end of its first month of operations, Darth Vader PI has the following adjusted trial balance on December 31, 2011. (in '000BDT)

	<u>Debit</u>	<u>Credit</u>
Cash	11,400	
Accounts Receivable	6,370	
Prepaid Insurance	1,950	
Supplies	750	
Equipment	30,000	
Notes Payable		10,000
Accounts Payable		12,350
Darth Vader, Capital		20,000
Darth Vader, Drawing	600	
Service Revenue		14,370
Salaries Expense	2,200	
Travel Expense	1,300	
Rent Expense	1,200	
Misc. Expense	200	
Supplies Expense	300	
Depreciation Expense	500	
Accumulated depreciation-Equipment		500
Interest Expense	300	
Interest Payable		300
Insurance Expense	450	
<b>Total</b>	<b>57520</b>	<b>57520</b>

**Instructions:**

- (a) Prepare an income statement (8.0)  
 (b) Prepare an owner's equity statement. (4.5)

Q.2. a) Give correcting journal of the following:

**Incorrect entry:** A collection of 780 on account from a customer (account receivable) was recorded as a debit to Cash and a credit to Service Revenue for Tk780. (4.5)

b) A list of transactions appears below:

- August 01 : Sanchita Khan invested Tk.200,000 cash in her new business, DreamWorks.  
 August 02 : Purchased equipment for Tk.90,000 cash.  
 August 10 : Rented a vehicle for the month and paid Tk.20,000.  
 August 15 : Purchased a 2-year insurance policy (prepayment) for Tk. 22,000.  
 August 17 : Received Tk. 25,000 cash advance from customers for future service to be provided.

- August 20 : Sold services for Tk.40,000 on account.
- August 22 : Paid Tk.7,000 wages for an assistant's work.
- August 24 : Withdrew Tk.10,000 for personal use.

**Instruction:**

**Journalize the transactions.**

**(8.0)**

**Q.3. a)** The following information pertains to Family Video Company.

- Cash balance per bank, July 31, \$7,263.
- Cash balance per books, July 31, \$7,284.
- July bank service charge not recorded by the depositor \$28.
- Deposits in transit, July 31, \$1,500.
- Bank collected \$900 note for Family in July, plus interest \$36, less fee \$20. The collection has not been recorded by Family, and no interest has been accrued.
- Outstanding checks, July 31, \$591.

**Instructions:**

Prepare a bank reconciliation statement at July 31.

**(10.0)**

b) What are the limitations of a trial balance?

**(2.5)**

**Part-B**

**Q.4.** Carver Construction Company is under contract to build a condominium at a contract price of \$2,000,000. The building will take 18 months to complete at an estimated cost of \$1,400,000. Construction began in November 2004, and was finished in April 2006. Actual construction costs incurred in each year were: 2004, \$140,000; 2005, \$910,000; and 2006, \$350,000.

**Compute the gross profit to be recognized in each year.**

**(12.5)**

**Q.5. a)** Write down the components of prime cost and conversion cost?

**(4.0)**

b) Holcim Cement Ltd. has seen noticeable fluctuation in its shipping expense from month to month, as shown below:

Month	Units Shipped	Total Shipping expense
January	4	2200
February	7	3100
March	5	2600
April	2	1500
May	3	2200
June	6	3000
July	8	3600

**Required:**

- A. Using High-low method, estimate the cost formula for shipping expense.
- B. Using the cost formula you have derived above, what shipping expense would you expect to incur during a month in which 12 units are shipped?

**(6.5+2)**

**Q.6.** KSRM Ltd. has been manufacturing its own shades for its table lamps. The company is currently operating at 100% of capacity. Variable manufacturing overhead is charged to production at the rate of 50%

of direct labor cost. The direct materials and direct labor cost per unit to make the lamp shades are \$4.00 and \$6.00, respectively. Normal production is 60,000 table lamps per year.

A supplier offers to make the lamp shades at a price of \$13.50 per unit. If KSRM Ltd. accepts the supplier's offer, all variable manufacturing costs will be eliminated, but the \$50,000 of fixed manufacturing overhead currently being charged to the lamp shades will have to be absorbed by other products and will remain in cost structure.

**Instructions:**

- a) Prepare the incremental analysis for the decision to make or buy the lamp shades.
- b) Should KSRM Ltd. buy the lamp shades?
- c) Would your answer be different in (b) if the productive capacity released by not making the lamp shades could be used to produce income of \$40,000? (12.5)

Section-B

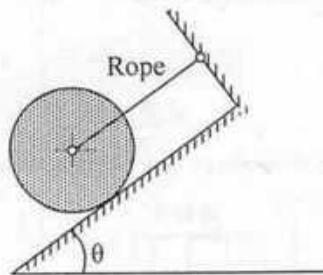
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Code: CE 101  
 Full Marks: 100 (=10×10)

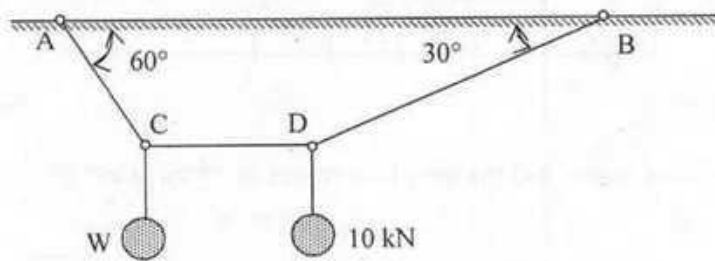
Course Title: Engineering Mechanics I  
 Time: 3 Hours

*There are fourteen (14) questions. Answer any ten (10)*

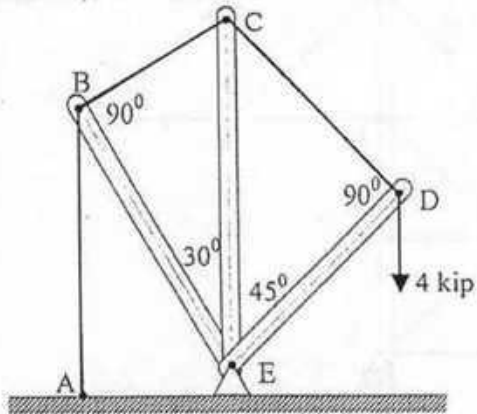
1. A 500 lb. cylinder rest on a smooth inclined plane. For a tension in the rope of 250 lb. find the inclination of the plane and the plane reaction.



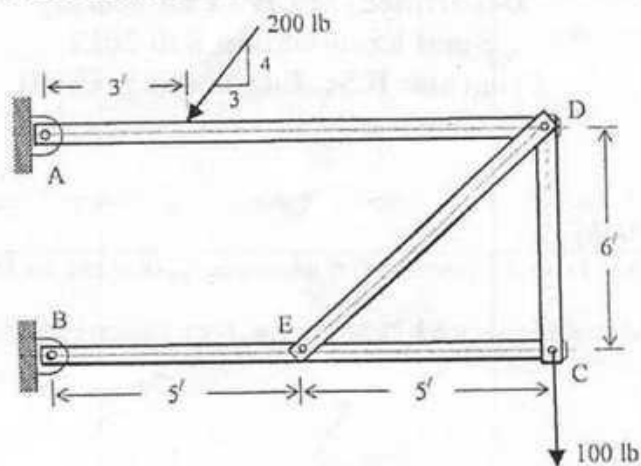
2. A chord supported at A and B carries a load of 10 kN at D and a load W at C. Find the value of W so that CD remains horizontal.



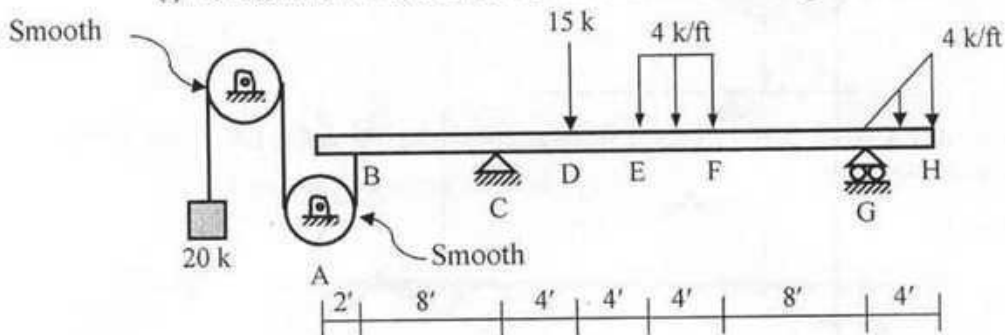
3. Determine tension in the cables AB, BC & CD.



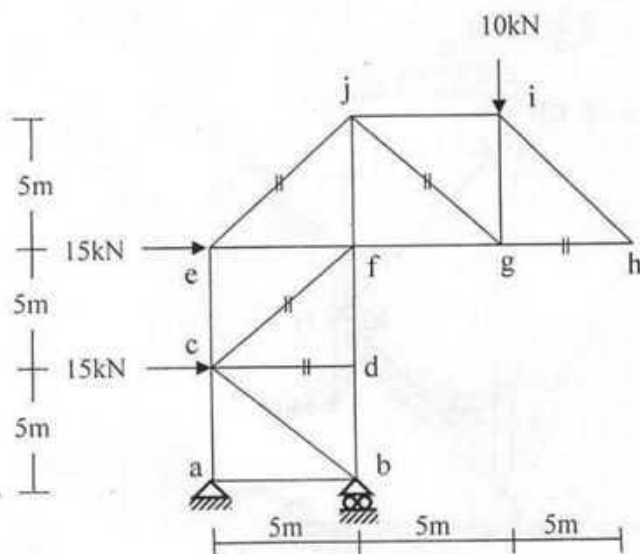
4. Determine support reactions at A & B and all other internal pins. Identify two-force members and determine the forces in those members. Assume all the members of the framework are weightless.



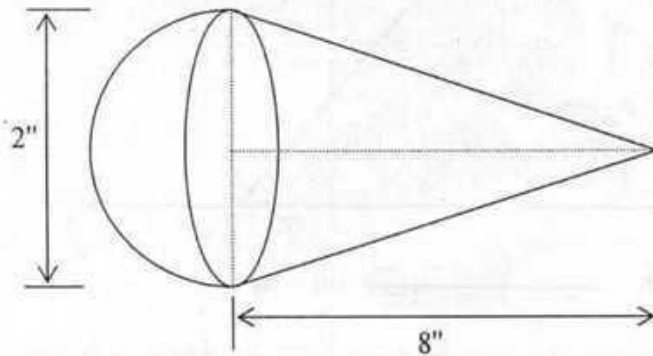
5. For the beam shown below, calculate  
 (i) the reactions at C and G, (ii) the shear force and bending moment at F.



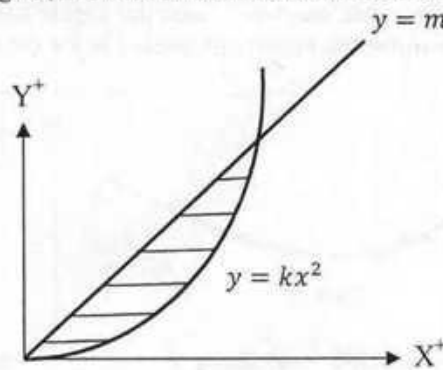
6. For the truss shown below, find the force in members cd, cf, ej, jg and gh.



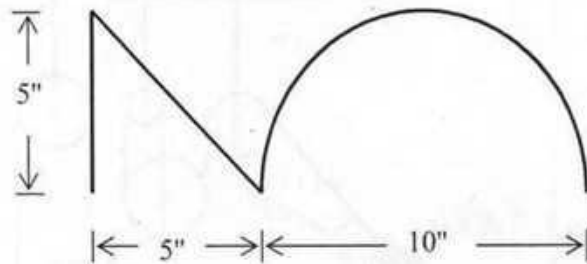
7. A hemisphere is attached to a right circular cone as shown below. Determine the location of centroid.



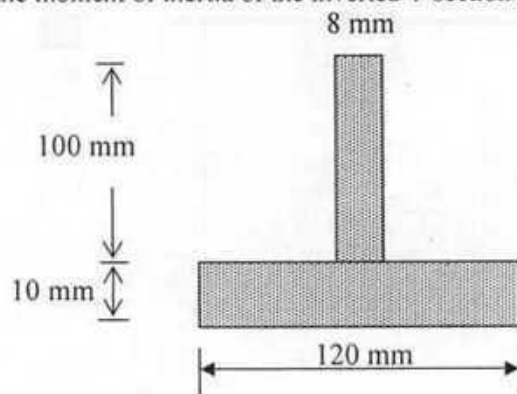
8. Refer to the following figure, find the co-ordinates of the centroid of the area bounded by  $y = mx$  and  $y = kx^2$ .



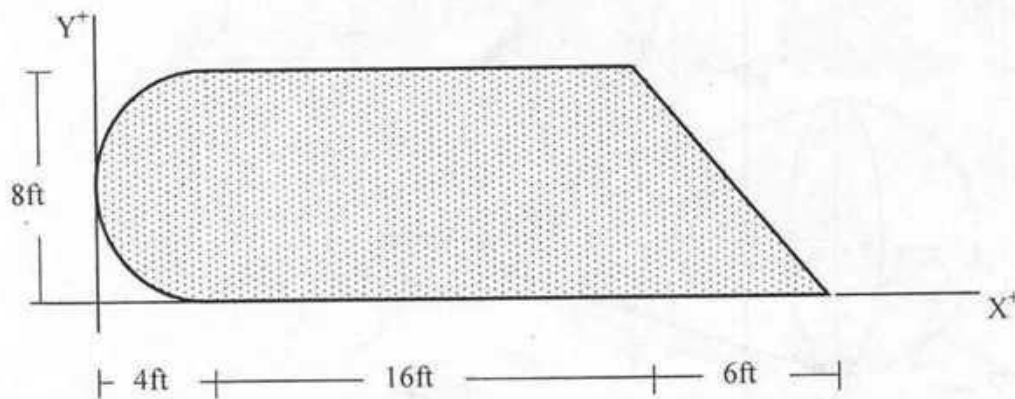
9. Determine the location of centroid of line shown below.



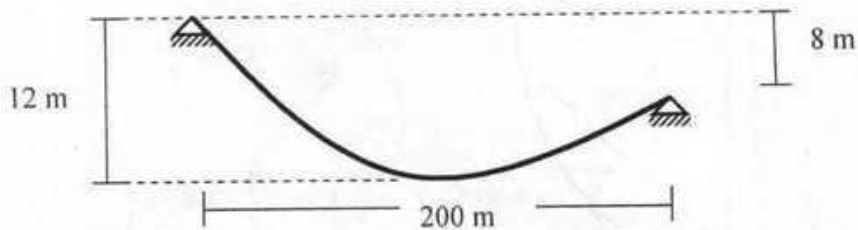
10. Write down the theorems of Pappus and Guldinus and prove it.
11. Calculate the moment of inertia of the inverted T-section about its centroidal axes ( $I_{xc}$  &  $I_{yc}$ ).



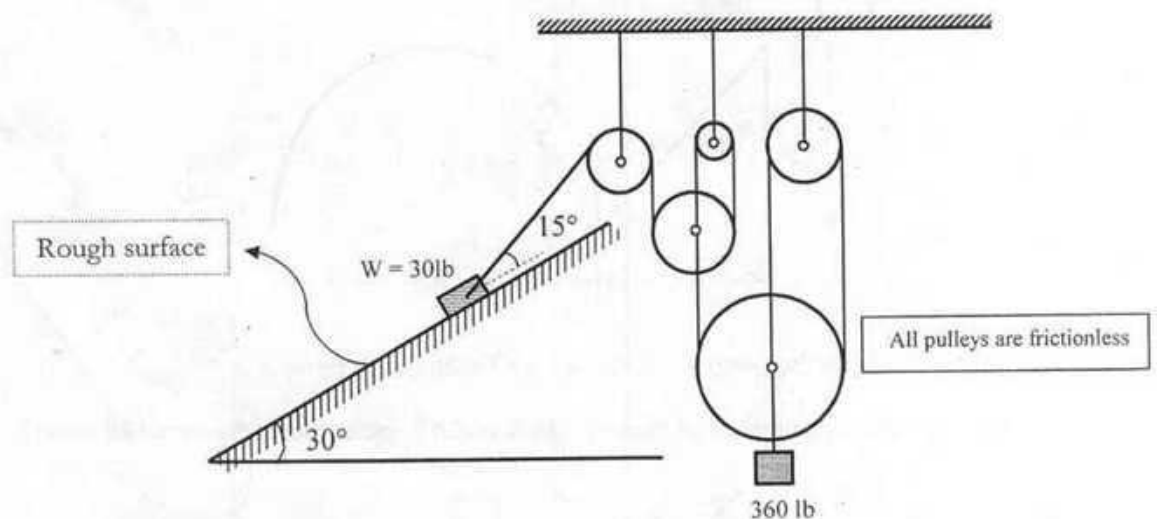
12. Calculate the moment of inertia of the following section about the X axis and Y axis.



13. A cable of uniform cross-sectional area is stretched between two supports 200 m apart with one end 8 m above the other as shown in figure below. The cable is loaded with a uniformly distributed load of  $20\text{ kN/m}$  and the sag of the cable measured from the higher end is  $12\text{ m}$ . Find the horizontal tension in the cable. Also determine the maximum tension in the cable.



14. In the figure shown below, the frictional force  $F = 0.15 \times \text{Surface Reaction}$ . Calculate the magnitudes of surface reaction, frictional force and resultant. Weight of Block =  $30\text{ lb}$ .



**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012 (Set 2)**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Engineering Mechanics II  
 Time: 3 hours

Credit Hours: 3.0

Course Code: CE 103 (A)  
 Full Marks: 100 (= 10 × 10)

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

1. Fig. 1 shows a rigid body  $abc$  with uniform bars  $ab$  and  $bc$  weighing 30 lb and 20 lb respectively.

Calculate the force  $Q$  (and corresponding value and location of normal force and friction force) required to

- (i) slide the body along  $bc$ , (ii) overturn the body

[Given:  $f_s = 0.40$ ].

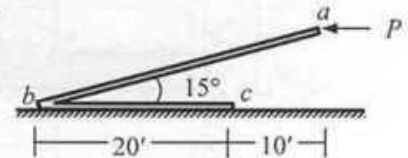


Fig. 1

2. Fig. 2 shows a rigid bar  $AB$  (weighing  $W_{AB} = 10$  lb) supported by cables  $Aa$  and  $Bb$ , which are both wrapped around pulley  $C$ .

Calculate the required weight  $W$  if it is at impending motion

- (i) upward, (ii) downward

[Given:  $f_s = 0.40$  for the pulley].

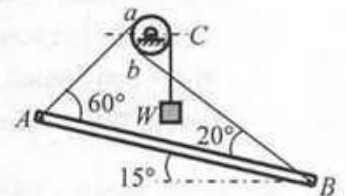


Fig. 2

3. Calculate the

- (i) Mass moment of inertia ( $I_z$ ) and  
 (ii) Radius of gyration ( $k_z$ )

of the concrete pile group-pile cap composite shown in Fig. 3 about the  $z$ -axis

[Given: Unit weight of concrete =  $150 \text{ lb/ft}^3$ ].

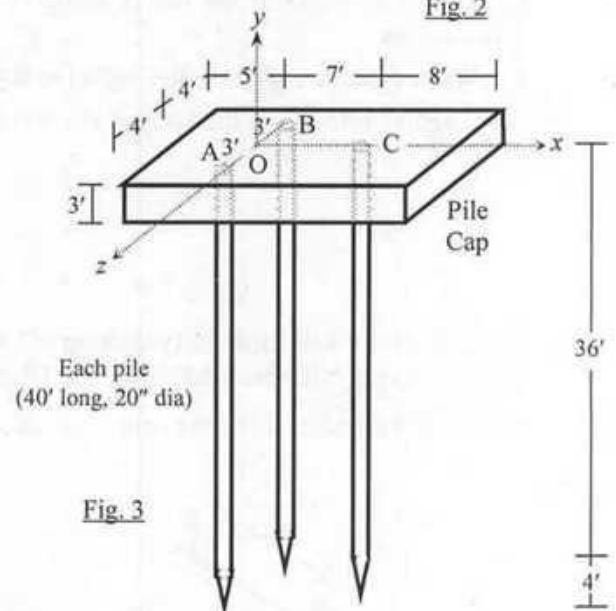


Fig. 3

4. Fig. 4 shows a body starting from rest at A, dropping freely (under gravity) to point B, and then moving along the curve  $x^2 + y^2 = 100$  at constant velocity  $v_B$  (the velocity gained at B) up to point D.

Calculate its

- (i) Horizontal and vertical velocity at C  
 (ii) Horizontal and vertical acceleration at C.

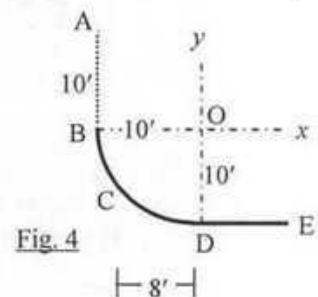


Fig. 4

5. The body (weighing 20 lbs) traveling as shown in Fig. 4 (and as described in Question 4) reaches D and then travels along a rough surface DE to stop at E. Calculate the

- (i) Centripetal force, normal force and friction force on the body at D,  
 (ii) Distance DE and time required to travel between AB and DE [Given:  $f_s = 0.40, f_k = 0.30$ ].

6. Fig. 5 shows a rigid body (*abcghdea*) being subjected to horizontal force  $P = 500$  lb/ft, resisted by normal force  $N$  and friction force  $F$  between the brick surface *hi* and the soil underneath.

Calculate the acceleration of the rigid body and corresponding value and location of  $N$  and  $F$

[Given:  $f_s = 0.40, f_k = 0.30$ ].

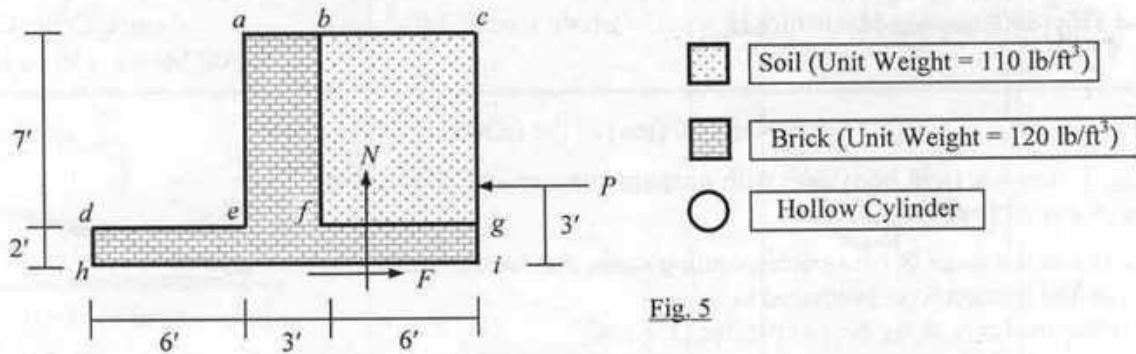


Fig. 5

7. Earth takes 24 hours to complete a full revolution around its own axis, and also travels at 18.6 mile/sec around the sun. Calculate its kinetic energy due to

- (i) Revolution about own axis,  
(ii) Motion around the sun

[Given: Weight of the earth =  $13 \times 10^{24}$  lb, Diameter of earth = 8000 mile]

8. Fig. 6 shows a rigid body *AB* (composed of uniform slender rod *A* and sphere *B*) rotating about *O*. If the rod *A* weighs 20 lb and sphere *B* weighs 100 lb, calculate the

- (i) Work done on *AB* (by self-weight) as it moves from  $\theta = 15^\circ$  to  $\theta = 90^\circ$   
(ii) Angular velocity of the body at  $\theta = 90^\circ$  if it starts from rest at  $\theta = 15^\circ$ .

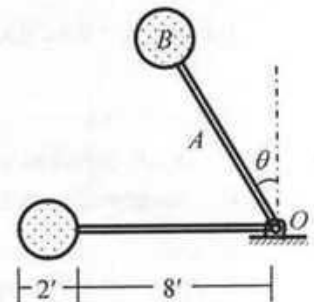


Fig. 6

9. Fig. 7 shows a solid sphere (weighing  $W$ ) rolling down 15 ft along a  $30^\circ$  inclined smooth surface and hitting a spring with the load-deflection ( $P$ - $\Delta$ ) curve as shown.

Calculate the weight  $W$  of the sphere required to deflect the spring by an amount  $\Delta =$  (i) 3 ft, (ii) 4 ft.

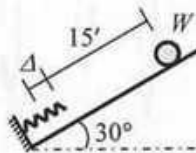
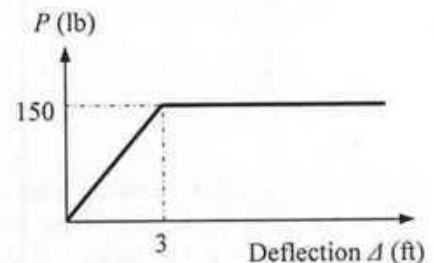


Fig. 7



10. Fig. 8 shows a curved pipeline *ABCD* (with cross-sectional area  $a_p = 20$  in<sup>2</sup>) supported at *A*, *D* and subjected to water flowing in (through *A*) and out (through *D*) at equal velocity  $u = v = 10$  ft/sec.

Calculate the

- (i) Magnitude and direction of the resultant force on the pipeline  
(ii) Reactions at supports *A* and *D*.

[Given: Unit weight of water = 62.5 lb/ft<sup>3</sup>]

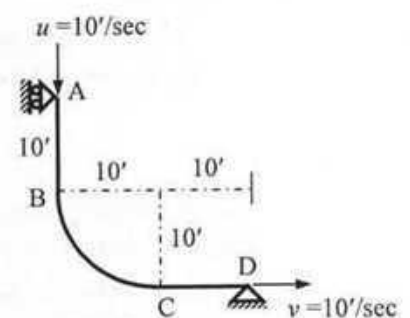


Fig. 8

11. An object  $a$  (weighing  $W_a = 150$  lb) is subjected to a horizontal force  $P = 90 \sin(t)$  due to ground motion, whose variation with time is shown in Fig. 9.
- If the object was initially at rest on a surface with  $f_s = 0.30$  and  $f_k = 0.20$ , calculate
- when the object will start moving
  - the maximum velocity achieved by the object
  - when the object will stop again.

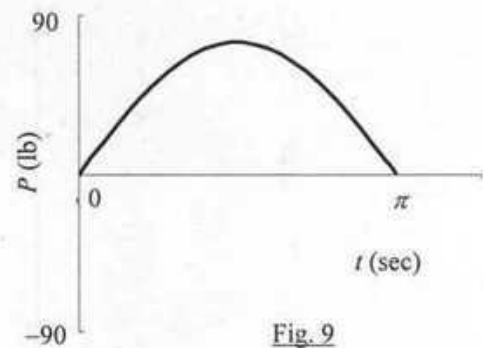


Fig. 9

12. Fig. 10 shows a cricket ball (weighing  $W_A = 0.30$  lb) hitting a stump (weighing  $W_B = 1.5$  lb, and initially at rest) with a velocity of  $u_A = 140$  ft/sec at an angle  $15^\circ$  with the horizontal.
- If the coefficient of restitution for the impact is  $e = 0.80$ , calculate the
- Velocity and direction of the ball and the stump after impact
  - Loss of energy in the impact.

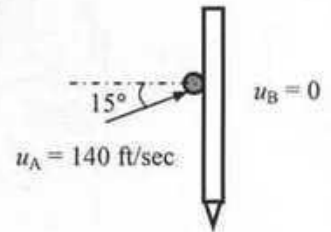


Fig. 10

13. For the space truss loaded as shown in Fig. 11
- Determine all member forces in terms of the applied force  $Q$
  - Calculate the allowable value of  $Q$  if the allowable force in member  $ab$  and  $ac$  is 50 kip and 25 kip respectively.

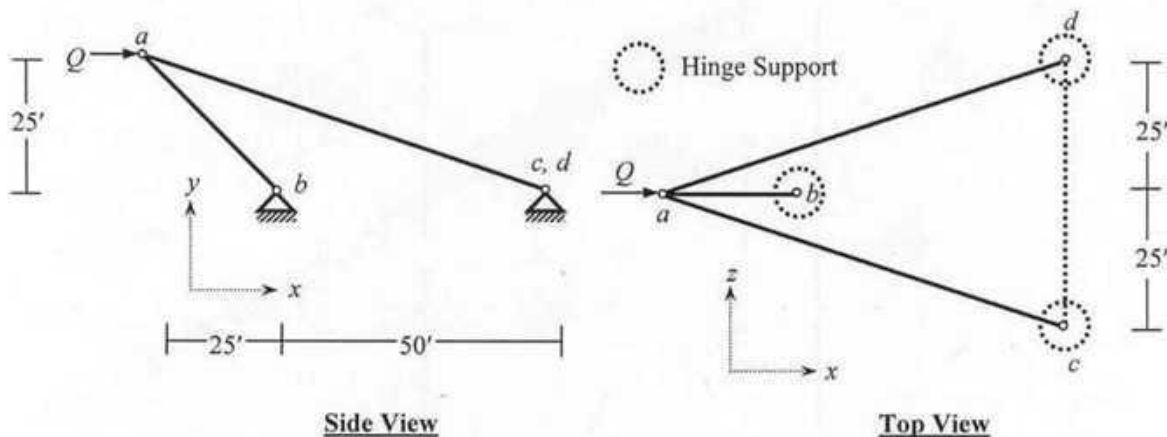


Fig. 11

14. If the pile-cap (shown in Fig. 3) weighs  $W = 75$  kips and a force  $P = 500$  kip acts on it vertically downward at O (i.e., in the negative  $y$ -direction), calculate the reactions in pile A, B and C.

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Engineering Mechanics II  
 Time: 3 hours

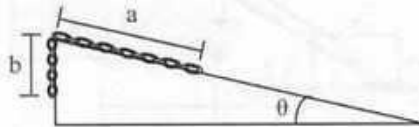
Credit Hours: 3.0

Course Code: CE 103  
 Full Marks: 100 (= 10 × 10)

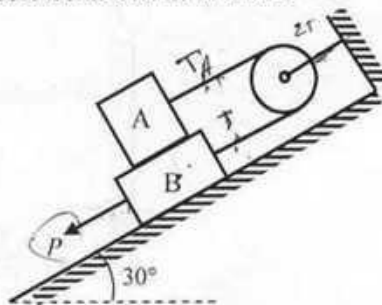
(13)

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

1. If the coefficient of static friction between the chain and the inclined plane is  $\mu_s = \tan \theta$ , determine the overhang length  $b$  so that the chain is on the verge of slipping up the plane. The chain weighs  $w$  per unit length.

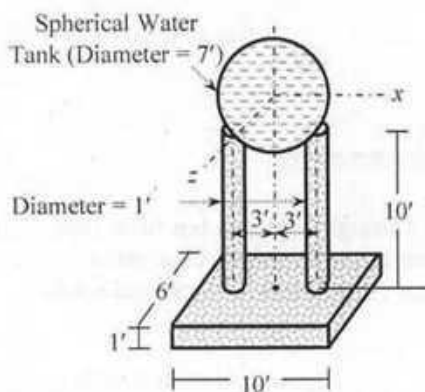


2. Block A and block B rests on each other, connected by a cord which passes over a frictionless pulley. Determine  
 a) The force  $P$  needed to resist the down ward motion of block A.  
 b) The tension in the cord connected to A and B.



$W_A = 75 \text{ lb}$   
 $W_B = 50 \text{ lb}$   
 $f_{\text{(Block A and B)}} = 0.15$   
 $f_{\text{(Block B and inclined surface)}} = 0.15$

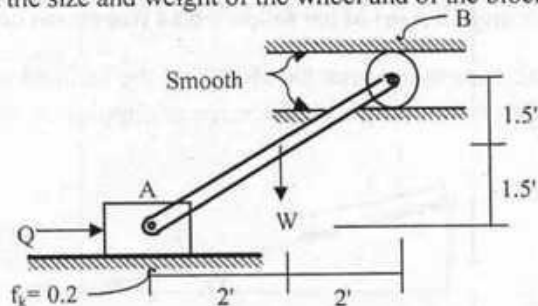
3. For the structure shown in the figure below, calculate the mass moment of inertia ( $I_y$ ) about the  $y$ -axis [Neglect the self-weight of the spherical water tank and assume the tank to be filled with water].



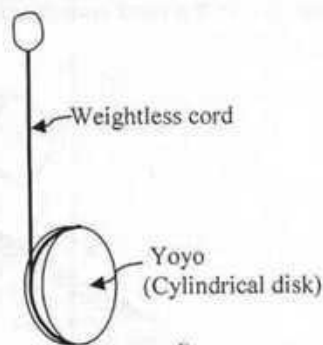
Water (Unit Weight = 62.5 lb/ft<sup>3</sup>)  
 Reinforced Concrete (Unit Weight = 150 lb/ft<sup>3</sup>)

4. If coefficient of kinetic friction for all contact surfaces shown in Question no. 2 is 0.10. Determine the acceleration of block B if  $P = 200 \text{ lb}$ .
5. A person jumps (with initial velocity = 0) from the top of a 1000 ft tall building and falls freely under gravity for 2 seconds before his parachute opens, and he falls with acceleration  $a = (g/v_0^2)(v_0^2 - v^2)$ , where  $g = 32.2 \text{ ft/sec}^2$ ,  $v_0 = 150 \text{ ft/sec}$  and  $v$  is the velocity of the person. Calculate the velocity when the person reaches ground.

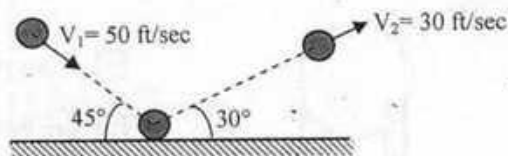
6. A wheel which is rotating at 300 rpm is slowing down at the rate of  $2 \text{ rad/sec}^2$ .
- What time will elapse before the wheel stops?
  - At what rate (in rpm) is the wheel revolving after 10 sec?
  - Through how many revolutions had it turned during the first 10 sec?
  - What is the total displacement?
  - Compute the number of revolutions from the time 10 sec until the wheel stops.
7. If the weight of the bar AB is  $W = 100 \text{ lb}$  and  $Q = 500 \text{ lb}$  find acceleration of the bar,  $\bar{a}$  and the reaction at B. Neglect the size and weight of the wheel and of the block.



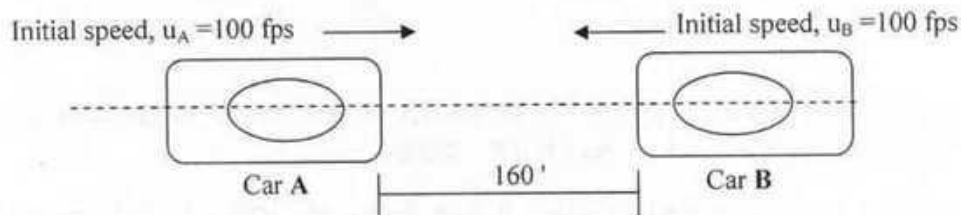
8. A boy is playing with a yoyo (which is a solid homogeneous cylindrical disk with a weightless cord wrapped about its mid section). One end of the cord is looped and the boy has his finger in it. If the yoyo is released at  $0.6 \text{ ft/sec}$  speed and moves vertically downward, what is the speed of its c.g. after a displacement of 1.5 ft?



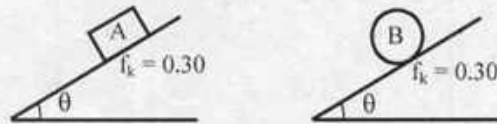
9. The 0.5 kg ball strikes the rough ground and rebounds with the velocities shown. Determine the magnitude of the impulse the ground exerts on the ball. Assume that the ball does not slip when it strikes the ground, and neglect the size of the ball and the impulse produced by the weight of the ball.



10. Two cars A and B are travelling in line along a straight highway but from opposite direction. Car A applies brakes and decelerates at a uniform rate of  $15 \text{ fps}^2$ . One second later car B applies brakes. At what minimum uniform rate must car B decelerate to avoid collision?

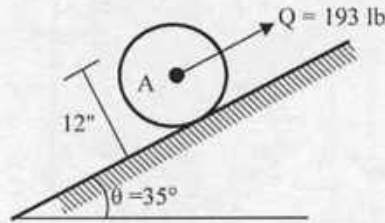


11. The figure below shows a box A and cylinder B moving down an inclined plane with  $f_k = 0.30$ . If both of them start from rest and move at the same speed, determine the angle  $\theta$ .

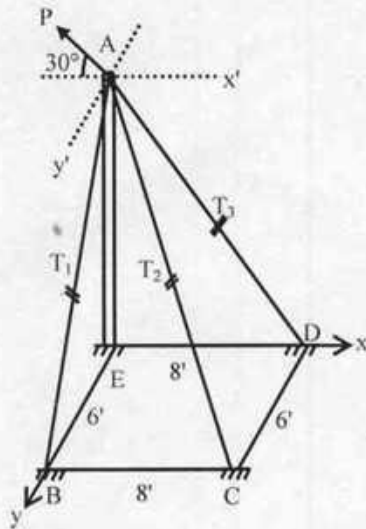


*Handwritten notes:*  
 $\mu_k = f_k$   
 $F = \mu_k N$

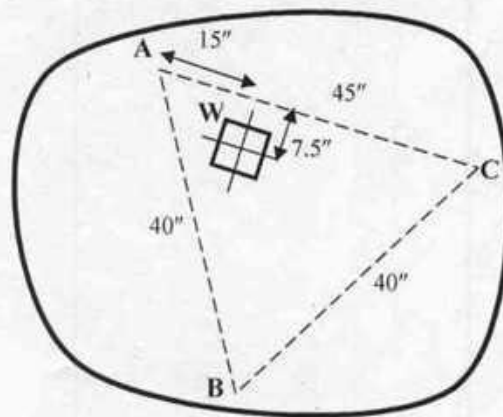
12. Body A is a 161 lb cylinder that is being rolled up an inclined surface by a constant force  $Q = 193$  lb. (i) What is the speed of its c.g. after a displacement of 15 ft. from rest? (ii) What is its angular acceleration?



13. In the following figure  $AE = 40$  ft and force  $P$  is in the plane  $x'-y'$ . The compressive force on  $AE$  is 20 kips and  $T_1 = 5$  kips. Calculate  $T_2$ ,  $T_3$  &  $P$ .



14. As shown in the following figure, the weight  $W = 90$  lb is placed on a weightless irregular shaped table which has supports at A, B and C. Find the reactions at supports A, B and C.



**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

1-2  
—————

Course Title: Surveying  
Time : 3 Hours

Course Code: CE 105  
Full Marks: 150

There are SEVEN questions. Answer any SIX.

1. (a) Write down the correction and its nature due to earth's curvature and refraction. Explain how the procedure of reciprocal leveling eliminates the effects of atmospheric refraction and earth's curvature. (3+4)
- (b) Define (i) Bench Mark (ii) Datum (iii) Elevation (iv) Turning Point (4)
- (c) The following consecutive readings were taken with a level (14)  
6.21, 4.92, 6.55, 8.42, 9.80, 6.67, 7.91, 10.21, 8.22, 7.0, 7.45  
The level was shifted after 4<sup>th</sup>, 7<sup>th</sup> and 9<sup>th</sup> readings. The reduced level at first point was 100 ft. Calculate the reduced levels of the points by using Height of Instrument Method and apply necessary checks.
2. (a) Write down the errors associated with compass surveying. Adjust a "closing error" by any method in a close traverse survey with proper example. (2+6)
- (b) Mention the guidelines of filling a "Field Book". What is contour? (3+2)
- (c) An excavation is to be made for a reservoir 20 m long and 12 m wide at the bottom, having side of the excavation slope at 2 horizontal to 1 vertical. Calculate the volume of excavation if the depth is 4 metres. The ground surface is level before excavation. (12)
3. (a) What are the instruments used in chain surveying? (3)
- (b) How is a chain survey executed in the field? (8)
- (c) A series of offsets were taken from a chain line to a curved boundary line at intervals of 60 feet in the following (14)  
0, 2.65, 3.80, 3.70, 4.65, 3.60 meters  
Compute the area between the chain line, the curved boundary and the end offsets by  
i) Trapezoidal Rule ii) Simpson's Rule
4. (a) What is meant by shift of a curve? Derive an expression for the same. (2+6)
- (b) Write down the characteristics of transition curve. (2)
- (c) Two tangents intersect at chainage 75+75, the deflection angle being 60° 30'. Calculate the necessary data for setting out a curve of 40 chain radius to connect the two tangents, if it is intended to set out the curve by offset from chords. Consider peg interval equals to 100 links, length of the chain being equal to 20 m (100 links). (15)

5. (a) A street bend which deflects  $60^{\circ}50'$  is to be designed for a maximum speed of 150 Km/h, a maximum centrifugal ratio of  $1/6$  and a maximum change of acceleration of  $35 \text{ cm/sec}^3$ , the curve consisting of a circular arc combined with two transition curves. Calculate a) the radius of the circular arc b) length of transition curve c) total length of the composition curve d) the chainage of the beginning and the end of the transition curve and e) the junctions of the transition curves with the circular arc if the chainage of the P.I is 4500 metres (16)

- (b) Three points A, B and C were photographed and their co-ordinates with respect to the lines joining the collimation marks on the photograph are given in the table below. The focal length of the lens is 75 mm. Determine the azimuths of the line OB and OC, if that of OA is  $355^{\circ} 30'$ . The axis of the camera was level at the time of the exposure at the station O. (9)

Point	X	Y
a	-45.52 mm	- 21.43 mm
b	+ 9.48 mm	-16.38 mm
c	+ 48.26 mm	+ 36.67 mm

6. (a) Define (i) Crab (ii) Drift (iii) Over Lapping (6)

- (b) A camera having focal length of 20 cm is used to take a vertical photograph to a terrain having an average elevation of 2000 m. What is the height above mean sea level at which an aircraft must fly in order to get the photograph at a scale of 1: 6000? (9)

- (c) Find the distance between two places P and Q along the parallel of latitude, given that latitudes of P and Q are  $27^{\circ} 0' \text{ N}$  and their longitudes are  $110^{\circ} 0' \text{ E}$  and  $131^{\circ} 27' \text{ W}$  respectively. (10)

7. (a) Define (i) Celestial Poles and Celestial Equator (ii) Celestial Horizon (iii) Zenith and Nadir. Draw necessary sketches. (9)

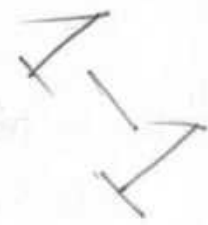
- (b) Find the shortest distance between two places S and T, given that the latitude of S and T are  $40^{\circ} 10' \text{ N}$  and  $32^{\circ} 20' \text{ N}$  and their longitudes are  $50^{\circ} 20' \text{ E}$  and  $55^{\circ} 28' \text{ E}$  respectively. Find also the direction of S on the great circle route. (16)

**Given formula:**

1.  $T = R \tan \frac{\Delta}{2}$ ,  $l = \frac{\pi R \Delta}{180^\circ}$ ,  $\delta = 1718.9 \frac{c}{R}$
2.  $O_1 = \frac{c^2}{2R}$ ,  $O_2 = \frac{C}{2R}(c+C)$ ,  $O_3 = \dots = O_{n-1} = \frac{C^2}{R}$ ,  $O_n = \frac{c'}{2R}(C+c')$
3.  $L_{transition} = \frac{v^3}{\alpha R}$ ,  $\Delta_s = 1719 \frac{L}{R}$ ,  $\Delta_c = \Delta - 2\Delta_s$ ,  $L_{circular} = \frac{\pi R \Delta_c}{180^\circ}$ ,  $s = \frac{L^2}{24R}$ ,  
 $\tan \theta = \frac{v^2}{gR}$
4.  $T = (R+s) \tan \Delta + \frac{L}{2}$
5.  $s_h = \frac{f}{H-h}$ ,  $L = (1-p_l)sl$ ,  $W = (1-p_w)sw$
6.  $a = L \times W$ ,  $N = \frac{A}{a}$
7.  $N_1 = \frac{L_1}{(1-p_l)sl} + 1$ ,  $N_2 = \frac{L_2}{(1-p_w)sw} + 1$
8.  $\tan \alpha_a = \frac{x_a}{f}$
9.  $\tan \alpha_b = \frac{x_b}{f}$
10. Level Section  $A = (b+nh)h$
11. Two-Level Section  $A = \{n(b/2)^2 + m^2(b+nh)h\}/(m^2-n^2)$
12. Three-Level Section  $A = \{b(h_1+h_2)/4 + h(w_1+w_2)/2\}$   
 $w_1 = m_1n/(m_1-n)(h+b/2n)$   
 $h_1 = m_1n/(m_1-n)(h+b/2m_1)$   
 $h_2 = m_2n/(m_2-n)(h-b/2m_2)$
13.  $V = \frac{d}{6}(A_1 + A_2 + 4A_m)$
14.  $\cos P = \frac{\cos p - \cos a * \cos b}{\sin a * \sin b}$
15.  $\tan(A+B)/2 = \cot(P/2) * \frac{\cos(a-b)/2}{\cos(a+b)/2}$
16.  $\tan(A-B)/2 = \cot(P/2) * \frac{\sin(a-b)/2}{\sin(a+b)/2}$

**Note:** Here the symbols have their usual meanings.

6



**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course title: **Introduction to Civil and Environmental Engineering**

Time: **2 hours**

Course: **CE 107 Section (A)**

Total Marks: **50**

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**Section A (Total Marks 15)**

Answer any **THREE**.

1. a) While designing a structure, which factors a structural engineer should keep in mind? (3)  
b) If someone asks you about the tasks of a 'civil engineer', what would be your answer? (2)
2. a) Write down the different steps involved in 'structural' design process. (3)  
b) List the different types of structural members. (2)
3. Give brief description of the four basic types of structures. (5)
4. a) Differentiate between 'dead load' and 'live load' with examples. (3)  
b) Define 'engineering ethics' and mention how you would apply it as an engineer. (2)

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**Section B (Total Marks 35)**

5. Describe the following (any two): (2x2=4)
  - a. Values knowledge and social justice as an environmental issue
  - b. Age Structure
  - c. Biodiversity
  - d. Water resources in Bangladesh
6. Assume that a population follows a simple logistic growth curve. Find the maximum sustainable yield as a function of carrying capacity, the current population size and current growth rate. (3)
7. Suppose the fish population in a pond follows a logistic curve until it stabilizes at 15,000. This year the numbers of fishes are 5,000 and its growth rate is 1.7%. When the fish number will reach 7,500 and 14000? (3)
8. Define water pollution? Write any four different categories of water pollutant along with their sources and impact. (2+4=6)

9. Define ecosystem and its components? (2)
10. If flood water puts raw sewage into a natural flowing stream what will be the possible relationship between dissolve oxygen and biochemical oxygen demand (BOD) along the up and downstream from the point of pollution. (3)
11. Show in a schematic diagram how photochemical and sulfurous smog develops? (4)
12. Answer any two of the following: (5x2=10)
- Briefly discuss the important urban environmental issues in Bangladesh. Show in a schematic diagram how photochemical and sulfurous smog develops?
  - What are the general effects of air pollution? Describe different sources of air pollution.
  - Discuss the possible adaptation measures that can be taken against the negative impacts due to sea level rise in Bangladesh.

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course title: **Introduction to Civil and Environmental Engineering**  
Course: **CE 107 Section (B)**

Time: **2 hours**  
Total Marks: **50**

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**Section A (Total Marks 15)**

Answer any **THREE**:

1. Briefly discuss the important urban environmental issues in Bangladesh. Show in a schematic diagram how photochemical and sulfurous smog develops? (5)
2. What are the general effects of air pollution? Describe different sources of air pollution. (5)
3. Discuss the possible adaptation measures that can be taken against the negative impacts due to sea level rise in Bangladesh. (5)
4. Define global warming. "The trapping heat in the atmosphere is somewhat analogous to a greenhouse" – explain. (5)

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**Section B (Total Marks 35)**

**(Answer question 5 and any three from questions 6 to 9)**

5. What are the functions of a 'Civil Engineer'? What do you understand by 'Engineering Ethics' and how would you apply it in your engineering career. (5)
6. a) What are the functions of soil compaction? List different equipment used for soil compaction in the field. (3)  
b) Define the following terms: (4.5)
  - i. Optimum moisture content
  - ii. Unified soil classification system
  - iii. Sieve analysis
- c) What type of information does a geotechnical engineer need to collect for a geotechnical project? (hint: soil strength) (2.5)
7. a) What are the functions of a 'Traffic Engineer'? (3)  
b) What does 'ITS' stand for? List 5 applications of ITS. (3)

- c) Provide brief description of **any** of the following document: (4)
- i. Bangladesh National Building Code
  - ii. Dhaka Metropolitan area integrated transport study
  - iii. Dhaka Urban Transport Network Development Study
8. a) Give brief description of the following tests: (4)
- i. Standard proctor test
  - ii. Modified proctor test
- b) If you are assigned the job of a 'Pavement designer', what tasks would you do? (3)
- c) While designing a structure, which factors a structural engineer should keep in mind? (3)
9. a) Define 'Operation Research'. Draw the flow chart showing the systems approach in Transport planning. (4)
- b) Differentiate between: (3)
- i. Live load and Dead load
  - ii. Cable and Arch
- c) How would you define 'Transportation Engineering'? What are the characteristics of an acceptable transport system'? (3)

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Engineering Materials  
Time: 3 Hours

Course Code: CE 201  
Full Marks: 150

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There are EIGHT Questions. Answer **SIX QUESTIONS including Question No. 1 and Question No. 2. QUESTIONS 1 & 2 are COMPULSORY.**

- 1 Concrete mix design is required for columns of UAP City Campus project at Firmgate based on the following data: (40)

Volume ratio of sand to total aggregate = 0.37  
Air Content = 1.5 % (air-entraining admixture is not used)  
Specific gravity of cement = 3.1 (OPC cement)  
Specific gravity of sand (SSD) = 2.65  
Specific gravity of coarse aggregate (SSD) = 2.65  
Design compressive strength (28 days) = 5000 psi  
Minimum required slump = 175 mm  
Maximum aggregate size =  $\frac{3}{4}$  inch, Aggregate type = Stone chips  
Dosage of superplasticizer = 6 ml/kg of cement if W/C is less than 0.5.

The following graphs are provided :

- Variation of compressive strength (28 days) with W/C,
- Variation of cement content with compressive strength (28 days) for different aggregate size and slump value.

Answer the following:

- (i) Prepare a trial mix of concrete based on the given data,
- (ii) Calculate the unit weight of the proposed trial mix,
- (iii) Prepare a mixture proportion table of the proposed trial mix,
- (iv) Calculate the compaction factor of the mix,
- (v) Calculate the volume ratio of the mix. Assume unit weights of cement, sand (SSD), and coarse aggregate (SSD) with void are  $1400 \text{ kg/m}^3$ ,  $1450 \text{ kg/m}^3$  and  $1400 \text{ kg/m}^3$ , respectively,
- (vi) Calculate cost of concrete per cubic meter based on the current unit rates of materials,
- (vii) Estimate the materials in weight and volume (cement, water, sand, and coarse aggregate) required to make five columns of ground floor. Height of the ground floor is 12 feet and section of column is 30 inch by 30 inch.
- (viii) Assume 5% surplus water in sand over SSD condition and the amount of bulking of sand is 20%. Make proper adjustments in mixture proportions.
- (ix) If it is necessary to make another mixture proportion of concrete of compressive strength 4000 psi, what possible changes are necessary in the mixture proportions of concrete?

- (x) If it is necessary to make another mixture proportion of concrete of compressive strength 6000 psi, what possible changes are necessary in the mixture proportions of concrete?

- 2 For a culvert construction project, the recommended FMs are 2.6 for sand and 6.6 for stone chips. From a nearby market, sand and stone chips samples were collected and sent to the Concrete Laboratory of University of Asia Pacific (UAP) for sieve analysis. The sieve analysis data are given below: (22)

ASTM Sieve	Amount Retained (g)	
	Sand	Stone Chips
3 inch	0	0
1.5 inch	0	0
1.06 inch	0	0
¾ inch	0	0
1/2 inch	0	1000
3/8 inch	0	1000
#4	0	2000
#8	0	950
#12	50	0
#16	70	0
#30	70	0
#40	70	0
#50	70	0
#100	5	0
#200	70	0
Pan	45	50

Answer the following:

- (i) Calculate FM of the samples (sand and stone chips),
- (ii) Draw grading curves of the samples,
- (iii) Discuss the possible ways to improve the FM of the samples to the recommended values,
- (iv) Comment on the samples based on the sieve analysis data and grading curves, and
- (v) From other source, another sand sample was collected and FM was found to be 3.2. In what proportions, the sand samples are to be mixed to achieve the required FM of sand?

Sieve openings for different sieves are provided (refer to the attached table).

- 3 (a) Draw typical stress-strain curves of steel for different grades (lower to higher). Explain the changes in mechanical properties of steel with the change of grades. (2.5)
- (b) Define initial tangent modulus, secant modulus, and tangent modulus. How do you determine Young's modulus of concrete from stress-strain curve? (2.5)
- (c) Define the following mechanical properties of a material: (3)
  - (i) Malleability,
  - (ii) Creep and
  - (iii) Fatigue strength.

- (d) Write a short note on worldwide cement consumption of cement with its influence to the global environment. (3)
- (e) Write down the main field tests of bricks. (3)
- (f) What is a pug mill? How do you check the consistency of brick earth before molding? (3)
- (g) Write the functions of frog mark on brick. (2)
- (h) Discuss the functions of lime, silica, and alumina in brick earth. (3)
- 4 (a) Draw the flow diagram of cement manufacturing process. Also, draw a schematic diagram of rotary kiln (used for cement manufacturing) and discuss the physical and chemical changes that happen in the different zones of the kiln. (5)
- (b) What do you mean by hydration of cement? Write the hydration reactions of cement and discuss the morphology of the hydration product. (4)
- (c) Compare blended cement and OPC with respect to the following: (5)
- (i) Heat of hydration,
  - (ii) Early strength,
  - (iii) Long-term strength,
  - (iv) Workability of fresh concrete and
  - (v) Microstructure of hardened concrete.
- (d) Write short notes on rapid hardening cement, slow setting cement and sulfate resisting cement. (5)
- (e) Define normal consistency, initial setting time, and final setting time of cement and also write their standard values as per ASTM. (3)
- 5 (a) Discuss seawater attack (due to carbonation, chloride, and sulfate) of concrete with chemical reactions. (8)
- (b) What is the significance of concrete cover in reinforced concrete structural members? "More cover concrete is necessary for structural members in contact with ground or water" – Why? (3)
- (c) Define workability of concrete. How is it measured? Discuss the effect of the following factors on workability of concrete: (3)
- i) Cement content,
  - ii) W/C ratio and
  - iii) Fineness modulus of sand.
- (d) Discuss the effect of W/C ratio on compressive strength, permeability, and durability of concrete. (4)
- (e) Compare entrained air and entrapped air in concrete. What are the purposes of using air entraining admixture in concrete? "It is not necessary to use air entraining admixture in Bangladesh for general construction works" - Why? (4)
- 6 (a) Discuss the influence of the following factors on compressive strength of concrete: (5)
- (i) FM of sand,
  - (ii) Ambient temperature,
  - (iii) Grading of aggregate,
  - (iv) Compaction and
  - (v) Curing.
- (b) "Cube strength of concrete is higher than the cylinder strength of concrete" – Why? (2)

- (c) Write short notes on the following: (6)
- (i) Self compacting concrete,
  - (ii) Porous concrete,
  - (iii) Maturity of concrete,
  - (iv) Setting and hardening of cement,
  - (v) Fineness of cement and
  - (vi) Soundness of cement.
- (d) Write short notes on the following: (5)
- (i) Alkali silica reaction (ASR),
  - (ii) Laitance,
  - (iii) Honeycomb,
  - (iv) Segregation and
  - (v) Bleeding.
- (e) Discuss the possible measures that are to be carefully considered for casting concrete in a cold environment. (2)
- (f) "High strength concrete is susceptible to autogeneous shrinkage" – Why? What measures are to be taken against it? (2)
- 7 (a) "The steel bars in concrete are protected from corrosion" – How? Explain the process of initiation of corrosion of steel in concrete due to carbonation and chloride. (3)
- (b) Discuss corrosion of steel in concrete with anodic and cathodic reactions. (5)
- (c) Write the possible measures to stop early corrosion of steel bars in concrete in marine environment. (3)
- (d) Write short notes on the following: (6)
- i) Formation of annual rings of a tree,
  - ii) Use of rubber in Civil Engineering works and
  - iii) Crystal structure and amorphous structure.
- (e) "Fly ash shows pozzolanic activity but OPC shows hydraulic activity" – Why? (2)
- (f) Discuss the empirical relationships for the following: (3)
- i) Compressive strength and tensile strength of concrete, and
  - ii) Compressive strength and Young's modulus of concrete.
- 8 (a) Write the objectives of seasoning timber. (3)
- (b) Discuss three industrial forms of timber. (3)
- (c) Discuss the functions of each ingredient of paint. (2)
- (d) Write short notes on the following: (9)
- (i) Use of plastic in Civil Engineering works,
  - (ii) Atomic packing factor for the body centered cubic unit cell,
  - (iii) Ingredients of varnish,
  - (iv) Electroplating,
  - (v) Vulcanization and
  - (vi) Atomic radius of face centered cubic unit cell.
- (e) What is bulking of sand? Compare bulking of fine sand, medium sand, and coarse sand. (2)
- (f) Write short notes on cold joint and construction joint. (3)

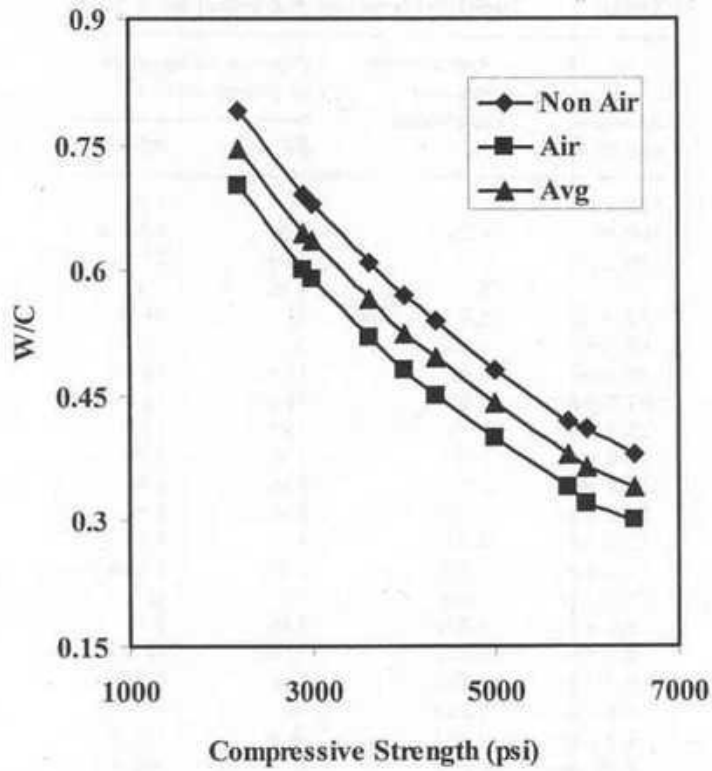


Fig. W/C versus Compressive Strength (aggregate type = stone chips)

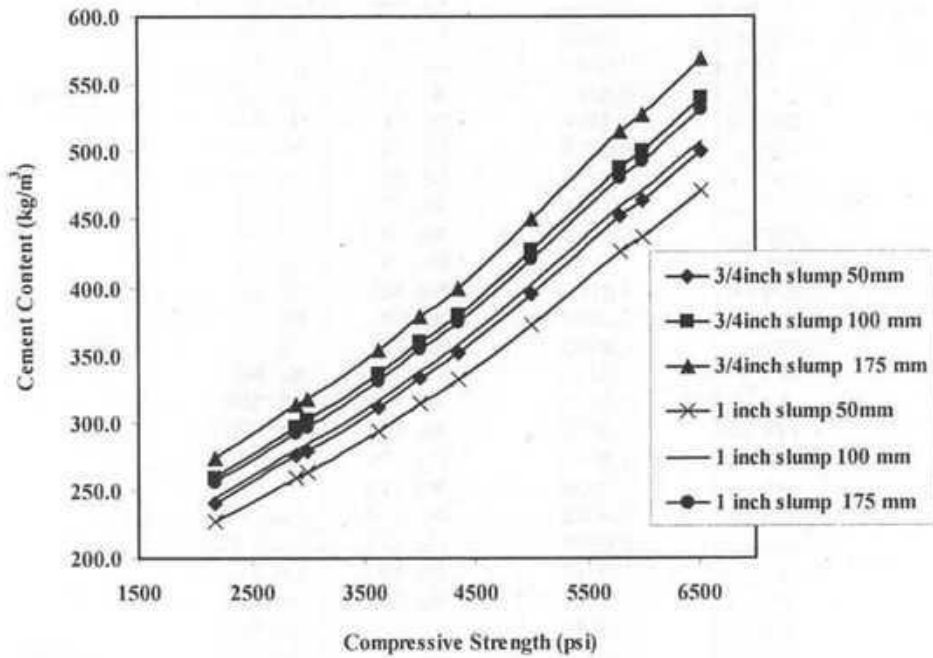


Fig. Cement Content versus Compressive Strength (aggregate type = stone chips)

**Table** Traditional American and British Sieve Sizes

Aperture mm or $\mu\text{m}$	Approximate Imperial equivalent in.	Previous designation of nearest size	
		BS	ASTM
125 mm	5	—	5 in.
106 mm	4.24	4 in.	4.24 in.
90 mm	3.5	3½ in.	3½ in.
75 mm	3	3 in.	3 in.
63 mm	2.5	2½ in.	2½ in.
53 mm	2.12	2 in.	2.12
45 mm	1.75	1¾ in.	1¾ in.
37.5 mm	1.50	1½ in.	1½ in.
31.5 mm	1.25	1¼ in.	1¼ in.
26.5 mm	1.06	1 in.	1.06
22.4 mm	0.875	7/8 in.	7/8 in.
19.0 mm	0.750	¾ in.	¾ in.
16.0 mm	0.625	5/8 in.	5/8 in.
13.2 mm	0.530	½ in.	0.530 in.
11.2 mm	0.438	—	7/16 in.
9.5 mm	0.375	3/8 in.	3/8 in.
8.0 mm	0.312	5/16 in.	5/16 in.
6.7 mm	0.265	¼ in.	0.265 in.
5.6 mm	0.223	—	No. 3½
4.75 mm	0.187	3/16 in.	No. 4
4.00 mm	0.157	—	No. 5
3.35 mm	0.132	No. 5	No. 6
2.80 mm	0.111	No. 6	No. 7
2.36 mm	0.0937	No. 7	No. 8
2.00 mm	0.0787	No. 8	No. 10
1.70 mm	0.0661	No. 10	No. 12
1.40 mm	0.0555	No. 12	No. 14
1.18 mm	0.0469	No. 14	No. 16
1.00 mm	0.0394	No. 16	No. 18
850 $\mu\text{m}$	0.0331	No. 18	No. 20
710 $\mu\text{m}$	0.0278	No. 22	No. 25
600 $\mu\text{m}$	0.0234	No. 25	No. 30
500 $\mu\text{m}$	0.0197	No. 30	No. 35
425 $\mu\text{m}$	0.0165	No. 36	No. 40
355 $\mu\text{m}$	0.0139	No. 44	No. 45
300 $\mu\text{m}$	0.0117	No. 52	No. 50
250 $\mu\text{m}$	0.0098	No. 60	No. 60
212 $\mu\text{m}$	0.0083	No. 72	No. 70
180 $\mu\text{m}$	0.0070	No. 85	No. 80
150 $\mu\text{m}$	0.0059	No. 100	No. 100
125 $\mu\text{m}$	0.0049	No. 120	No. 120
106 $\mu\text{m}$	0.0041	No. 150	No. 140
90 $\mu\text{m}$	0.0035	No. 170	No. 170
75 $\mu\text{m}$	0.0029	No. 200	No. 200
63 $\mu\text{m}$	0.0025	No. 240	No. 230
53 $\mu\text{m}$	0.0021	No. 300	No. 270
45 $\mu\text{m}$	0.0017	No. 350	No. 325
38 $\mu\text{m}$	0.0015	—	No. 400
32 $\mu\text{m}$	0.0012	—	No. 450

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

Course Title : Engineering Geology & Geomorphology  
 Time: 3 hours

Course # : CE 203  
 Full Marks: 120 (6 X 20 = 120)

**Section A**

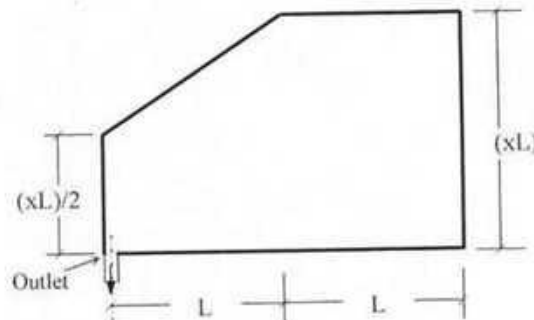
There are **four (4)** questions in this section, answer **any three (3)**

- |    |  |            |
|----|--|------------|
| 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) Describe, in brief, the principal zones of the earth from geologic point of view.  | 6          |
| 2. | (a) Classify (no description is required) major minerals. Discuss, in brief, major non-silicate minerals.  | 8          |
|    | (b) Classify fold (mention names only) based on geometry.  | 3          |
|    | (c) Classify and discuss briefly (with neat sketches) various types of faults according to the direction of movement and net slip.                                       | 9          |
| 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 <b>any four</b> of the following topics:-  | 5 X 4 = 20 |
|    | (i) Different geomorphic processes (no description required) based on origin   |            |
|    | (ii) Neat sketches of anticline, basin and dome  |            |
|    | (iii) Surface waves of earthquake (no sketch required)   |            |
|    | (iv) Typical geometry of a fold (with neat sketch)   |            |
|    | (v) Distinction between Ferromagnesian and non-Ferromagnesian silicates  |            |

**Section B**

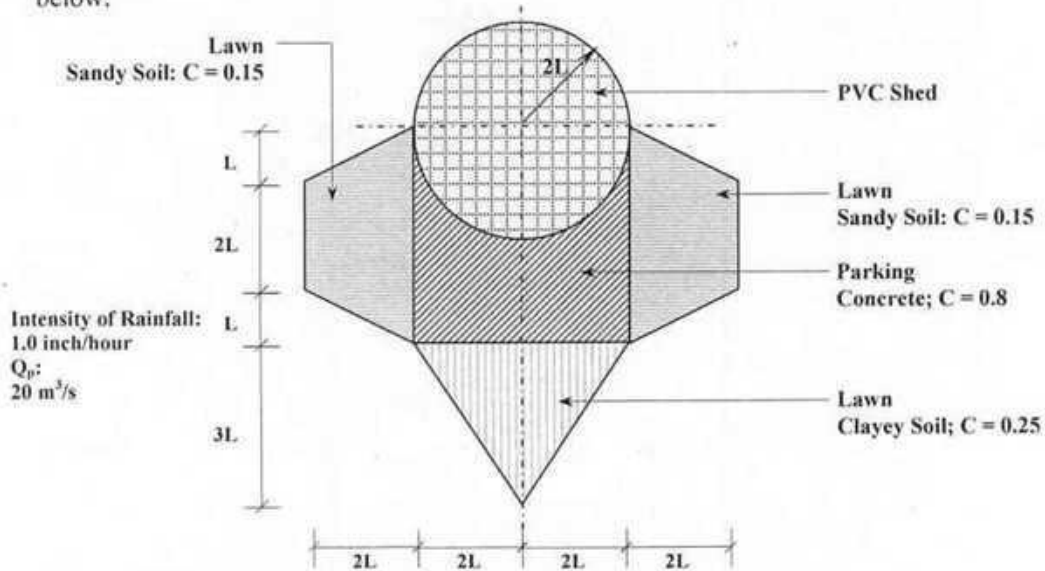
There are **four (4)** questions in this section, answer **any three (3)**

- |    |   |   |
|----|---|---|
| 5. | (a) Define infiltration and percolation.  | 2 |
|    | (b) Define with sketch: (1) Axial length (2) Time of Concentration.   | 2 |
|    | (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 |

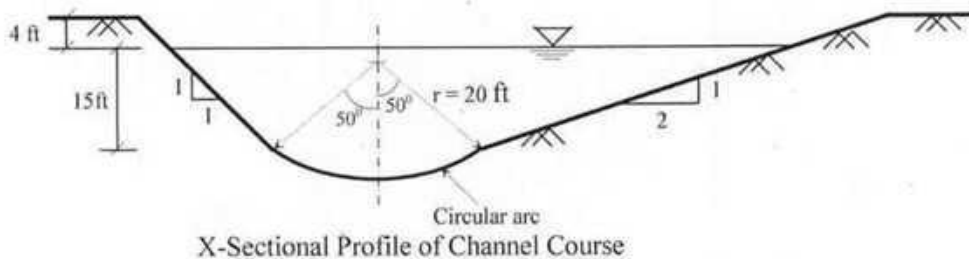


- (d) Using the information provided below, calculate  $L$  for the catchment area as shown below,

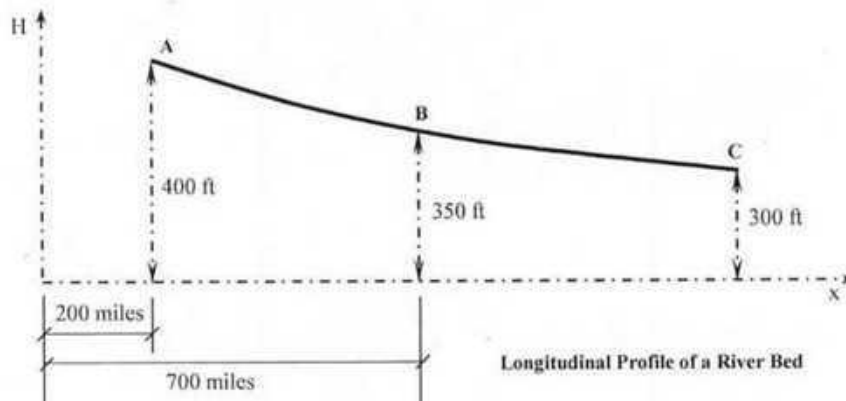
9



6. (a) Prove that  $\tau = \gamma_w R_{HS}$ ; where symbols carry their usual meanings. 5  
 (b) For a stream having triangular X-section and  $D \lll T$ , prove that  $\tau \propto D$  4  
 where-----  
 $\tau$  = 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  $4.33 \times 10^{-4}$ . Calculate the tractive pressure along the channel. 7

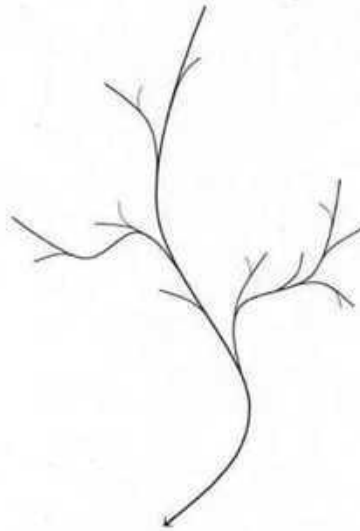


7. (a) Write short notes on various types of loads of a river. 3  
 (b) Prove that  $H = ae^{-bx}$ ; where symbols carry their usual meanings. 5  
 (c) Using the figure shown below, calculate the horizontal distance between B and C. 5



- (d) Rank the streams of the following drainage basin having a total catchment area of 9,111 square kilometer. The results of the survey are summarized in the table below.

7



Stream 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 down the major factors affecting drainage pattern. Discuss, in brief, and draw sketches of any five types of drainage patterns. 10
- (b) 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. 5
- (c) Discuss, in brief, the ways valleys are deepened. 5

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

Course Code: CE 205

Course Title: Numerical Analysis & Computer Programming

Time: 3 hours

Full Marks: 90 (60+30)

[There are two sections **SECTION A** and **SECTION B**. Answer both the sections]

**SECTION A (Numerical Analysis)**

[Answer any 6 (Six) of the following 8 questions]

1. Use Taylor's method to evaluate the numerical solution of the following ordinary differential equation, for  $x = 7$ . Here  $y(0) = 1$  and desired accuracy = 0.0001. 10

$$\frac{dy}{dx} = 5x - 3xy^2$$

2. By Newton's forward difference formula obtain  $dy/dx$  and  $d^2y/dx^2$  for  $x = 1.2$  from the following table of values of  $x$  and  $y$ : 10

x	y	x	y
1.0	2.7183	1.8	6.0496
1.2	3.3201	2.0	7.3891
1.4	4.0552	2.2	9.0250
1.6	4.9530		

3. The strength ( $S$ ) of concrete at different times ( $t$ ) is shown in the following table. Derive a best-fit equation of the form  $S = 3(1 - e^{-bt})$  for the data shown in table and calculate  $S$  for  $t = 28$  days. 10

t (days)	3	7	14	21
S (ksi)	1.5	2.1	2.6	3.1

2.9

4. The discharge ( $Q$ ) through a hydraulic structure for different values of head ( $H$ ) is shown below. Calculate the discharge  $Q$  for  $H=3.0$  ft, using Newton's Divided-Difference Interpolation Method. 10

H (ft)	1.3	2.2	2.8	4.2
Q (cft/sec)	28	66	98	165

5. A solid of revolution is formed by rotating about the  $x$ -axis, the area between the  $x$ -axis, the lines  $x = 0$  and  $x = 1$ , and a curve through the points with the following co-ordinates: 10

x	0.00	0.25	0.50	0.75	1.00
y	1.0000	0.9896	0.9589	0.9089	0.8415

Estimate the volume of the solid formed (Use *Simpson's 1/3* Rule).

6. Using Gauss-Seidel method solve the following systems of equations: 10
- $$12x_1 + 3x_2 - 5x_3 = 1$$
- $$x_1 + 5x_2 + 3x_3 = 28$$
- $$3x_1 + 7x_2 + 13x_3 = 76$$
- Will the solution converge using this method? Initially use  $x_1 = 1, x_2 = 0$  and  $x_3 = 1$ .
7. Solve the following system by Crout's method: 10
- $$3x_1 + 2x_2 + x_3 = 10$$
- $$2x_1 + 3x_2 + 2x_3 = 14$$
- $$x_1 + 2x_2 + 3x_3 = 14$$
8. Derive a best-fit equation in the form of  $y = a_0 + a_1x + a_2x^2 + a_3x^3$  for the points (0,1), (1,2), (2,4), (3,5) and (4,6). Also find the S. 10

**SECTION B (Computer Programming)**

[Answer any 3 (Three) of the following 4 questions]

1. Write a program to find out the summation of the following series: 10  
 $1^2 + 2^2 + 3^2 + 4^2 + \dots + n^2$
2. Illustrate a program that can add matrix A and matrix B given below. 10
- $$A = \begin{pmatrix} 2.0 & 5.5 & 3.2 \\ 5.1 & -7.4 & 1.9 \\ 2.5 & 3.7 & 8.1 \end{pmatrix} \quad B = \begin{pmatrix} 4.0 & 3.1 & 4.5 \\ 0.0 & -1.2 & 7.2 \\ 2.2 & 0.9 & 2.0 \end{pmatrix}$$
3. Write a program that reads a number and writes on the screen if it is even or odd. 10
4. Describe a program that calculates the real roots of any quadratic equation  $ax^2 + bx + c = 0$  for given values of a, b and c. 10

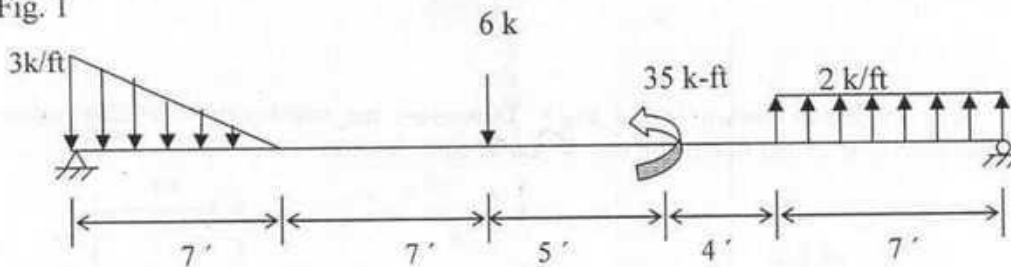
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Code: CE 211  
 Full Marks: 100 (=10×10)

Course Title: Mechanics of Solids I  
 Time: 3 hrs

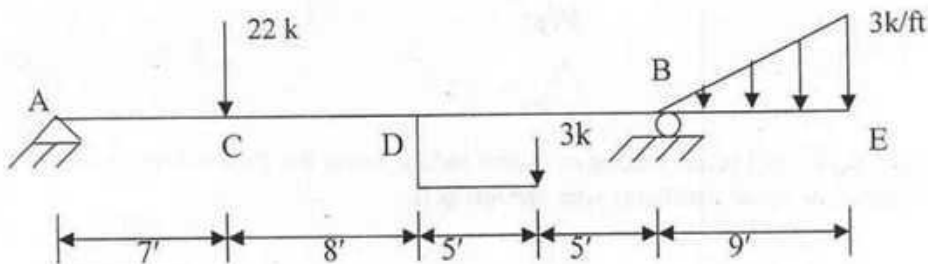
*There are FOURTEEN (14) questions in this paper. Answer any TEN (10).  
 Assume any missing data reasonably.*

1. Draw axial force, shear force and bending moment diagram for the beam with loads as shown in Fig. 1 (10)



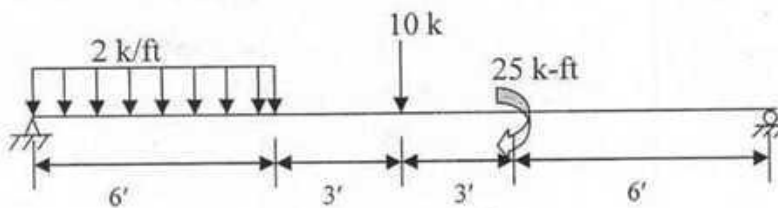
**Fig. 1**

2. Draw the S.F.D and B.M.D of the Beam as shown in Fig.2 using summation method. Provide brief calculation (10)



**Fig. 2**

3. Using singularity function to determine the expressions of shear force and bending moment for the beam loaded as shown in Fig.3. Hence draw shear force and bending moment diagram for the beam. (10)



**Fig.3**

4. Draw the shear force and bending moment diagrams for the structure shown in Fig 4. (10)

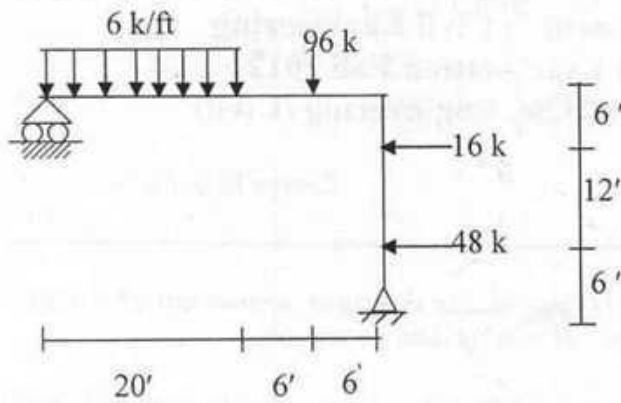


Fig.4

5. A beam is loaded as shown in the Fig.5. Determine the maximum allowable value of  $w$  if (10)  
allowable stress is 15 ksi in tension and 20 ksi in compression.

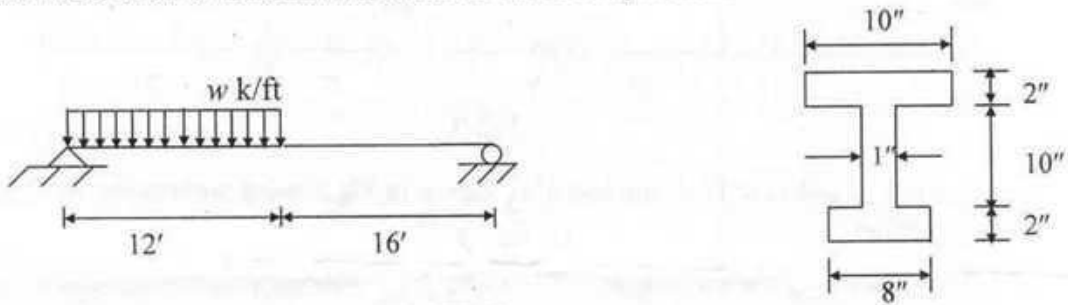
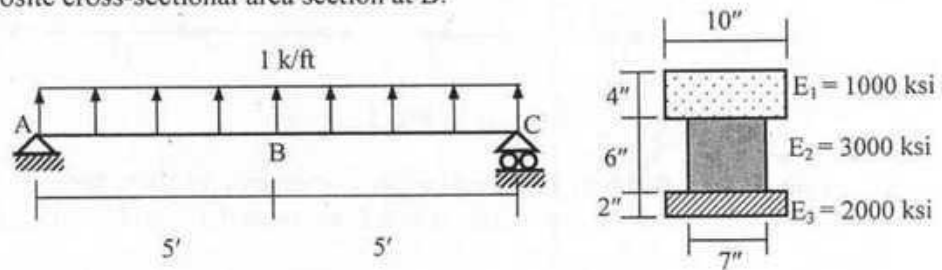


Fig.5

6. For a simply supported beam loaded as shown below, draw the flexural stress and strain diagrams (10)  
over the composite cross-sectional area section at B.



Cross Section at B

7. A steel beam is loaded as shown in Fig.7. Calculate shearing stress at levels indicated at section A-A. Also draw the shear stress distribution diagram. (10)

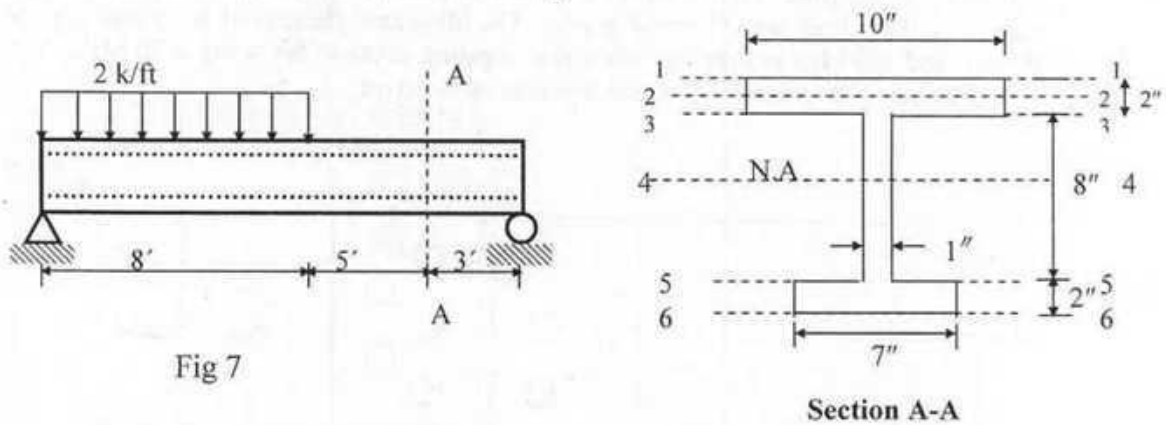


Fig 7

Section A-A

8. A L-3"×3"×0.5" angle (Fig.8), which is to be welded to a gusset plate carries a load of 90 kips to a gusset plate along its centroidal axis. (10)

(a) Determine the lengths of a side fillet welds required at the heel and toe of the angle for a non-eccentric connection. Assume that the allowable shearing stress through the throat of each weld is 21 ksi (i.e  $F_v = 21$  ksi)

(b) Resolve question (a) assuming that a fillet weld of maximum permissible size is added along the entire length of the end of the angle.

Use 5/16" fillet weld.

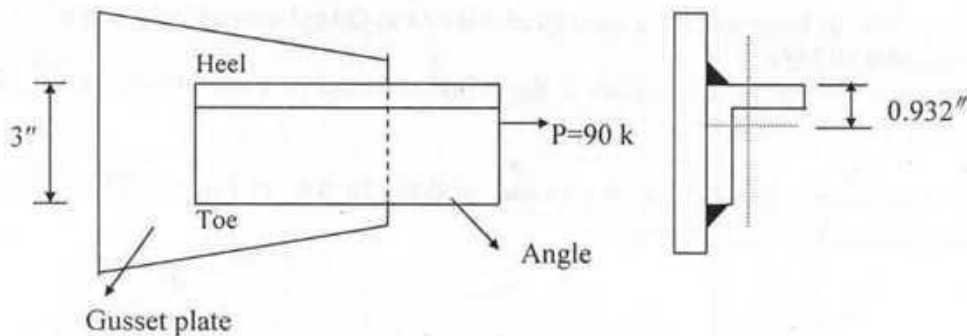


Fig.8

9. Define (a) Modulus of Elasticity (b) Modulus of Resilience (c) Poisson's Ratio (d) Yield Strength (10)  
(e) Modulus of Toughness (f) Ductility

10. Determine the safe capacity of the double-riveted butt joint shown in Fig.10 and hence the efficiency of the joint. The thickness of the main plate is 16 mm and that of cover plate is 10 mm each. The rivets are 20 mm diameter. The allowable stresses of the plates are 100 MPa in tension and 130 MPa in bearing. Allowable shearing stress of the rivets is 70 MPa. Assume rivet hole diameter is 3 mm more than the diameter of the rivet. (10)

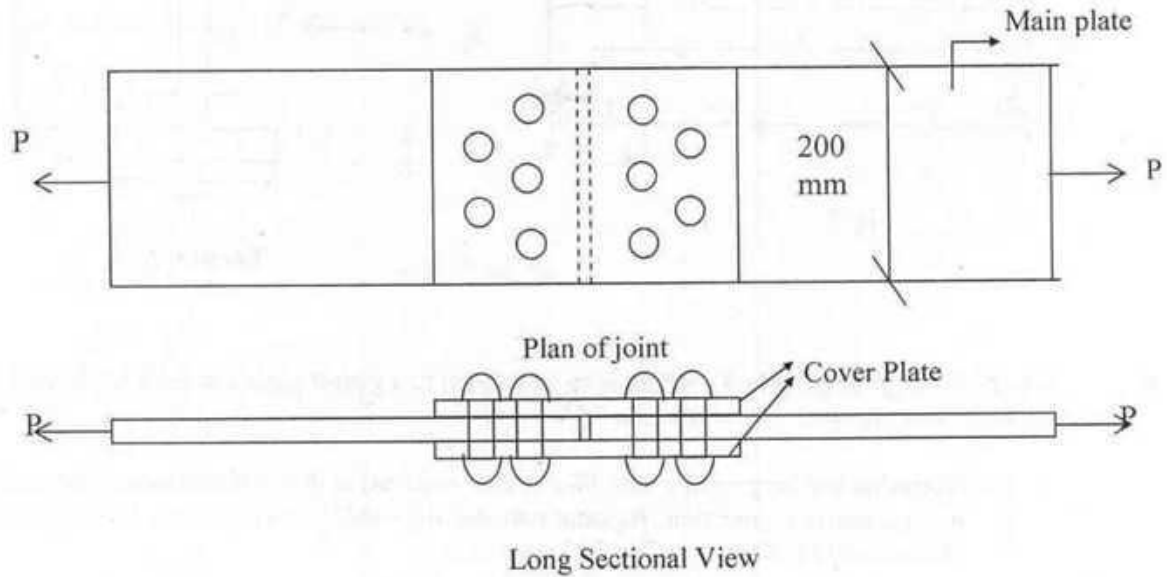


Fig. 10

11. Consider a closed cylindrical steel pressure vessel. The radius of the cylinder is 1000mm and its wall thickness is 10mm. (10)
- Determine the hoop and the longitudinal stresses in the cylindrical wall caused by an internal pressure of 0.80 MPa.
  - Calculate the change in diameter of the cylinder caused by pressurization. Given  $E=200\text{GPa}$  and  $\nu=0.25$ . Assume that  $r_i=r_o=r$ .
12. Locate the Shear Center for the beam section shown in Fig.12. The thickness,  $t$  is constant throughout the section. (10)

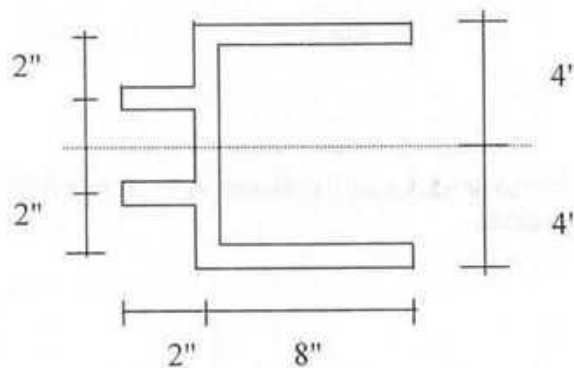


Fig.12

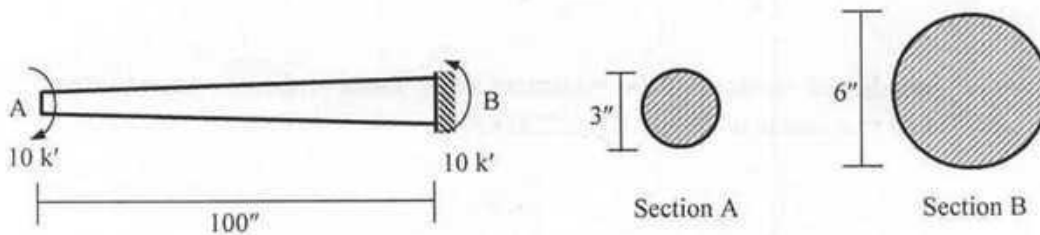
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title : Mechanics of Solids II  
 Time : 3 hours

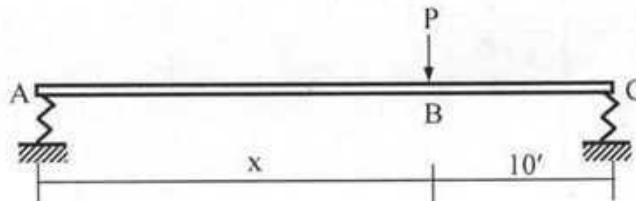
Course Code: CE 213  
 Full Marks : 10x10=100

(There are 14 questions. Answer any 10.)

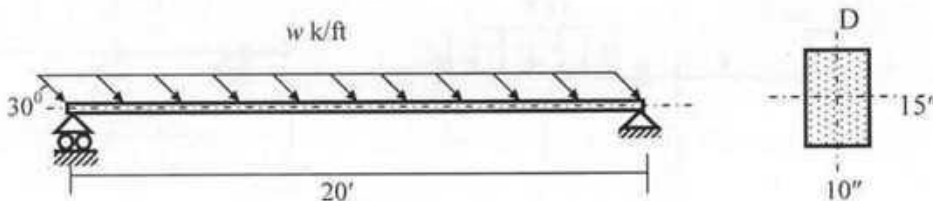
1. For the following beam subjected to torque at A & B, calculate the torsional rotation at A if the cross-section diameter varies from 3" at A to 6" at B [Given:  $G = 12000$  ksi].



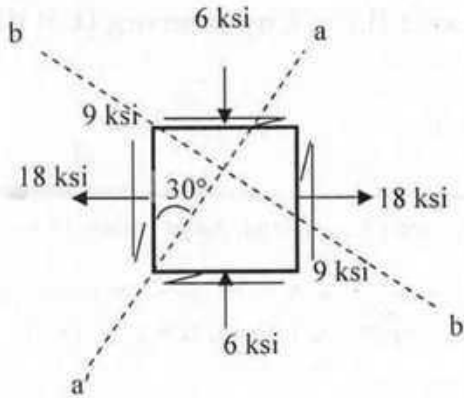
2. In the figure shown below, calculate the load  $P$ , the distance  $x$  and the combined shear stress for the spring at A if both the springs A and C deflect 1" due to the applied load. Given, coil diameter = 1", number of coils = 5, shear modulus = 12000 ksi and the average coil diameter is 5" for both spring.



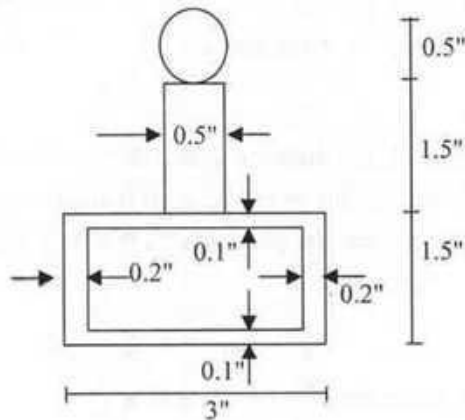
3. The combined shear stress at point D of mid span section of the following beam is 14 ksi. Calculate the following
- Distributed load ' $w$ ' on the beam and
  - Location of neutral axis.



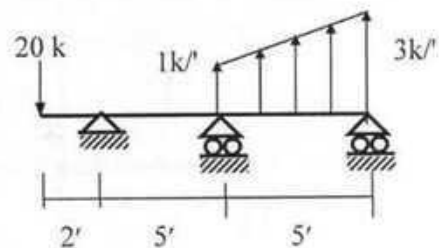
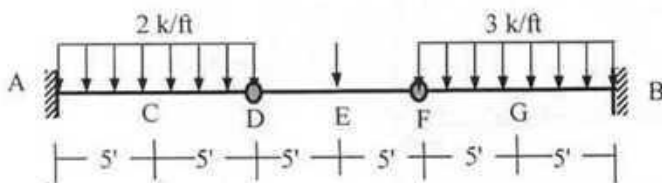
4. Use the Mohr's circle or stress transformation to calculate the normal stress and shear stress on the plane a-a' and plane b-b' shown in the element below. Line a-a' and b-b' are perpendicular to each other. Also calculate the magnitude and direction of maximum and minimum normal stress.



5. Calculate the magnitude and location of the maximum shear stress in the compound section shown below when subjected to a torque of 20 k-ft. [ $G=12000$  ksi].

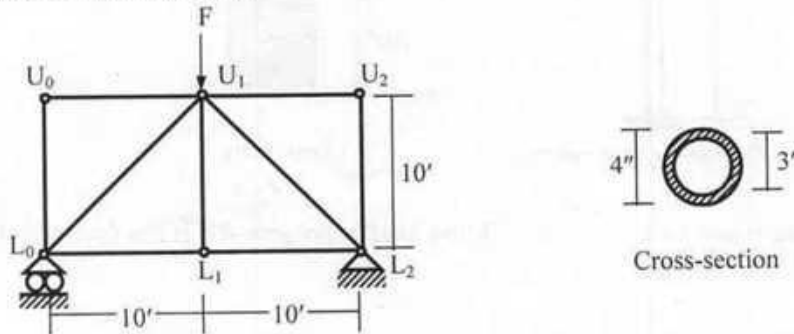


6. For the beams shown below,
- Write the expression for loading function  $w(x)$  using singularity functions,
  - Write down the boundary conditions,
  - Comment on whether the beams are statically determinate or indeterminate and
  - Draw the qualitative deflected shapes.

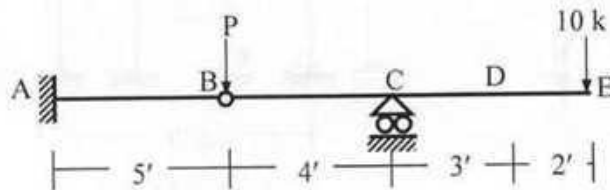


7. Prove the Euler formula of critical load for slender column and state the assumption used for deriving the formula.

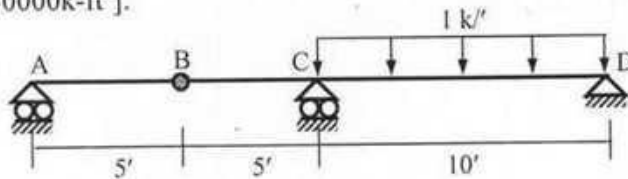
8. Calculate the allowable value of  $F$  for the truss shown below using the AISC-ASD criteria. [Given: The truss members are hollow circular tubes of 4" outside and 3" inside diameter,  $E = 29000$  ksi,  $f_y = 50$  ksi for all members].



9. For the beam shown below, use the Singularity Function Method to calculate the force  $P$  needed to make the deflection at  $B$  equal to zero [Given:  $EI = 40 \times 10^3$  k-ft<sup>2</sup>].

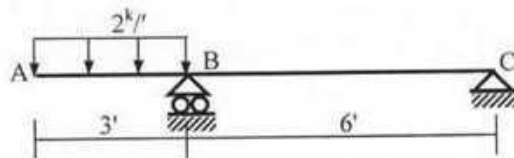


10. Use the conjugate beam method to calculate deflection at  $B$  and rotation at  $A$  [Given:  $EI = 40000$  k-ft<sup>2</sup>].

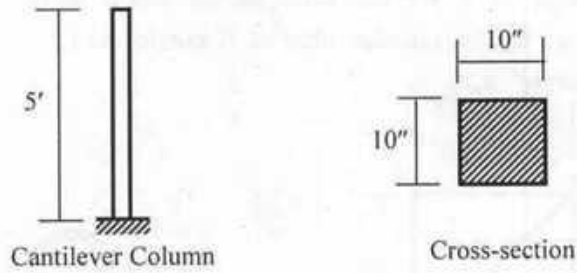


11. Solve Problem 10 using the Moment-Area Theorem.

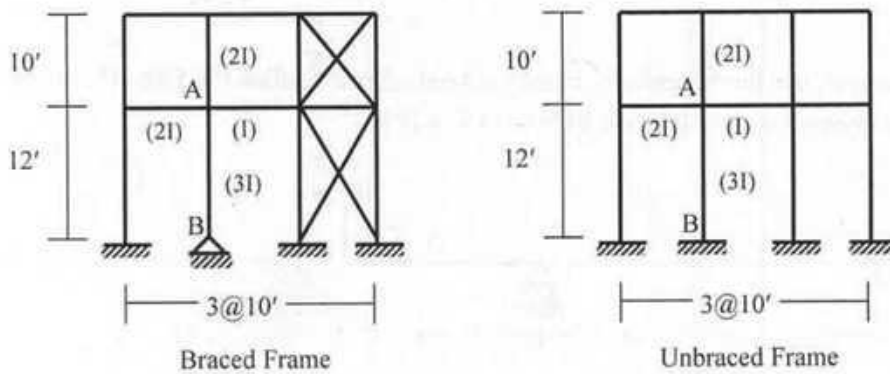
12. Calculate the deflection at  $A$  for the following beam. [ $EI_{AB} = 40,000$  k-ft<sup>2</sup>,  $EI_{BC} = 20,000$  k-ft<sup>2</sup>].



13. A 5-ft long cantilever column has a 10"×10" cross-section as shown below and is made of a nonlinear material with stress-strain relationship given by  $\sigma = 4(1 - e^{-100\epsilon})$ , where  $\sigma$  is the stress (ksi) and  $\epsilon$  is the strain. Calculate the critical load for the column.



14. Refer to the following figure calculate the buckling load in column AB if the frame is (i) braced, (ii) unbraced [Given:  $EI = 40,000 \text{ k-ft}^2$ ].



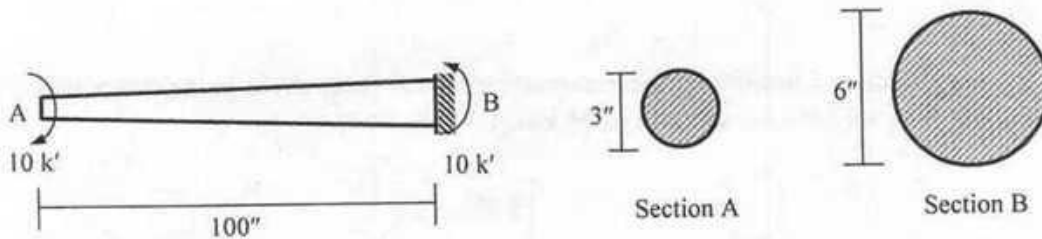
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title : Mechanics of Solids II  
 Time : 3 hours

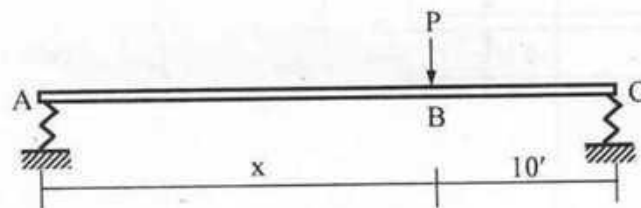
Course Code: CE 213 (B set)  
 Full Marks : 10x10=100

(There are 14 questions. Answer any 10.)

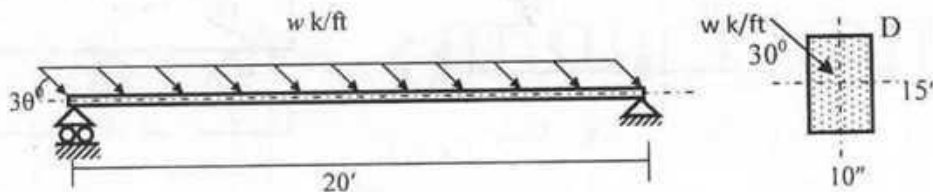
1. Refer to the following beam subjected to torque at A and B. Calculate the torsional rotation at A if the cross-section diameter varies from 4" at A to 8" at B [Given:  $G = 12000$  ksi].



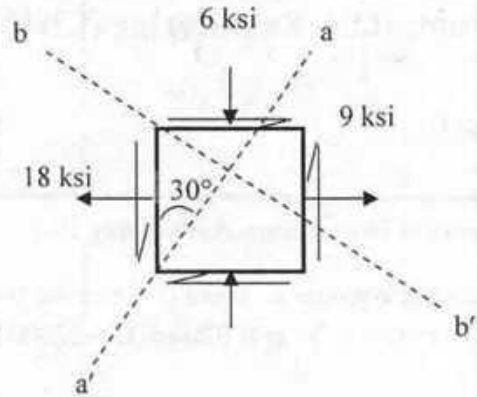
2. In the figure shown below, calculate the load  $P$ , the distance  $x$  and the total shear stress for the spring at A if both the springs A and C deflect 1" due to the applied load. Both springs have coil diameter = 1", number of coils = 5 and shear modulus = 12000 ksi and the average coil diameter is 5" .



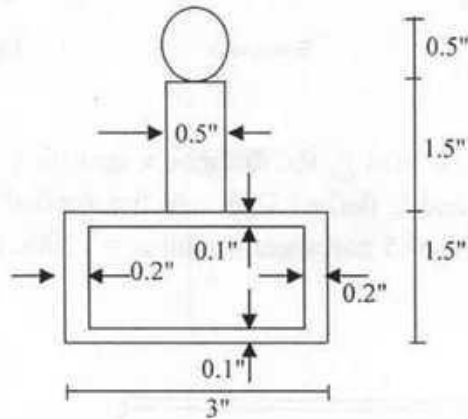
3. The skewed bending stress at point D of mid span section of the following beam is 14 ksi. Calculate the following:
- Distributed load ' $w$ ' on the beam, and
  - Location of the neutral axis.



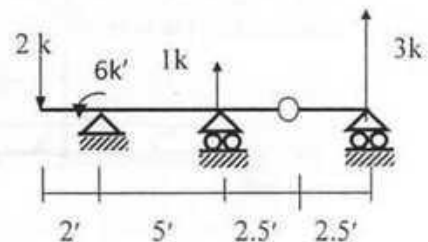
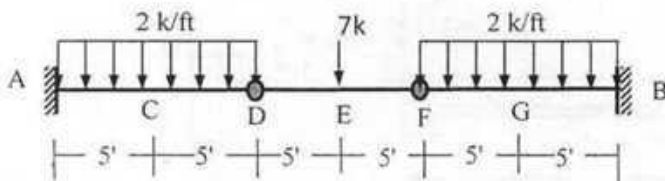
4. Use the Mohr's circle or stress transformation to calculate the normal stress and shear stress on the plane a-a' and plane b-b' shown in the element below. Line a-a' and b-b' are perpendicular to each other. Also calculate the magnitude and direction of maximum and minimum normal stress.



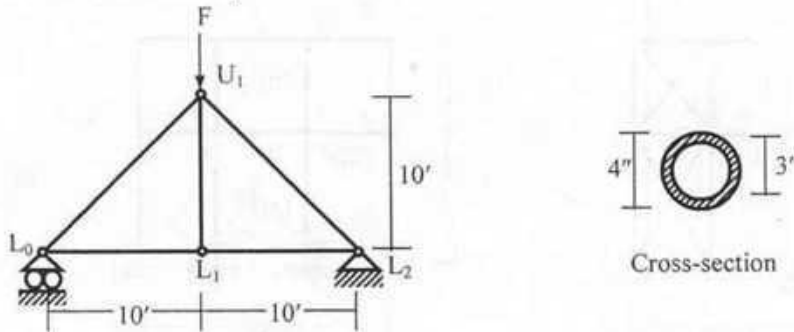
5. Calculate the magnitude and location of the maximum torsional shear stress in the compound section shown below which is subjected to a torque of 25 k-ft. [ $G=12000$  ksi].



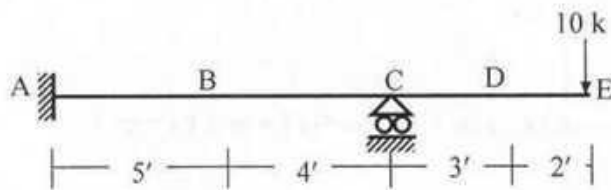
6. For the beams shown below,  
 a) Write the expression for loading function  $w(x)$  using singularity functions,  
 b) Write down the boundary conditions,  
 c) Comment on whether the beams are statically determinate or indeterminate, and  
 d) Draw the qualitative deflected shapes.



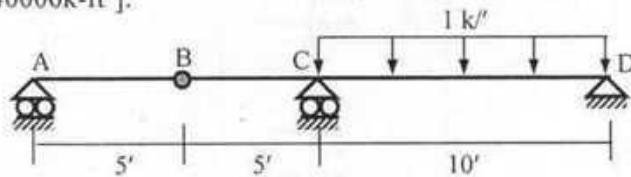
7. Prove that the Kern Area of a section is bounded by  $b/6+h/6=1$  lines and also find the Kern zone of a column section of  $12'' \times 10''$ . Here,  $b$  is the breadth and  $h$  is the height of the section.
8. Calculate the allowable value of  $F$  for the truss shown below using the AISC-ASD criteria. [Given: The truss members are hollow circular tubes of 4" outside and 3" inside diameter,  $E = 29000$  ksi,  $f_y = 50$  ksi for all members].



9. For the beam shown below, use the Singularity Function Method to calculate rotation and deflection at B. Also draw the shear force diagram of the beam. [Given:  $EI = 40 \times 10^3$  k-ft<sup>2</sup>].

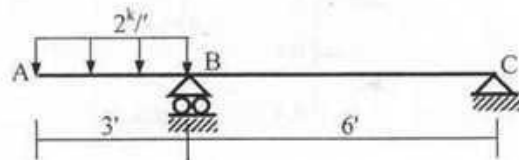


10. Use the conjugate beam method to calculate deflection at B and rotation at A. [Given:  $EI = 40000$  k-ft<sup>2</sup>].

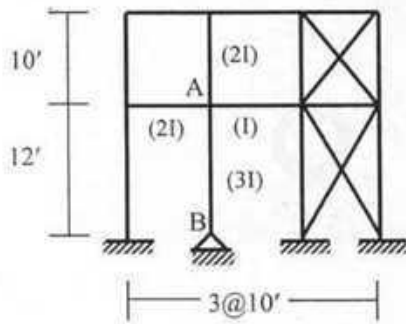


11. Solve Problem 10 using the Moment-Area Theorem.

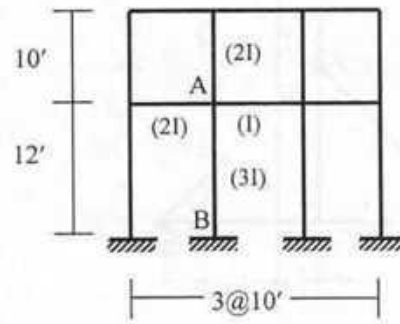
12. Calculate the deflection at A for the following beam. [ $EI_{AB} = 40,000$  k-ft<sup>2</sup>,  $EI_{BC} = 20,000$  k-ft<sup>2</sup>].



13. Using the AISC ASD column formulas, select a 20-ft long W-section having one fixed and one pin end column to carry a concentric load of 180 Kips. The structural steel is to be A572, having  $\sigma_{yp} = 50\text{ksi}$ .
14. Calculate the buckling load of column AB for the following braced and un-braced frames.  
[Given:  $EI = 40,000 \text{ k-ft}^2$ ].

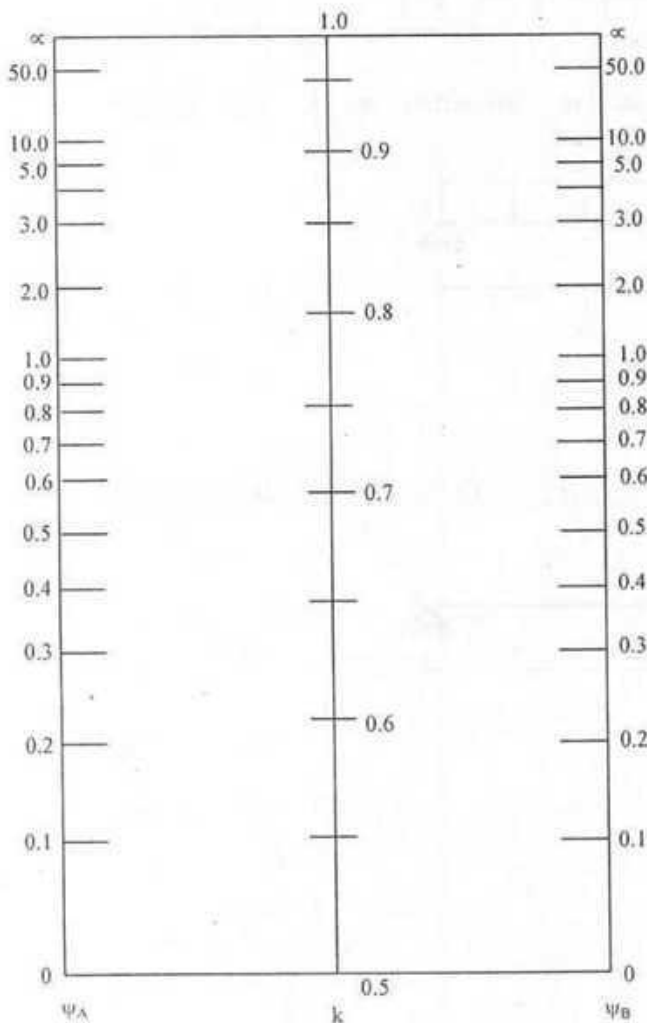


Braced Frame

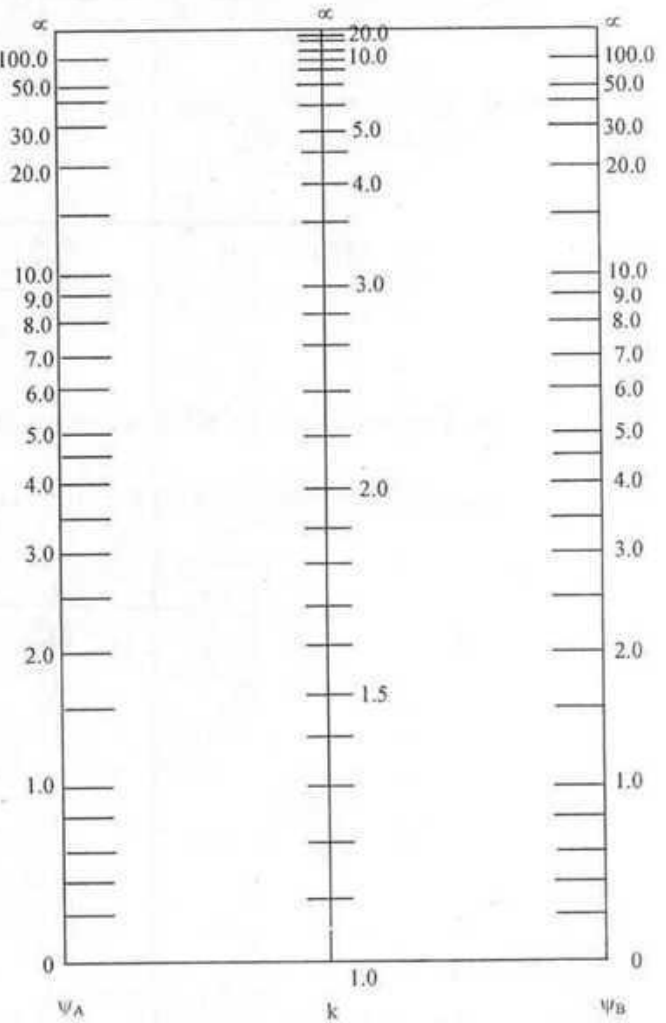


Un-braced Frame

Alignment Charts for Effective Length Factors  $k$



Braced Frames



Unbraced Frames

### List of Useful Formulae for CE 213

\* Torsional Rotation  $\phi_B - \phi_A = \int (T/J_{eq}G) dx$ , and  $= (TL/J_{eq}G)$ , if  $T$ ,  $J_{eq}$  and  $G$  are constants

Section	Torsional Shear Stress	$J_{eq}$
Circular	$\tau = Tc/J$	$\pi d^4/32$
Thin-walled	$\tau = T/(2(A) t)$	$4(A)^2/(ds/t)$
Rectangular	$\tau = T/(\alpha bt^2)$	$\beta bt^3$

b/t	1.0	1.5	2.0	3.0	6.0	10.0	$\alpha$
$\alpha$	0.208	0.231	0.246	0.267	0.299	0.312	0.333
$\beta$	0.141	0.196	0.229	0.263	0.299	0.312	0.333

\* Biaxial Bending Stress:  $\sigma_x(z, y) = M_x y/I_x + M_y z/I_y$

\* Combined Axial Stress and Biaxial Bending Stress:  $\sigma_x(x, y) = -P/A - M_x y/I_x - M_y z/I_y$

\* Corner points of the kern of a Rectangular Area are  $(b/6, 0)$ ,  $(0, h/6)$ ,  $(-b/6, 0)$ ,  $(0, -h/6)$

\* Maximum shear stress on a Helical spring:  $\tau_{max} = \tau_{direct} + \tau_{torsion} = P/A + Tr/J = P/A (1 + 2R/r)$

\* Stiffness of a Helical spring is  $k = Gd^4/(64R^3N)$

\*  $\sigma_{xx}' = (\sigma_{xx} + \sigma_{yy})/2 + \{(\sigma_{xx} - \sigma_{yy})/2\} \cos 2\theta + (\tau_{xy}) \sin 2\theta = (\sigma_{xx} + \sigma_{yy})/2 + \sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2} \cos(2\theta - \alpha)$

$\tau_{xy}' = -\{(\sigma_{xx} - \sigma_{yy})/2\} \sin 2\theta + (\tau_{xy}) \cos 2\theta = \tau_{xy}' = -\sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2} \sin(2\theta - \alpha)$

where  $\tan \alpha = 2 \tau_{xy}/(\sigma_{xx} - \sigma_{yy})$

\*  $\sigma_{xx(max)} = (\sigma_{xx} + \sigma_{yy})/2 + \sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2}$ ; when  $\theta = \alpha/2, \alpha/2 + 180^\circ$

$\sigma_{xx(min)} = (\sigma_{xx} + \sigma_{yy})/2 - \sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2}$ ; when  $\theta = \alpha/2 \pm 90^\circ$

\*  $\tau_{xy(max)} = \sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2}$ ; when  $\theta = \alpha/2 - 45^\circ, \alpha/2 + 135^\circ$

$\tau_{xy(min)} = -\sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2}$ ; when  $\theta = \alpha/2 + 45^\circ, \alpha/2 - 135^\circ$

\* Mohr's Circle: Center  $(a, 0) = [(\sigma_{xx} + \sigma_{yy})/2, 0]$  and radius  $R = \sqrt{\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2}$

\* For Yielding to take place

Maximum Normal Stress Theory (Rankine):

$$|\sigma_1| \geq Y, \text{ or } |\sigma_2| \geq Y.$$

Maximum Normal Strain Theory (St. Venant):

$$|\sigma_1 - \nu\sigma_2| \geq Y, \text{ or } |\sigma_2 - \nu\sigma_1| \geq Y.$$

Maximum Shear Stress Theory (Tresca):

$$|\sigma_1 - \sigma_2| \geq Y, |\sigma_1| \geq Y, \text{ or } |\sigma_2| \geq Y$$

Maximum Distortion-Energy Theory (Von Mises):  $\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2 \geq Y^2$

\*  $M(x) = EI \kappa \cong EI d^2v/dx^2$

\*  $w(x) \cong EI d^4v/dx^4$ .

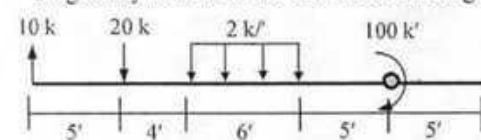
$$V(x) = \int w(x) dx \cong EI d^3v/dx^3,$$

$$M(x) = \int V(x) dx \cong EI d^2v/dx^2$$

$$S(x) = \int M(x) dx \cong EI dv/dx \cong EI \theta(x),$$

$$D(x) = \int S(x) dx \cong EI v(x)$$

\* Singularity Functions for Common Loadings



$$w(x) = 10\langle x-0 \rangle^{-1} - 20\langle x-5 \rangle^{-1} - 2\langle x-9 \rangle^0 + 2\langle x-15 \rangle^0 + 100\langle x-20 \rangle^{-2} + C_B\langle x-20 \rangle^{-3}.$$

\* First Moment-Area Theorem:  $\theta_B - \theta_A = \int (M/EI) dx$

\* Second Moment-Area Theorem:  $(x_B - x_A) \theta_B - v_B + v_A = \int x (M/EI) dx$

\* Conjugate Beam Method

Original Beam	Free End	Fixed End	Hinge/Roller End	Internal Support	Internal Hinge
Conjugate Beam	Fixed End	Free End	Hinge/Roller End	Internal Hinge	Internal Support

\* Euler Buckling Load:  $P_{cr} = \pi^2 EI_{min}/(kL)^2$

\* Effect of Initial Imperfection:  $v(x) = v_0/[1 - P/P_{cr}] \sin(\pi x/L) \Rightarrow v(L/2) = v_0/[1 - P/P_{cr}]$

\* Effect of Load Eccentricity:  $\lambda^2 = P/EI \Rightarrow v(L/2) = e [\sec \lambda L/2 - 1] = e [\sec \{(\pi/2)\sqrt{(P/P_{cr})}\} - 1]$

\* Effect of Material Nonlinearity:  $P_{cr} = \pi^2 E_t I/L^2 \Rightarrow \sigma_{cr} = \pi^2 E_t/\eta^2$

\* Eccentric Loading with Elasto-plastic Material:

$v(L/2) = e [\sec \{(\pi/2)\sqrt{(P/P_{cr})}\} - 1]$  for the elastic range; and

$v(L/2) = M_p/P - e$ , for the plastic range

\*  $k = 1.0$  for Hinge-Hinged Beam,  $0.7$  for Hinge-Fixed Beam,  $0.5$  for Fixed-Fixed Beam,  $2.0$  for Cantilever Beam

In general,  $k$  is obtained from  $\psi_A$  and  $\psi_B$  for braced and unbraced frames

\* AISC-ASD Method,  $\eta = L_e/r_{min}$ , and  $\eta_c = \pi\sqrt{(2E/f_y)}$

If  $\eta \leq \eta_c$ ,  $\sigma_{all} = f_y [1 - 0.5(\eta/\eta_c)^2]/FS$ , where  $FS = [5/3 + 3/8(\eta/\eta_c) - 1/8(\eta/\eta_c)^3]$

If  $\eta > \eta_c$ ,  $\sigma_{all} = (\pi^2 E/\eta^2)/FS$ , where  $FS = \text{Factor of safety} = 23/12 = 1.92$

\* Moment magnification factor for a Simply Supported Beam

For concentrated load at midspan  $\phi = [\tan(\lambda L/2)/(\lambda L/2)]$ , subjected to end moments only  $= [\sec(\lambda L/2)]$

Under UDL  $= 2 [\sec(\lambda L/2) - 1]/(\lambda L/2)^2$ , according to AISC code  $= 1/(1 - P/P_{cr})$

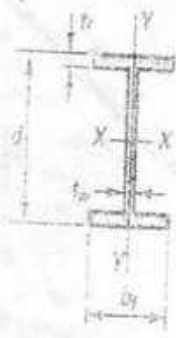


TABLE 4A. AMERICAN STANDARD STEEL W SHAPES DIMENSIONS AND PROPERTIES  
U.S. CUSTOMARY UNITS (ABRIDGED LIST)

Designation*	Area A	Depth d	Web		Flange		Axis X-X		Axis Y-Y	
			Thickness $t_w$	Width $b_f$	Thickness $t_f$	$I_x$	$r_x$	$I_y$	$r_y$	
in. x lb/ft	in <sup>2</sup>	in	in	in	in	in <sup>4</sup>	in	in <sup>4</sup>	in	
W36 x 245	72.1	36.08	0.800	16.510	1.350	16100	15.0	1010	3.75	
230	67.6	35.90	0.760	16.470	1.260	15000	14.9	940	3.73	
150	44.2	35.85	0.625	11.975	0.940	9040	14.3	270	2.47	
135	39.7	35.55	0.600	11.950	0.790	7800	14.0	225	2.38	
W33 x 201	59.1	33.68	0.715	15.745	1.150	11500	14.0	740	3.56	
130	38.3	33.09	0.580	11.510	0.855	6710	13.2	218	2.39	
118	34.7	32.86	0.550	11.480	0.740	5900	13.0	187	2.32	
W30 x 191	56.1	30.68	0.710	15.040	1.185	9170	12.8	673	3.46	
173	50.8	30.44	0.655	14.985	1.065	8200	12.7	598	3.43	
W27 x 161	47.4	27.59	0.660	14.020	1.080	6280	11.5	497	3.24	
146	42.9	27.38	0.605	13.965	0.975	5630	11.4	443	3.21	
94	27.7	26.92	0.490	9.990	0.745	3270	10.9	124	2.12	
84	24.8	26.71	0.460	9.960	0.640	2850	10.7	106	2.07	
W18 x 60	17.6	18.24	0.415	7.555	0.695	984	7.47	50.1	1.69	
50	14.7	17.99	0.355	7.495	0.570	800	7.38	40.1	1.65	
46	13.5	18.06	0.360	6.060	0.605	712	7.25	22.5	1.29	
35	10.3	17.70	0.300	6.000	0.425	510	7.04	15.3	1.22	
W16 x 26	7.68	15.69	0.250	5.500	0.345	301	6.26	9.59	1.12	
W14 x 193	56.8	15.48	0.890	15.710	1.440	2400	6.50	931	4.05	
159	46.7	14.98	0.745	15.565	1.190	1900	6.38	748	4.00	
99	29.1	14.16	0.485	14.565	0.780	1110	6.17	402	3.71	
90	26.5	14.02	0.440	14.520	0.710	999	6.14	362	3.70	
W12 x 72	21.1	12.25	0.430	12.040	0.670	597	5.31	195	3.04	
65	19.1	12.12	0.390	12.000	0.605	533	5.28	174	3.02	
50	14.7	12.19	0.370	8.080	0.640	394	5.18	56.3	1.96	
45	13.2	12.06	0.335	8.045	0.575	350	5.15	50.0	1.94	
40	11.8	11.94	0.295	8.005	0.515	310	5.13	44.1	1.93	
W10 x 112	32.9	11.36	0.755	10.415	1.250	716	4.66	236	2.68	
60	17.6	10.22	0.420	10.080	0.680	341	4.39	116	2.57	
49	14.4	9.98	0.340	10.000	0.560	272	4.35	93.4	2.54	
45	13.3	10.10	0.350	8.020	0.620	248	4.33	53.4	2.01	
39	11.5	9.92	0.315	7.985	0.530	209	4.27	45.0	1.98	
33	9.71	9.73	0.290	7.960	0.435	170	4.19	36.6	1.94	
W8 x 67	19.7	9.00	0.570	8.280	0.935	272	3.72	88.6	2.12	
58	17.1	8.75	0.510	8.220	0.810	228	3.65	75.1	2.10	
40	11.7	8.25	0.360	8.070	0.560	146	3.53	49.1	2.04	
31	9.13	8.00	0.285	7.995	0.435	110	3.47	37.1	2.02	
28	8.25	8.06	0.285	6.535	0.465	98.0	3.45	21.7	1.62	
24	7.08	7.93	0.245	6.495	0.400	82.8	3.42	18.3	1.61	
21	6.16	8.28	0.250	5.270	0.400	75.3	3.49	9.77	1.26	
18	5.26	8.14	0.230	5.250	0.330	61.9	3.43	7.97	1.23	

American standard wide-flange shapes are designated by the letter W followed by the nominal depth in inches with the weight in pounds per linear foot given last.

University of Asia Pacific  
Department of Civil Engineering  
Final Examination Fall 2012

Course Title: Fluid Mechanics  
Time: 3.0 hour

Course No: CE 221  
Full Marks: 150

The symbols have their usual meanings.  
The figures at the right margin indicate full marks.

There are **eight questions**. Answer **Question No. 4** as compulsory and **any five** from the rest.

1. (a) Write short note (any two): (2X3=6)

- i. Stream function
- ii. Flow net
- iii. Stagnation point.

(b) Write down the equation of a streamline in 3D flow. State three characteristics of a streamline. (3+6=9)

(c) The velocity potential for a 2D flow is given by the expression  $\phi = x^2 - y^2$ . Determine the velocity components, stream function and flow rate between the streamlines passing through A (1,1) and B (1,2). (10)

2. (a) Explain why a correction factor is applied while calculating the kinetic energy of fluid flow. (4)

(b) Derive the general equation of continuity for flow through pipes. Reduce the equation for steady incompressible flow. (10+2=12)

(c) A pipe AB (figure 1) is of uniform diameter. The pressure at A is  $170 \text{ kN/m}^2$  and at B is  $280 \text{ kN/m}^2$ . If a crude oil ( $S = 0.90$ ) is flowing through the pipe, determine the direction of flow and head loss. (9)

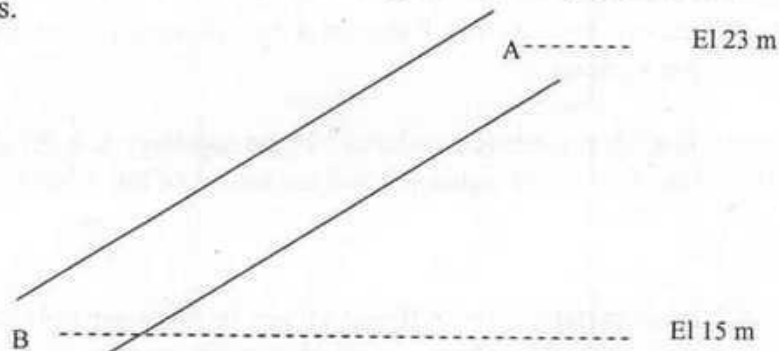


Figure 1

3. (a) Write down the impulse-momentum equation in three directions. Also state the relations between absolute and relative velocities with a neat sketch. (3+6=9)

(b) A nozzle at the end of a pipe (figure 2) discharges oil ( $S = 0.8$ ) from a tank to atmosphere. Estimate the discharge from the nozzle when the head  $H$  in the tank is 4.0 m. The loss in the pipe can be taken as  $20V_1^2/2g$ , where  $V_1$  = velocity in the pipe. The loss of energy in the nozzle can be assumed to be  $0.11V_2^2/2g$ , where  $V_2$  = velocity in the nozzle. Also determine the pressure at the base of the nozzle. (16)

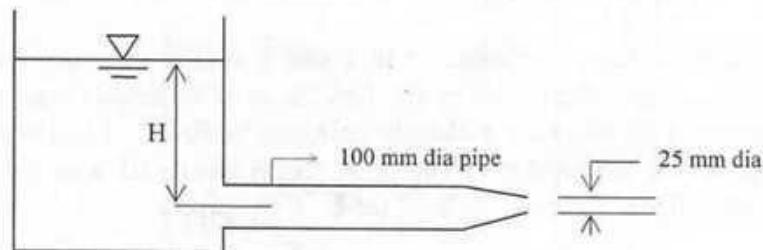


Figure 2

4. (a) Define Cavitation. Write down the necessary condition for cavitation to occur in pipe flow. What measures should be taken to avoid such problem? (3+3+3=9)

(b) A curved pipe section of length 10 m that is attached to the straight pipe section as shown in figure 3. Determine the resultant force on the curved pipe, and find the horizontal component of the jet reaction. All significant data are given in the figure. Assume an ideal fluid with  $\gamma = 8.80 \text{ kN/m}^3$ . (16)

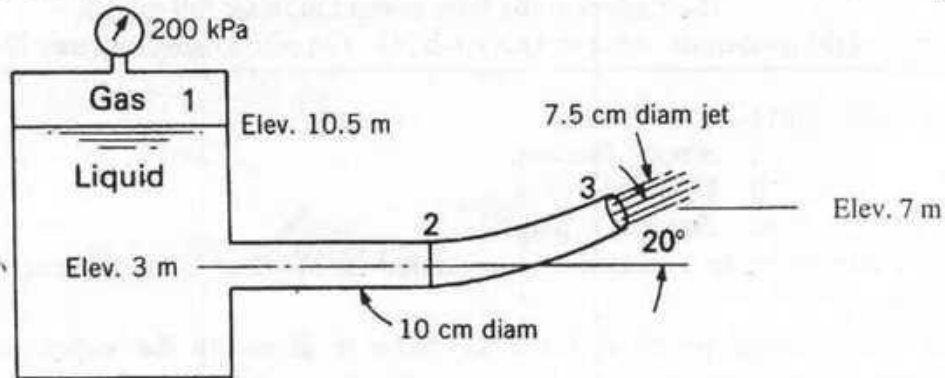


Figure 3

5. (a) A Centrifugal Pump Impeller has  $r_1 = 0.3 \text{ m}$ ,  $r_2 = 1.0 \text{ m}$ ,  $\beta_1 = 120^\circ$ ,  $\beta_2 = 135^\circ$ , and thickness of  $0.1 \text{ m}$  parallel to the axis of rotation. If it delivers  $2.50 \text{ m}^3/\text{s}$  with no tangential velocity component at the entrance (i.e. radial flow pump), what is the rotational speed? For this condition calculate:

- i. Torque
- ii. Power of the machine
- iii. Energy given to each Newton of water. (15)

(b) Derive an expression for the drag force on a sphere as it moves through a viscous liquid by Buckingham's  $\pi$  Method. (10)

6. (a) What do you mean by geometric similarity? If the capillary rise ( $h$ ) depends upon the specific weight ( $\gamma$ ), surface tension of liquid ( $\sigma$ ) and the radius of the tube ( $r$ ), show that

$$h = r \cdot f\left(\frac{\sigma}{\gamma r^2}\right) \quad (2+7=9)$$

(b) A horizontal Venturimeter having a throat  $10 \text{ cm}$  in diameter is installed in a  $30 \text{ cm}$  pipe and is used for measuring the flow of oil of specific gravity  $0.9$ . The oil-mercury differential manometer shows a gage difference of  $18 \text{ cm}$ . Calculate the actual discharge in liters per second if the meter coefficient is  $0.98$ . Given, (10)

$$Q_a = \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2gh}$$

(c) Write short note: (2X3=6)

- i. Hydraulically rough boundary
- ii. Viscous sublayer in turbulent flow

7. (a) A pipeline  $50 \text{ m}$  long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first  $20 \text{ m}$  of its length from the tank, the pipe is  $25 \text{ cm}$  in diameter and its diameter suddenly enlarges to  $50 \text{ cm}$ . The height of water level in the tank is  $10 \text{ m}$  above the center of the pipe. Considering all losses of head that occurs, determine the rate of flow. Assume  $f = 0.02$  for both the pipes. (8)

(b) Two reservoirs with a difference in water surface elevation of 8 m are connected by two pipes in series as shown in figure 4. The equivalent roughness heights of the two pipes are 2.0 and 0.3 mm respectively. Find discharge by equivalent velocity head method. Given  $\nu = 3 \times 10^{-6} \text{ m}^2/\text{s}$ . Use Moody diagram for friction factor. (17)

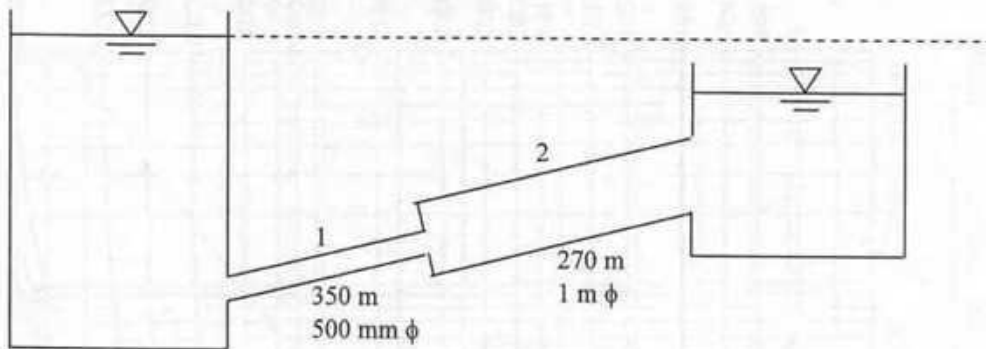


Figure 4

8. (a) The pipes in the system shown in figure 5 are all new cast iron ( $e = 0.25 \text{ mm}$ ). With a flow of  $0.70 \text{ m}^3/\text{s}$ , find the head loss from B to C. Given  $\nu = 1.14 \times 10^{-6} \text{ m}^2/\text{s}$ . (15)

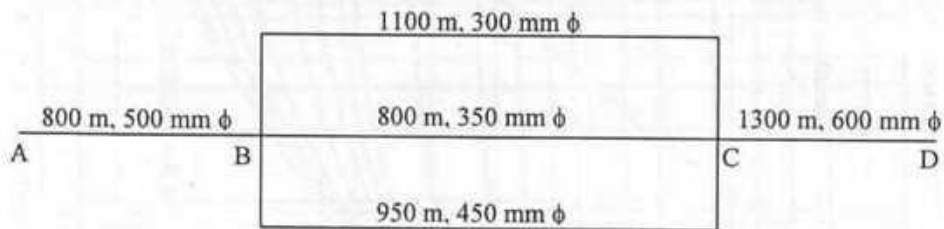


Figure 5

(b) If the flows into and out of a two-loop pipe system are as shown in figure 6, determine the flow in each pipe. The  $k$ -values for each pipe are given in the figure. Use Hardy Cross method. (10)

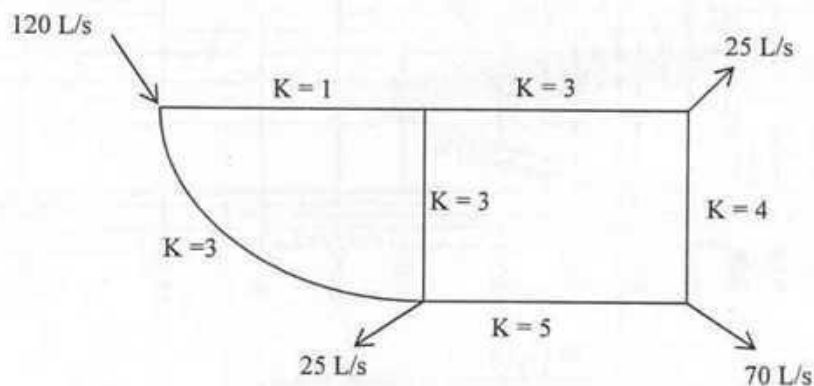


Figure 6

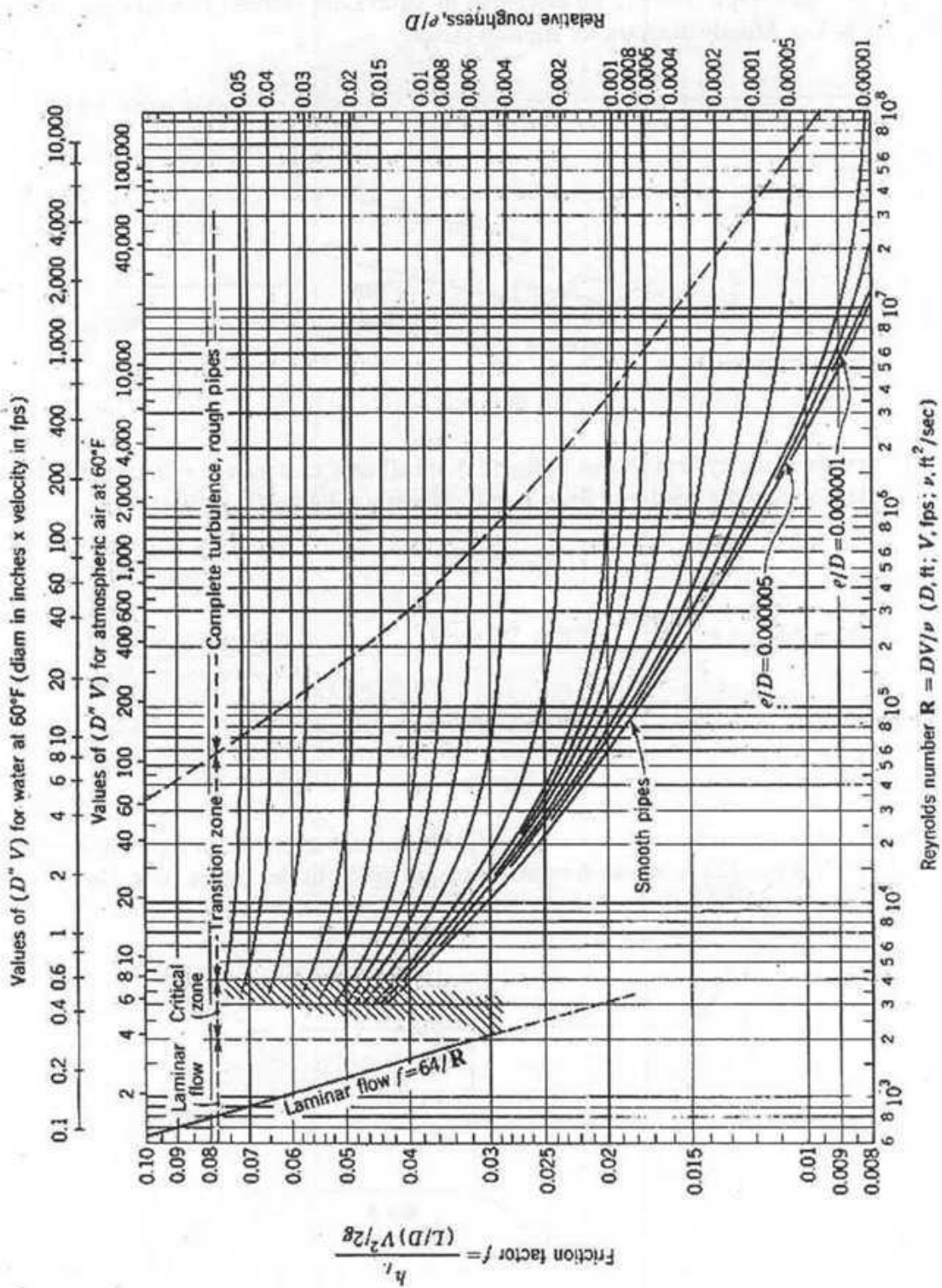


Figure7: friction factor for pipes (Moody Diagram)

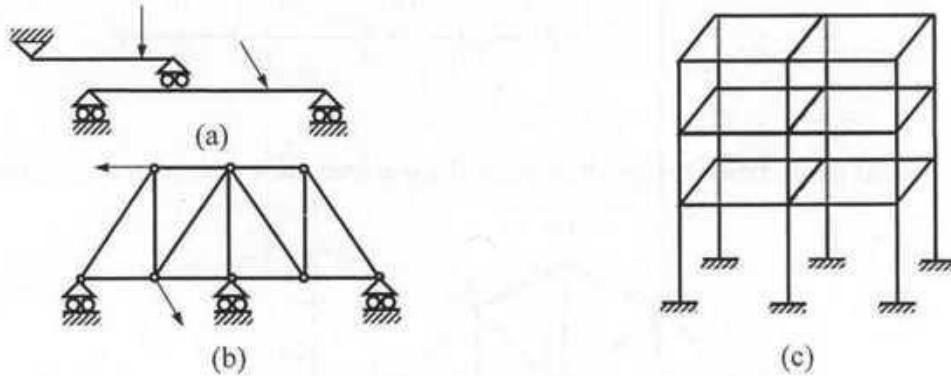
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**

Course Title: Structural Analysis & Design I  
 Time: 3.00 Hours

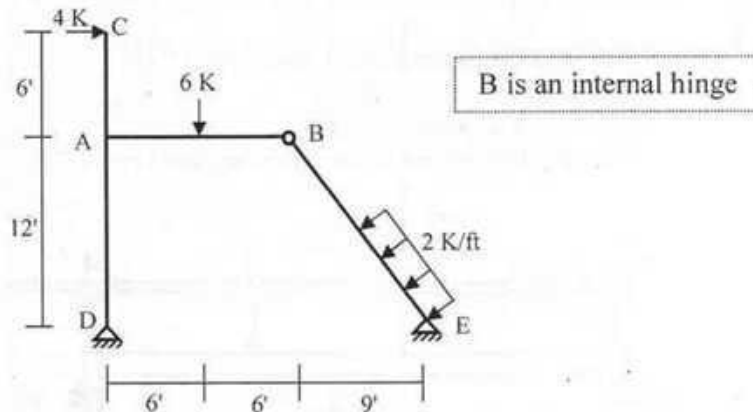
Course Code: CE 311  
 Full Marks: 100 (=10×10)

*There are fourteen (14) questions in this paper. Answer any ten (10).  
 Assume any missing data reasonably.*

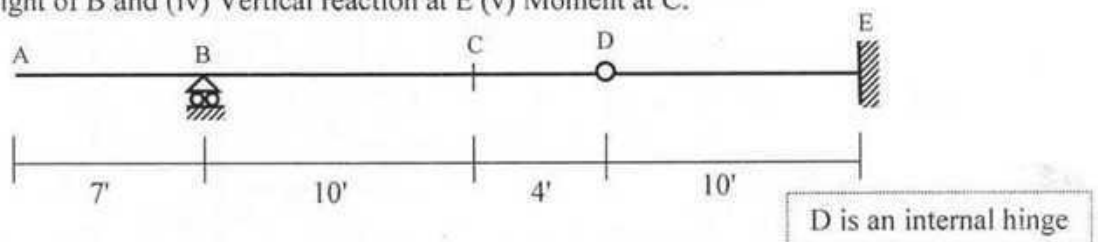
1. Classify each of the structures shown below as statically determinate or statically indeterminate, stable or unstable. If statically indeterminate, report the number of degrees of indeterminacy.



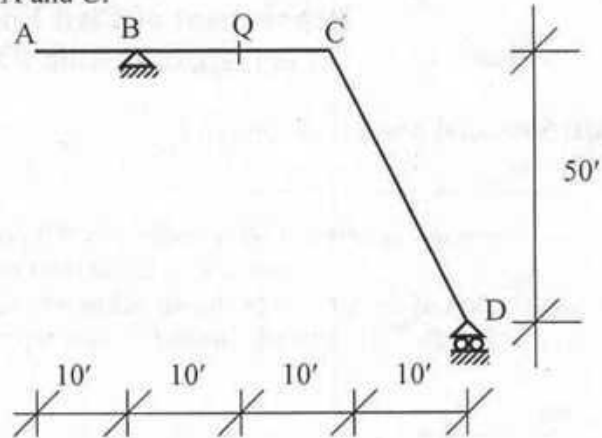
2. For the frame given below:  
 a) Determine the degree of static indeterminacy (dosi)  
 b) Draw the axial force, shear force and bending moment diagram for AB and BE part of the frame.



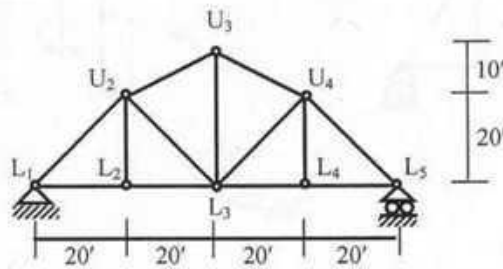
3. For the beam shown below, draw Influence lines for (i) Reaction at B, (ii) Shear at C, (iii) Shear just right of B and (iv) Vertical reaction at E (v) Moment at C.



4. Draw the influence lines for shear force and bending moment at Q of the frame shown in the figure. Load moves between A and C.

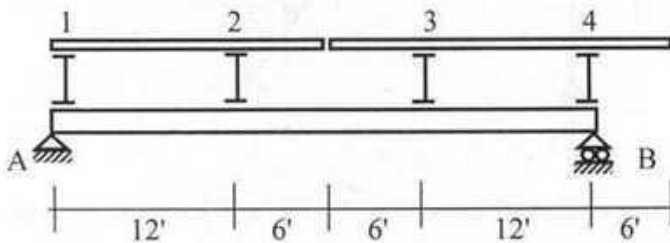


5. For the truss shown below, draw the influence lines for forces in members  $U_2U_3$ ,  $U_2L_3$  and  $L_2L_3$

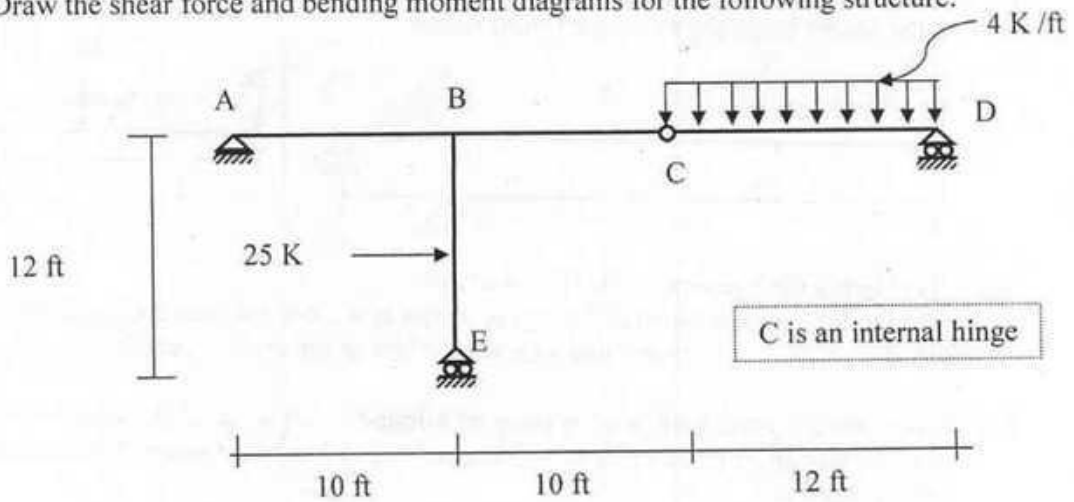


6. Girder AB supports a floor system as shown in the figure below. Draw the Influence line for

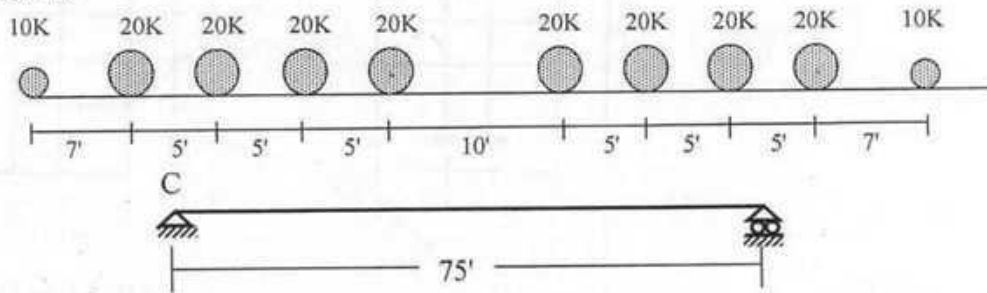
- (i) Floor beam reaction at panel point "3"
- (ii) Support reaction at "A"
- (iii) Shear in panel 2-3 and
- (iv) Bending moment for girder at panel point "2".



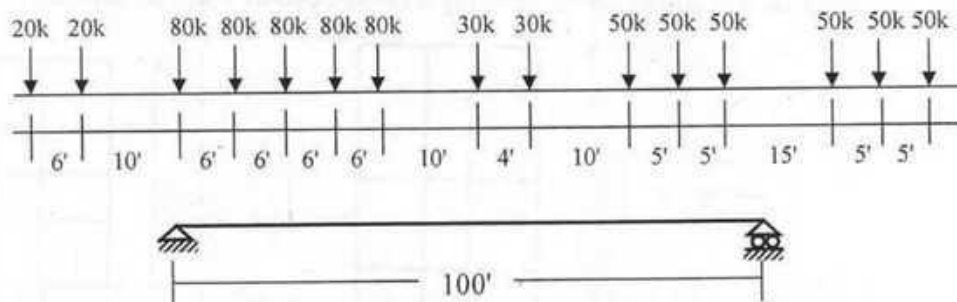
7. Draw the shear force and bending moment diagrams for the following structure.



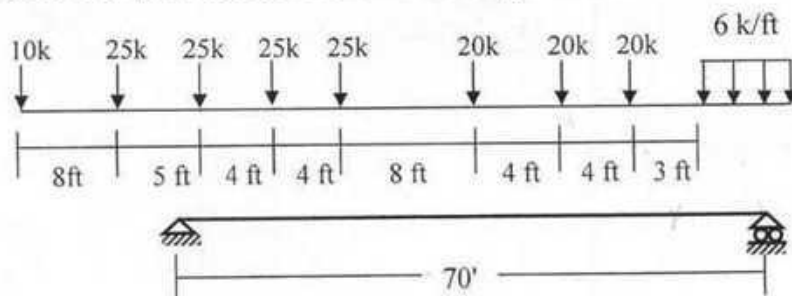
8. Calculate the maximum reaction at support C of a deck girder due to the loads as shown in the figure below



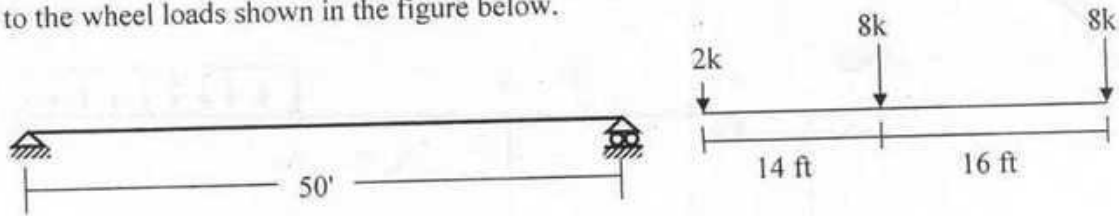
9. Calculate the maximum live load shear at the quarter point from the left support of a simply supported beam of span 100 ft due to the axle loads of a heavy freight locomotive shown below.



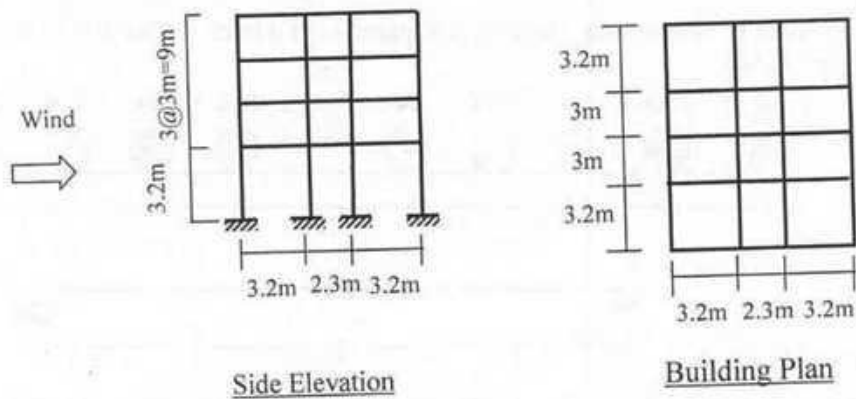
10. Calculate the maximum bending moment at the one-third point of a simply supported beam of span 70 ft due to the wheel loads shown in the figure below.



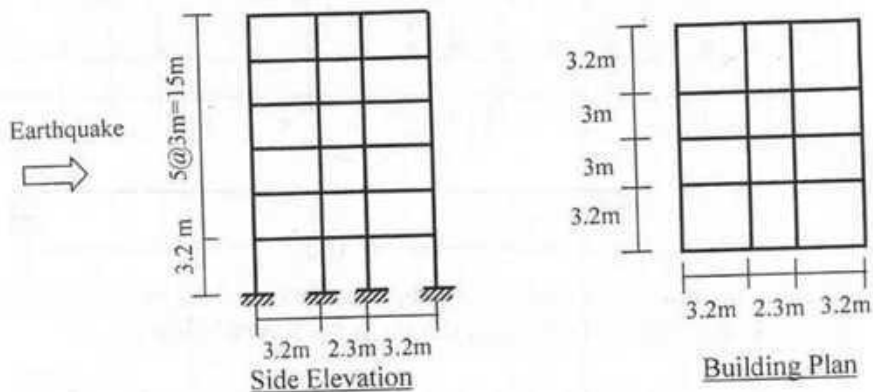
11. Calculate the absolute maximum bending moment of a simply supported beam of span 50 ft due to the wheel loads shown in the figure below.



12. (a) Derive the "general cable theorem".  
 (b) Derive an expression defining the shape of a cable subjected to uniformly distributed load with respect to horizontal axis with origin at left end of a cable.
13. Calculate the wind load at each story of a four-storied hospital building (shown below) located at a flat terrain in Dhaka (Basic wind speed = 210 km/hr). Assume the structure to be subjected to Exposure B.



14. Calculate the seismic load at each story of a six-storied hospital building (shown below) located in Dhaka (Zone 2). Assume the structure to be an Ordinary Moment Resisting Frame (OMRF) built on soil condition  $S_2$ , carrying a Dead Load of  $9 \text{ kN/m}^2$  (Including partition load).



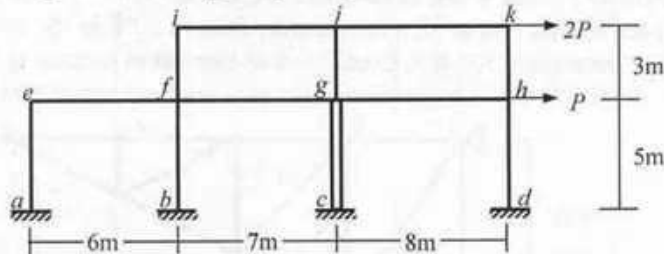
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title : Structural Engineering II  
 Time : 3 hour

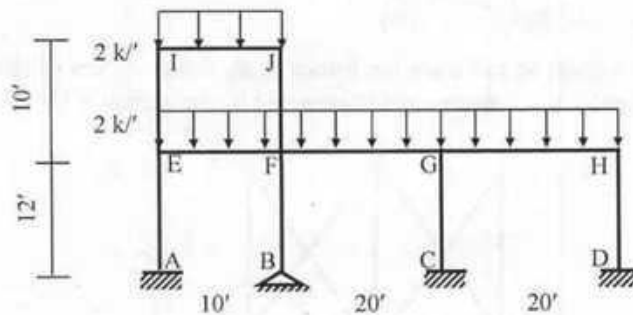
Course Code: CE 313  
 Full Marks : 100

(There are 14 questions. Answer **any 10**. Each question carries equal marks)

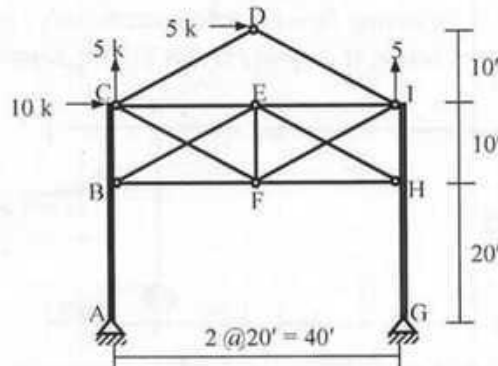
- For the frame loaded as shown below, calculate the value of  $P$  if the
  - Calculate the value of  $P$  if the maximum bending moment in column  $cg$  is  $75 \text{ kN-m}$
  - Draw Bending Moment Diagram (BMD) of the beams



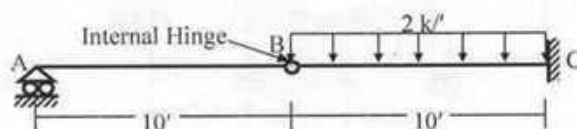
- Analyze the two-storied frame structure loaded as shown below using the approximate location of hinges to draw the bending moment diagrams of the beams and columns.



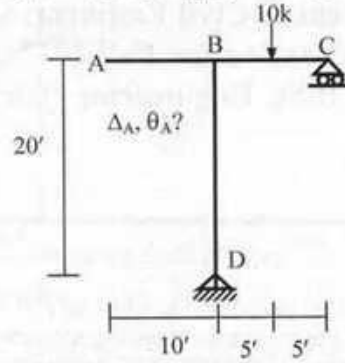
- In the structure shown below,
  - Use the Portal Method to calculate the reactions at support A, G and draw the BMD of ABC.
  - Calculate the forces in members CD, BE, CF, assuming diagonal members to take tension only.



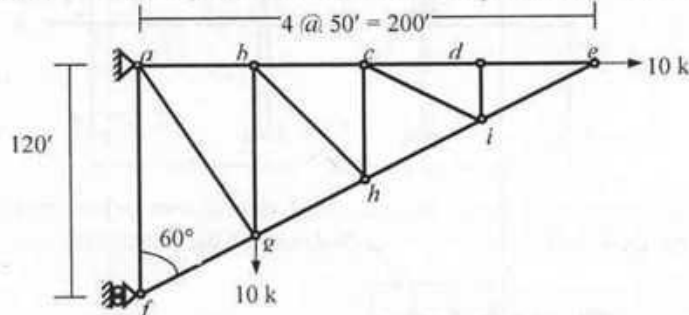
- Use the Unit Load Method (considering flexural deformation only) to calculate the vertical deflection at B of the beam shown below [Given:  $EI = 40 \times 10^3 \text{ k-ft}^2$ ,  $GA^* = 200 \times 10^3 \text{ k}$ ].



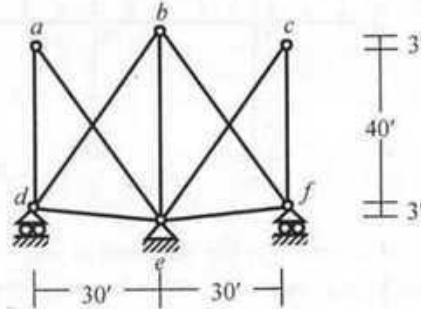
5. Use the Method of Virtual Work to calculate the vertical deflection at A ( $\Delta_{A,v}$ ).  
 [Given  $EA = 400 \times 10^3$  k,  $GA^* = 125 \times 10^3$  k,  $EI = 40 \times 10^3$  k-ft<sup>2</sup>].



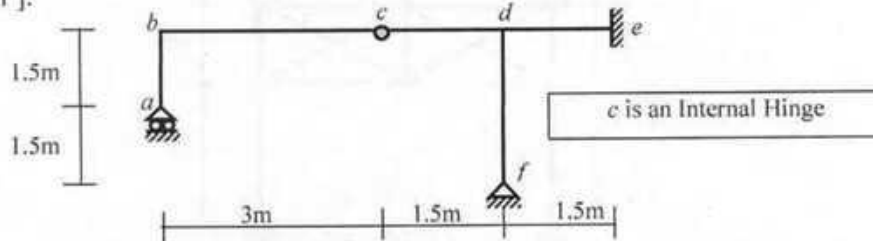
6. Use the Method of Virtual Work to calculate the vertical deflection at joint *f* in the truss shown below, for (i) the applied loads, (ii) a temperature drop of 20°F in the cord *af*.  
 [Given:  $EA/L = \text{constant} = 500$  k/ft, Coefficient of thermal expansion  $\alpha = 5.5 \times 10^{-6}/^\circ\text{F}$ ].



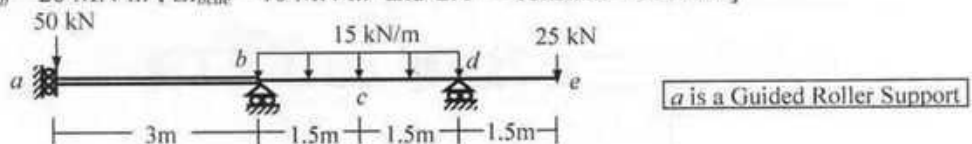
7. Use the Flexibility Method to calculate the forces in all the members of the truss *abcdef* shown below, if support *e* settles 0.05' downward [Given:  $EA/L = \text{constant} = 1000$  k/ft].



8. Use Flexibility Method (considering flexural deformations only) to draw the bending moment diagram of the frame shown below, if support *f* settles 15-mm downward [Given:  $EI = \text{constant} = 20$  MN-m<sup>2</sup>].



9. Use the Flexibility Method (considering flexural and shear deformations) to draw the bending moment diagram of the beam loaded as shown below  
 [Given:  $EI_{ab} = 20$  MN-m<sup>2</sup>,  $EI_{bcde} = 10$  MN-m<sup>2</sup> and  $GA^* = \text{constant} = 600$  MN]



10. (i) Calculate the degree of static indeterminacy (dosi) of the structures shown below.  
 (ii) Draw the qualitative influence line for  $M_A$  for the frame shown below.

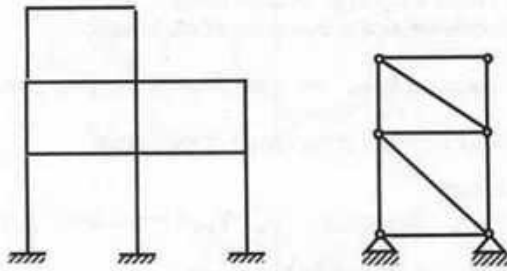


Figure for question 10. (i)

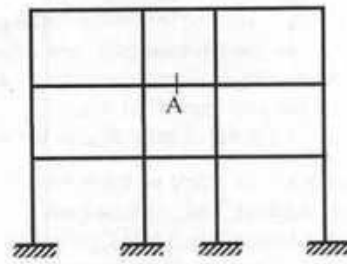
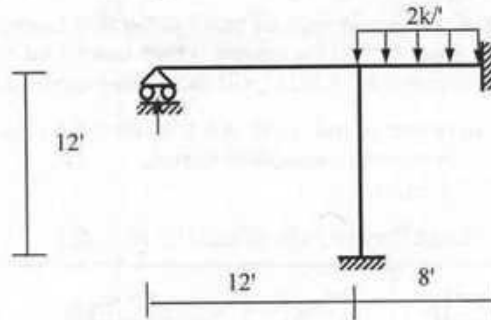
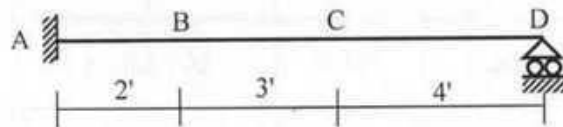


Figure for question 10. (ii)

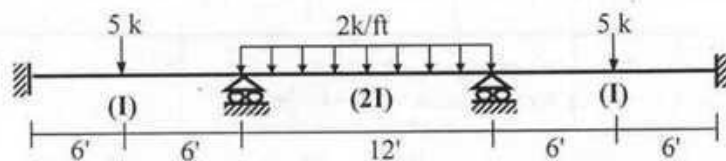
11. Draw the BMD of the following frame using moment distribution method



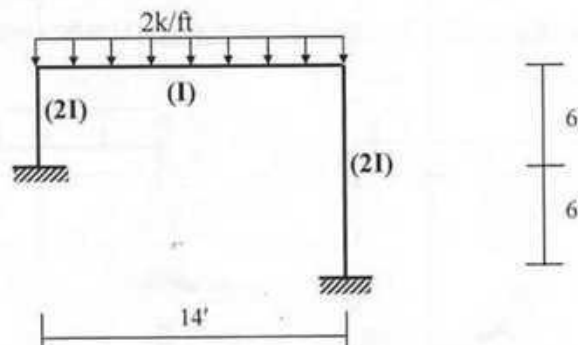
12. Draw the influence line for the vertical reaction at A and D. Also determine the quantitative value of  $V_A$ ,  $V_B$  &  $M_C$ . Given:  $EI$  constant.



13. Use moment distribution method to draw the SFD and BMD of the following beam.



14. Calculate joint moments and draw BMD for the following frame using moment distribution method.



### List of Useful Formulae for CE 313

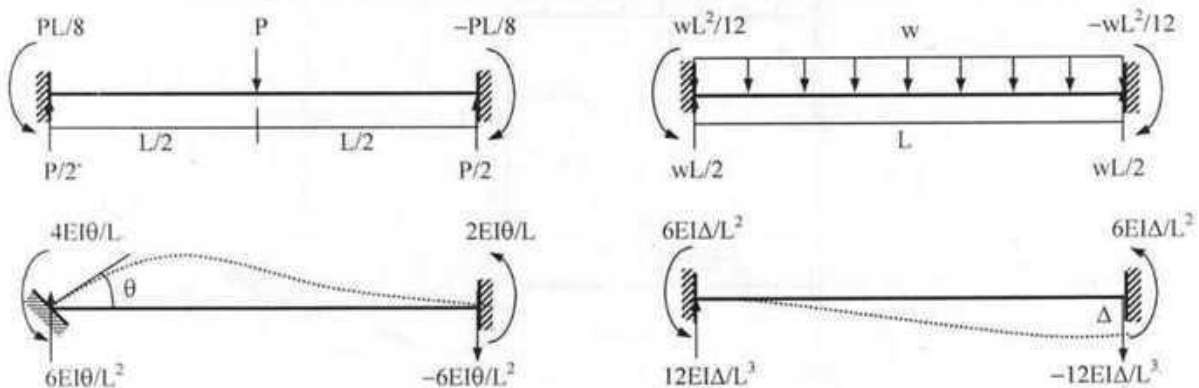
- \* Portal Method for multi-storied frames assumes
  - The shear force in an interior column is twice the shear force in an exterior column.
  - There is a point of inflection at the center of each column, and at the center of each beam.
- \* Cantilever Method is based on three assumptions
  - The axial force in each column of a story is proportional to its horizontal distance from the center of gravity of all the columns of the story.
  - There is a point of inflection at the center of each column, and at the center of each beam.
- \* Vertical Analysis based on approximate location of hinges
  - $M_{(+)} = 0.08 wL^2$ ,  $M_{(-)} = 0.045 wL^2$ ,  $V_{(+)} = wL/2$ , and  $V_{(-)} = -wL/2$
- \* Vertical Analysis using ACI Coefficients
  - $M_{(+)}$  (i) For end spans, if discontinuous end is (a) unrestrained =  $wL^2/11$ , (b) restrained =  $wL^2/14$
  - (ii) For interior spans =  $wL^2/16$
  - $M_{(-)}$  (i) At the exterior face of first interior supports for (a) Two spans =  $wL^2/9$ , (b) More spans =  $wL^2/10$
  - (ii) At the other faces of interior supports =  $wL^2/11$
  - (iii) For spans not exceeding 10', of where columns are much stiffer than beams =  $wL^2/12$
  - (iv) At the interior faces of exterior supports, if the support is (a) a beam =  $wL^2/24$ , (b) a column =  $wL^2/16$
  - V (i) In end members at first interior support =  $\pm 1.15wL/2$ , (ii) At all other supports =  $\pm wL/2$
- \* Deflection of truss due to load, temperature change and misfit,  $\Delta = \sum N_i dL = \sum N_i (N_0 L / EA + \alpha \Delta T L + \Delta L)$
- \* Deflection of beams/frames due to axial, shear and flexural deformation,
 
$$\Delta = \int (x_1 x_0 / EA) dS + \int (v_1 v_0 / GA^*) dS + \int (m_1 m_0 / EI) dS$$

#### Integration of Product of Functions ( $I = \int f_1 f_2 dS$ )

$f_2 \backslash f_1$					
	AaL	BaL/2	AaL/2	(A+B)aL/2	[A+4C+B]aL/6
	AbL/2	BbL/3	AbL/6	[A+2B]bL/6	[2C+B]bL/6
	AaL/2	BaL/6	AaL/3	[2A+B]aL/6	[A+2C]aL/6
	A(a+b)L/2	B(a+2b)L/6	A(2a+b)L/6	[A(2a+b)+B(a+2b)]L/6	[Aa+Bb+2C(a+b)]L/6

- \* dosi for 2D trusses =  $m + r - 2j$ , for 3D trusses =  $m + r - 3j$
- \* dosi for 2D frames =  $3m + r - h - 3j$ , for 3D frames =  $6m + r - 3h - 6j$
- \* Deflection of beams/frames due to axial, shear and flexural deformation,
 
$$\Delta_{ij} = \int (x_i x_j / EA) dS + \int (v_i v_j / GA^*) dS + \int (m_i m_j / EI) dS; \quad M = m_0 + F_1 m_1 + F_2 m_2 + \dots, \text{ etc.}$$
- \* Compatibility of deflection  $\Rightarrow \Delta_{i,0} + F_1 \Delta_{i,1} + F_2 \Delta_{i,2} + \dots + F_n \Delta_{i,n} = \Delta_i$ ; etc
- \* For member with fixed far end, Rotational stiffness =  $4EI/L$ , Carry over factor = 0.5
- \* For member with hinged/roller/discontinuous far end, Rotational stiffness =  $3EI/L$ , Carry over factor = 0
- \* The moment distribution factors of members OA, OB,..... are  $[K_{OA}/K_O]$ ,  $[K_{OB}/K_O]$ ,..... respectively

#### Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings



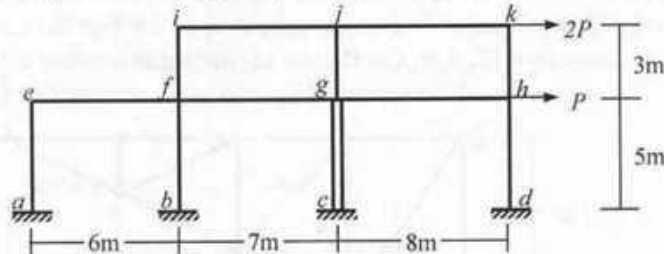
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title : Structural Engineering II  
 Time : 3 hour

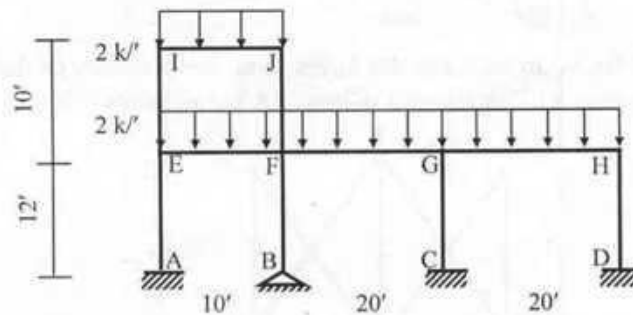
Course Code: CE 313  
 Full Marks : 100

(There are 14 questions. Answer any 10. Each question carries equal marks)

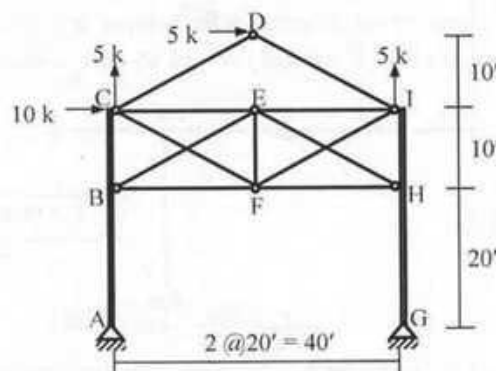
- For the frame loaded as shown below, calculate the value of  $P$  if the
  - Calculate the value of  $P$  if the maximum bending moment in column  $cg$  is  $75 \text{ kN-m}$
  - Draw Bending Moment Diagram (BMD) of the beams



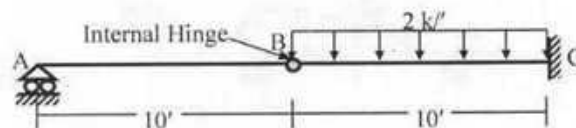
- Analyze the two-storied frame structure loaded as shown below using the approximate location of hinges to draw the bending moment diagrams of the beams and columns.



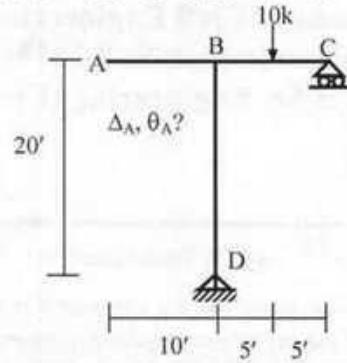
- In the structure shown below,
  - Use the Portal Method to calculate the reactions at support A, G and draw the BMD of ABC.
  - Calculate the forces in members CD, BE, CF, assuming diagonal members to take tension only.



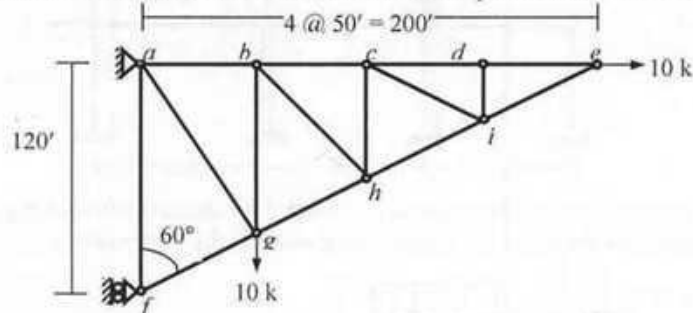
- Use the Unit Load Method (considering flexural and shear deformations) to calculate the vertical deflection at B of the beam shown below [Given:  $EI = 40 \times 10^3 \text{ k-ft}^2$ ,  $GA^* = 200 \times 10^3 \text{ k}$ ].



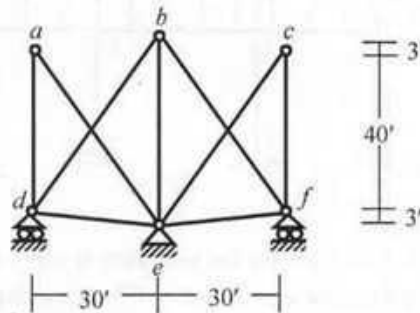
5. Use the Method of Virtual Work to calculate the vertical deflection at A ( $\Delta_{A,v}$ ).  
 [Given  $EA = 400 \times 10^3$  k,  $GA^* = 125 \times 10^3$  k,  $EI = 40 \times 10^3$  k-ft<sup>2</sup>].



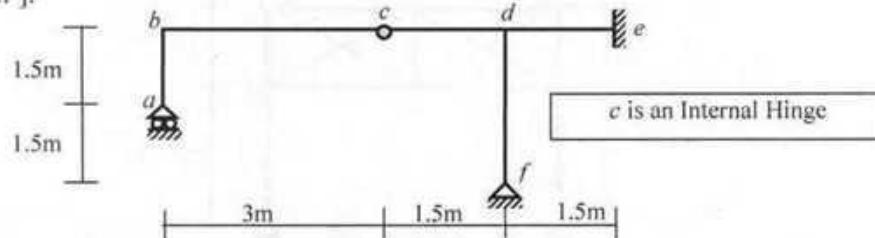
6. Use the Method of Virtual Work to calculate the vertical deflection at joint *f* in the truss shown below, for (i) the applied loads, (ii) a temperature drop of 20°F in the cord *af*.  
 [Given:  $EA/L = \text{constant} = 500$  k/ft, Coefficient of thermal expansion  $\alpha = 5.5 \times 10^{-6}/^\circ\text{F}$ ].



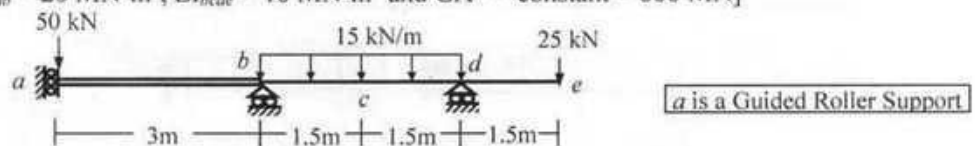
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9. Use the Flexibility Method (considering flexural and shear deformations) to draw the bending moment diagram of the beam loaded as shown below  
 [Given:  $EI_{ab} = 20$  MN-m<sup>2</sup>,  $EI_{bcde} = 10$  MN-m<sup>2</sup> and  $GA^* = \text{constant} = 600$  MN]



10. (i) Calculate the degree of static indeterminacy (dosi) of the structures shown below.  
 (ii) Draw the qualitative influence line for  $M_A$  for the frame shown below.

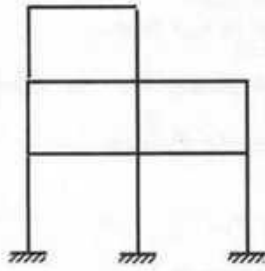


Figure for question 10. (i)

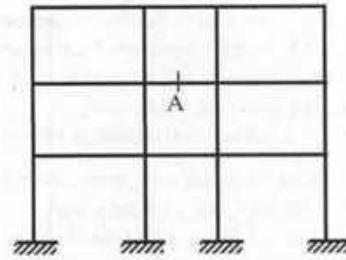
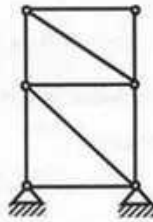
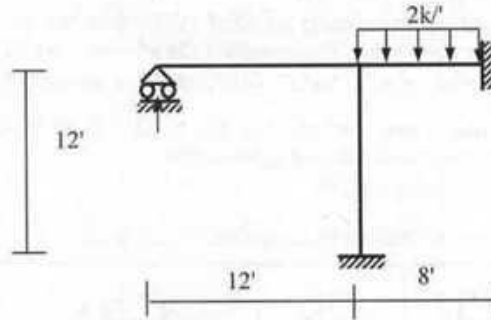
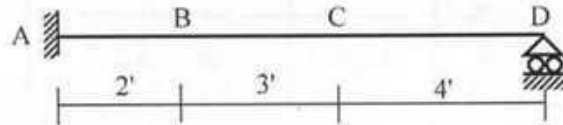


Figure for question 10. (ii)

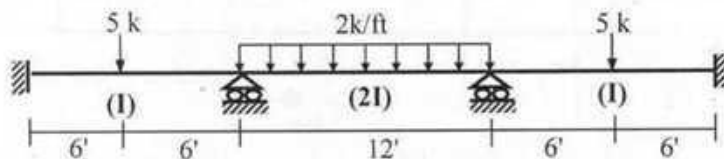
11. Draw the BMD of the following frame using moment distribution method



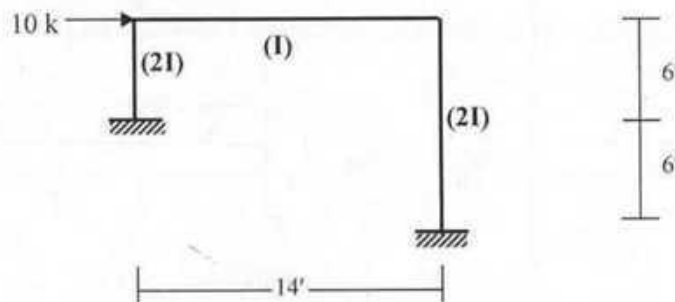
12. Draw the influence line for the vertical reaction at A and D. Also determine the quantitative value of  $V_A$ ,  $V_B$  &  $M_C$ . Given:  $EI$  constant.



13. Use moment distribution method to draw the SFD and BMD of the following beam.



14. Calculate joint moments and draw BMD for the following frame using moment distribution method.



### List of Useful Formulae for CE 313

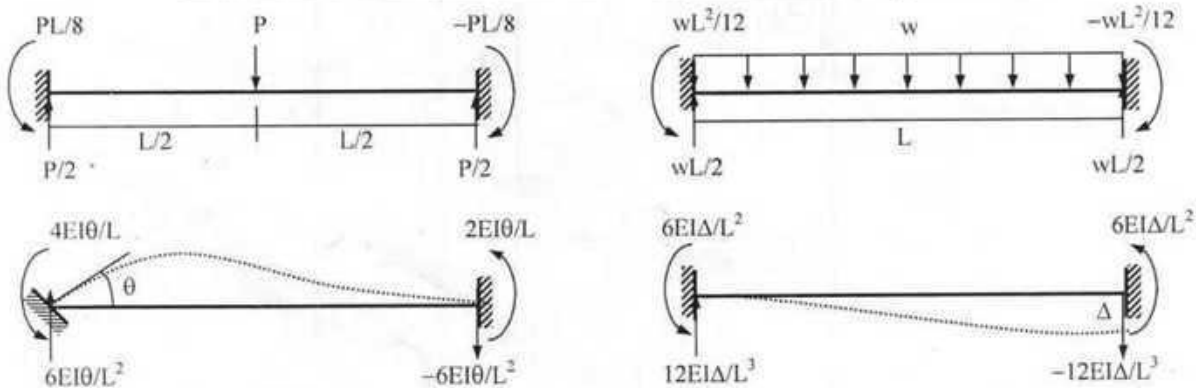
- \* Portal Method for multi-storied frames assumes
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  - The axial force in each column of a story is proportional to its horizontal distance from the center of gravity of all the columns of the story.
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- \* Vertical Analysis based on approximate location of hinges
  - $M_{(+)} = 0.08 wL^2$ ,  $M_{(-)} = 0.045 wL^2$ ,  $V_{(+)} = wL/2$ , and  $V_{(-)} = -wL/2$
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  - $M_{(-)}$  (i) At the exterior face of first interior supports for (a) Two spans =  $wL^2/9$ , (b) More spans =  $wL^2/10$
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  - $V$  (i) In end members at first interior support =  $\pm 1.15wL/2$ , (ii) At all other supports =  $\pm wL/2$
- \* Deflection of truss due to load, temperature change and misfit,  $\Delta = \sum N_1 dL = \sum N_1 (N_0 L/EA + \alpha \Delta T L + \Delta L)$
- \* Deflection of beams/frames due to axial, shear and flexural deformation,
 
$$\Delta = \int (x_1 x_0/EA) dS + \int (v_1 v_0/GA^*) dS + \int (m_1 m_0/EI) dS$$

#### Integration of Product of Functions ( $I = \int f_1 f_2 dS$ )

$f_2 \backslash f_1$					
	$AaL$	$BaL/2$	$AaL/2$	$(A+B)aL/2$	$[A+4C+B]aL/6$
	$AbL/2$	$BbL/3$	$AbL/6$	$[A+2B]bL/6$	$[2C+B]bL/6$
	$AaL/2$	$BaL/6$	$AaL/3$	$[2A+B]aL/6$	$[A+2C]aL/6$
	$A(a+b)L/2$	$B(a+2b)L/6$	$A(2a+b)L/6$	$[A(2a+b)+B(a+2b)]L/6$	$[Aa+Bb+2C(a+b)]L/6$

- \*  $dosi$  for 2D trusses =  $m + r - 2j$ , for 3D trusses =  $m + r - 3j$
- \*  $dosi$  for 2D frames =  $3m + r - h - 3j$ , for 3D frames =  $6m + r - 3h - 6j$
- \* Deflection of beams/frames due to axial, shear and flexural deformation,
 
$$\Delta_{i,j} = \int (x_1 x_j/EA) dS + \int (v_1 v_j/GA^*) dS + \int (m_1 m_j/EI) dS; \quad M = m_0 + F_1 m_1 + F_2 m_2 + \dots, \text{ etc.}$$
- \* Compatibility of deflection  $\Rightarrow \Delta_{i,0} + F_1 \Delta_{i,1} + F_2 \Delta_{i,2} + \dots + F_n \Delta_{i,n} = \Delta_i$ ; etc
- \* For member with fixed far end, Rotational stiffness =  $4EI/L$ , Carry over factor = 0.5
- \* For member with hinged/roller/discontinuous far end, Rotational stiffness =  $3EI/L$ , Carry over factor = 0
- \* The moment distribution factors of members OA, OB,..... are  $[K_{OA}/K_O]$ ,  $[K_{OB}/K_O]$ ,.....respectively

#### Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings



**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

Section B

Course Title: Design of Concrete Structures I  
Time: 3 hours

Credit Hours: 3.0

Course Code: CE 315  
Full Marks: 100

**Part A**

[Answer any 03 (three) of the following 4 questions]

**Full Marks: 30 [=3×(5+5)]**

1. (i) What is a 'transformed' RC section? Explain with reference to cracked and uncracked section.  
(ii) What is Whitney's stress block? Explain why it is used in USD.
2. (i) What is the balanced steel ratio ( $\rho_b$ )? Derive the expression for balanced steel ratio in a beam in USD.  
Why does the ACI recommend a maximum steel ratio less than  $\rho_b$ ?  
(ii) Explain the effects of Web Reinforcement on the shear resistance of RC beams.
3. (i) Explain the terms Web-Shear Crack and Flexure-Shear Crack.  
Also explain why the Web-Shear Stress is greater than Flexure-Shear Stress.  
(ii) What is temperature and shrinkage reinforcement? Explain why it is provided in RC slabs.  
Narrate the ACI code provisions for temperature and shrinkage reinforcement in slabs.
4. (i) With the help of sketches, briefly discuss the bar cutoff requirement of ACI Code.  
(ii) Explain why the development length of compression bars is smaller than that of tension bars.

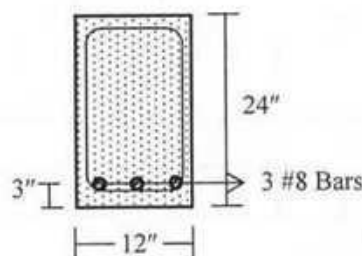
**Part B**

(Answer any 7 (seven) of the following 10 questions)

Full Marks: 70 [=7×10]

[Given:  $f_c = 3$  ksi,  $f_y = 50$  ksi,  $f_s = 20$  ksi for all questions]

5. Calculate the moment capacity of the beam section shown in Fig.1
  - i) for uncracked section
  - ii) for cracked section.



**Fig. 1**

6. Use the BMD of a two span continuous beam (Fig.2) to  
 i) calculate the total load ( $w_u$ ) for Section B (Fig. 3) to reach its ultimate moment capacity, and  
 ii) compare it with  $w_u$  ignoring compression bars (i.e., assuming Section B is singly reinforced).

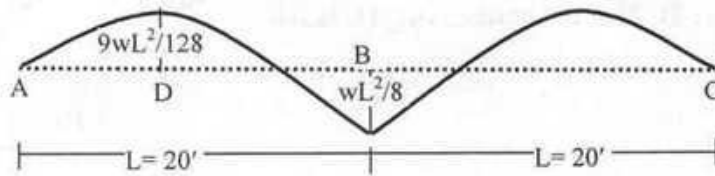


Fig. 2

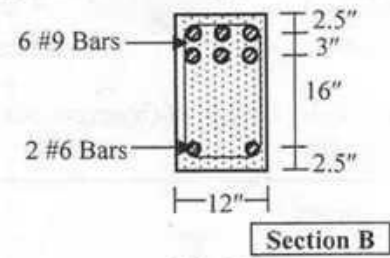


Fig. 3

7. Use WSD to design (with neat sketches) rectangular section ( $b=12''$ ,  $h=24''$ ) at D if  $w=5$  k/ft is applied on the beam shown in Fig.2 of Question 6.
8. Determine ultimate design moment for the "L" beam (marked A) as shown in Fig.4 and determine the allowable live load on the slab.  $FF=30$  psf, Random Wall Loads= $30$  psf. Use USD method.

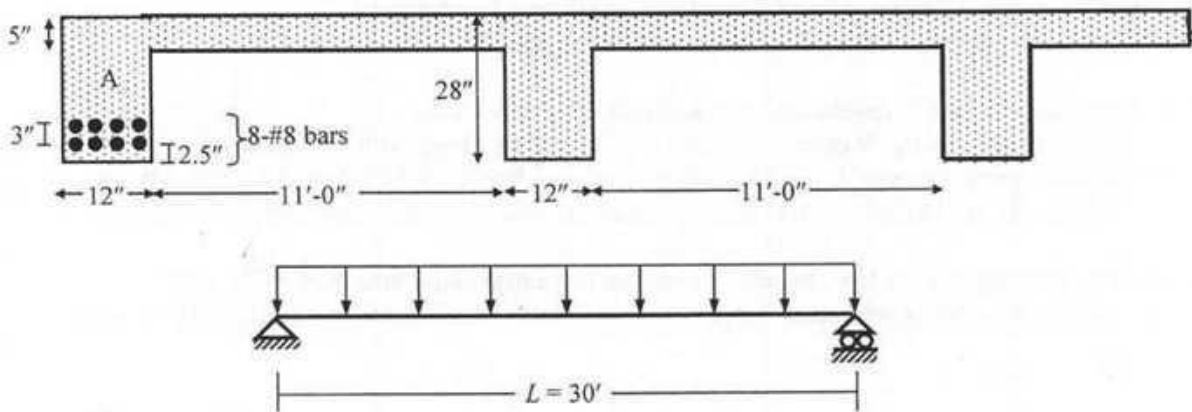


Fig. 4

9. A floor slab 4 inch thick is supported by reinforced concrete beams, 11' c/c, which together with slab acts as T-beams (see Fig.5). The slab supports a service live load of 150 psf and a superimposed dead load of 50 psf. The supporting beams have span of 25' (simply supported). Design the beam 'B' (with sketch) using WSD method.

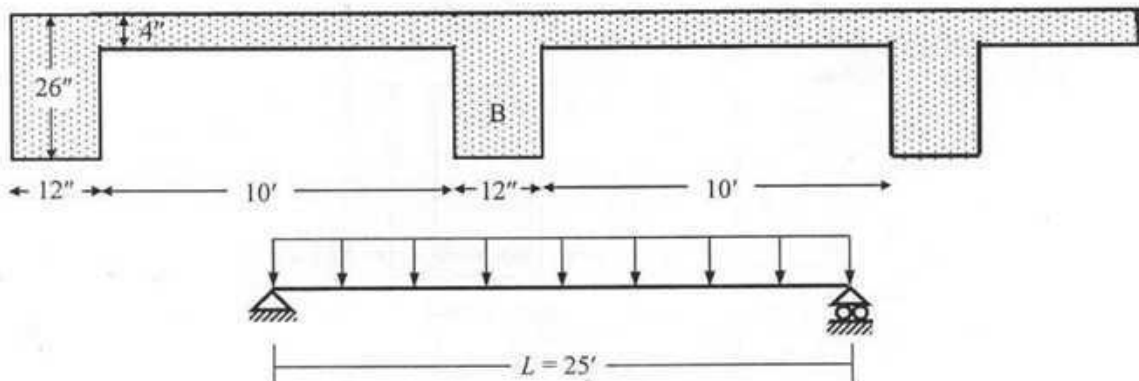


Fig. 5

10. Using WSD method, determine the shear reinforcement and stirrup layout for the beam shown in Fig. 6 and 7.

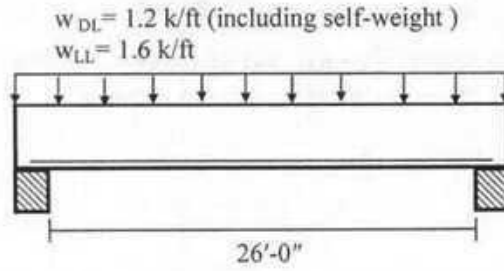


Fig.6

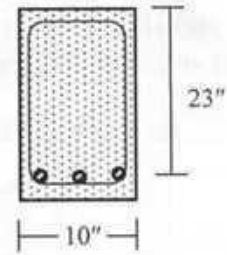


Fig.7

11. Refer to the beam of Fig. 8, use USD method to
- calculate the intensity of uniformly distributed load that can be applied on the beam,
  - calculate the point where the centre bar of the beam can be terminated, and
  - check whether adequate embedment length is provided for continued and discontinued rebars.

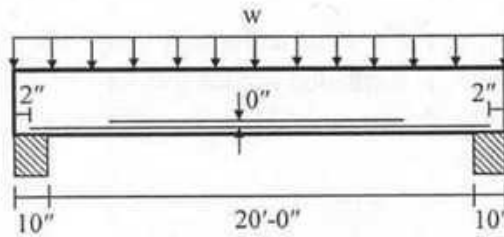
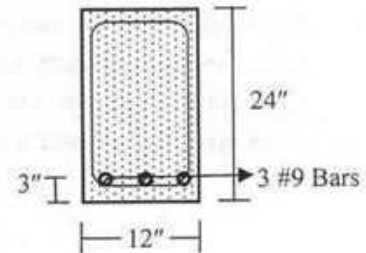


Fig. 8



- 12.(a) In reference to Question 11, check the shear at cut-off point in accordance with ACI code and redesign the stirrup spacing if necessary [Given: Stirrup provided at cut-off point is #3, 2L @7" c/c].
- (b) If # 6 bars are to be spliced to # 7 bars, and if the bars are confined by a closely spaced spiral (Fig. 9), what is the minimum required lap length ( $l_{splice}$ ) for the splice? (Spirals are not shown in figure and assume the column is subjected to a compressive force).

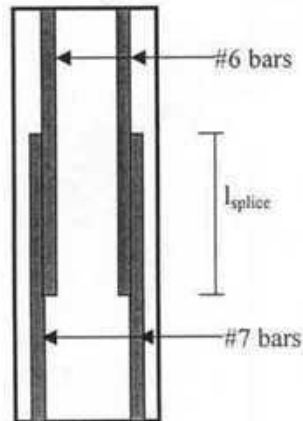


Fig.9

13. The tensile flexural reinforcement required in the cantilever beam shown in Fig.10 is  $A_s = 2.80 \text{ in}^2$ , which is provided by 3 #9 bars (for  $d = 18''$ ), while #3 transverse reinforcements with 1.5" cover are provided starting at 4" from column face, with 3 @ 8" c/c and 5 @ 10" c/c.

Check if the #9 bar (shown in figure below) are provided adequate  
 (a) development length in the beam, (b) embedment within the column.

If hooks are required specify detailed dimensions.

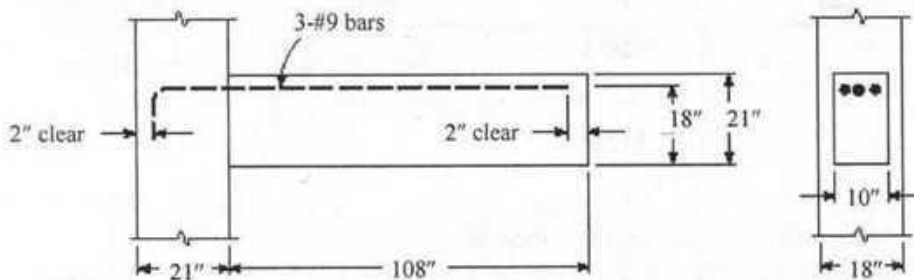


Fig.10

14. Fig.11 shows a one way slab fixed at one end and simply supported at the other end. The slab is to be designed to carry a uniformly distributed service live load of 200 psf. The dead load due to floor finish is 50 psf. Design the slab using USD method. Show details of reinforcing steel both in the longitudinal and transverse directions.

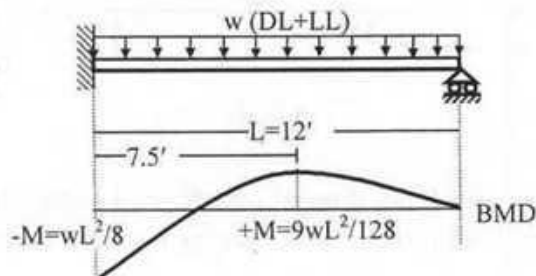


Fig. 11



### Shear Design

\*  $v_{crf} = 1.9\sqrt{f'_c}$  and  $v_{crv} = 3.5\sqrt{f'_c}$  (in psi)

\*  $v_{cr} = 1.9\sqrt{f'_c} + 2500\rho_s(Vd/M) \leq 3.5\sqrt{f'_c}$ , often approximated as  $v_{cr} = 2\sqrt{f'_c}$  [and =  $1.1\sqrt{f'_c}$  in WSD]

\*  $S = A_v f_v d / (V_{ext} - V_c) = A_v f_v / \{(v_{ext} - v_c) b\}$  for vertical stirrups, and

$S = A_v f_v d (\sin \alpha + \cos \alpha) / (V_{ext} - V_c) = A_v f_v (\sin \alpha + \cos \alpha) / \{(v_{ext} - v_c) b\}$  for inclined stirrups

#### Summary of ACI Shear Design Provisions (Vertical Stirrups)

	WSD	USD	Additional Provisions
Design Shear Force	$V_w$	$V_n = V_u/\phi$ [ $\phi = 0.85$ ]	Calculated at $d$ from Support face
Min <sup>m</sup> Section Depth	$V_w/5\sqrt{f'_c} b_w$	$V_u/10\sqrt{f'_c} b_w$	$f_y \leq 60$ ksi
Concrete Shear Strength $v_c$	$1.1\sqrt{f'_c}$	$1.9\sqrt{f'_c} + 2500\rho_s(Vd/M)$ OR $2\sqrt{f'_c}$	$\sqrt{f'_c} \leq 100$ psi $Vd/M \leq 1.0$
No Stirrup	$V_w \leq V_c/2$	$V_n \leq V_c/2$	
Max <sup>m</sup> Spacing	$d/2, 24" S = A_v f_y / 50 b_w$	$d/2, 24" S = A_v f_y / 50 b_w$	To be halved if $V_n \geq 6\sqrt{f'_c} b_w d$ OR $V_w \geq 3\sqrt{f'_c} b_w d$ in WSD

### Effect of Axial Force on Shear Strength

#### \* Axial Compression

$v_c = 1.9\sqrt{f'_c} + 2500\rho_s(V_u d / M_u)$ , except that a modified moment  $M_m = M_u - N_u(4h - d)/8$  is taken for  $M_u$

The upper limit of  $3.5\sqrt{f'_c}$  is replaced by  $v_c \leq 3.5\sqrt{f'_c} \sqrt{1 + N_u/500A_g}$

As an alternative  $v_c = 2\sqrt{f'_c} (1 + N_u/2000A_g)$

#### \* Axial Tension

$v_c = 2\sqrt{f'_c} (1 + N_u/500A_g)$ , but not less than zero ( $N_u$  is negative for tension). As an alternative  $v_c = 0$

### One-way Slab

\*  $l_{min} = L_n/20$  (Simply supported),  $L_n/24$  (One end continuous),  $L_n/28$  (Both end continuous),  $L_n/10$  (Cantilever)

[All these are to be multiplied by  $(0.4 + f_y/100)$ ]

\*  $A_{s, temp} = 0.0025 b t$

### Development Length

For tension bars without anchorage

\*  $L_d/d_b = (3/40) (f_y/\sqrt{f'_c}) (\alpha\beta\gamma\lambda) / \{(c + K_{tr})/d_b\}$  [where,  $\alpha = 1.0$  or  $1.3$ ,  $\lambda = 1.0$  or  $0.8$ ]

Table 1

Simplified tension development length in bar diameters according to the 1995		
ACI Code		
	No.6 and smaller bars deformed wires	No.7 and larger bars
Clear spacing of bars being developed or spliced $\geq d_s$ , $\geq d_s$ clear cover $\geq d_s$ and stirrups or ties throughout $l_d$ not less than the Code minimum.	$\frac{l_d}{d_b} = \frac{f_y \alpha \beta \lambda}{25 \sqrt{f'_c}}$	$\frac{l_d}{d_b} = \frac{f_y \alpha \beta \lambda}{20 \sqrt{f'_c}}$
Clear spacing of bars being developed or spliced $\geq 2 d_s$ and clear cover $\geq d_s$	Same as above	Same as above
Other cases	$\frac{l_d}{d_b} = \frac{3 f_y \alpha \beta \lambda}{50 \sqrt{f'_c}}$	$\frac{l_d}{d_b} = \frac{3 f_y \alpha \beta \lambda}{40 \sqrt{f'_c}}$

For tension bars with anchorage

\*  $L_d/d_b \geq 0.02 (\beta\lambda) (f_y/\sqrt{f'_c})$

For compression bars

\*  $L_d/d_b \geq 0.02 (f_y/\sqrt{f'_c})$  OR  $0.0003 f_y$

**Lap Splices**

For bars in tension

Lap Length =  $L_d$  [for Class A],

and =  $1.3 L_d$  [for Class B]

	Maximum percent of $A_s$ spliced within required lap length	
	50	100
$\frac{A_s \text{ provided}}{A_s \text{ required}}$		
Equal to or greater than 2	Class A	Class B
Less than 2	Class B	Class B

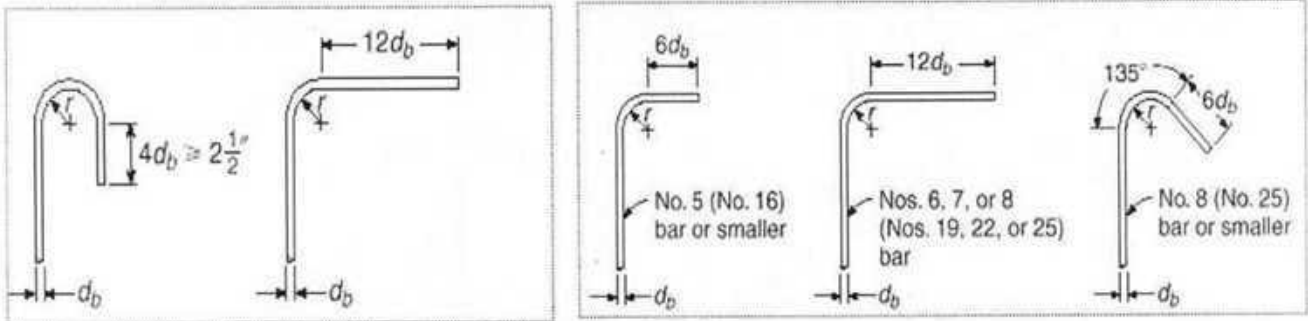
For bars in compression

Lap Length =  $0.5f_y d_b$  [ $f_y \leq 60$  ksi],

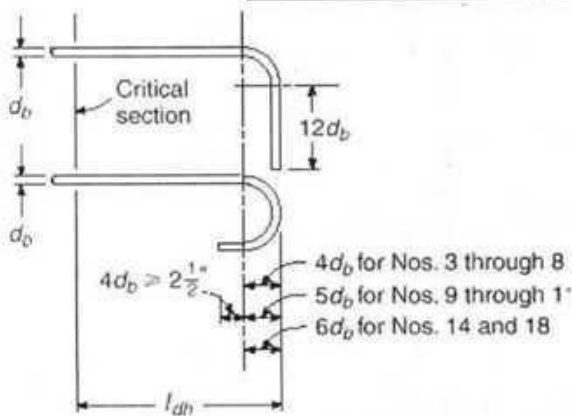
and =  $(0.9f_y - 24)d_b$  [ $f_y > 60$  ksi]

Reinforcement in a compression member confined with ties (effective area of ties $\geq 0.0015bs$ ; $b$ =column dimension in inch and $s$ =spacing of ties in inch)	$0.83l_d$
Reinforcement in a compression member confined with continuous spirals	$0.75l_d$

\* splice length in compression should not be less than 12 inch



Standard Bar Hooks: (a) Main Reinforcement, (b) Stirrups and Ties



Bar Details for development of Standard Hooks

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012 (Set 2)**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Design of Concrete Structures I  
 Time: 3 hours

Credit Hours: 3.0

Course Code: CE 315  
 Full Marks: 100 (= 10 × 10)

**PART A**

[Answer any 7 (seven) of the following 10 questions]

[Given:  $f'_c = 4$  ksi,  $f_y = 60$  ksi for all questions]

1. For the RC section shown in Fig. 1, calculate the

- (i) Allowable tensile force
- (ii) Positive and negative cracking moment.

2. For the RC section shown in Fig. 1, calculate the

- (i) Allowable compressive force
- (ii) Allowable positive and negative bending moment.

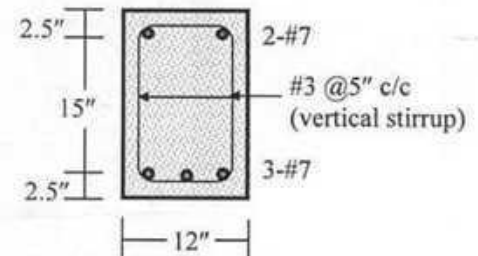


Fig. 1

3. Fig. 1 shows section  $c$  obtained by USD of the beam  $abcd$  loaded as shown in Fig. 2. Use BMD of the beam to

- (i) Calculate the corresponding live load  $F$  (neglecting beam self-weight).
- (ii) Design (by USD) section  $b$  of the beam for the load calculated in (i).
- (iii) Show the reinforcements in the longitudinal profile of the beam.

4. Fig. 1 shows section  $c$  obtained by WSD of the beam  $abcd$  loaded as shown in Fig. 2. Use SFD of the beam to

- (i) Calculate the corresponding live load  $F$  (neglecting beam self-weight) for the stirrup spacing shown in Fig. 2.
- (ii) Calculate (by WSD) the stirrup spacing at section  $a$  and  $b$  of the beam for the load calculated in (i).
- (iii) Show the shear reinforcements in the longitudinal profile of the beam.

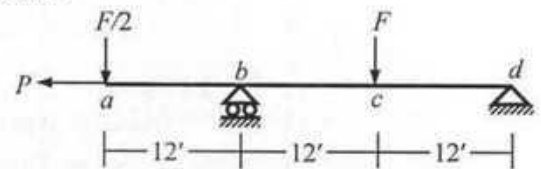


Fig. 2

5. Fig. 1 shows section  $c$  obtained by USD of beam  $abcd$  (shown in Fig. 2). Calculate (by USD) the

- (i) ACI Code prescribed shear force carrying capacity ( $V_c$ ) of the section without shear reinforcement (if the axial force  $P = 0$ ).
- (ii) Axial Force  $P$  required to make  $V_c = 0$ , and corresponding live load  $F$  (neglecting beam self-weight) for the stirrup spacing shown in Fig. 2.
- (iii) Stirrup spacing at section  $a$  and  $b$  of the beam for the load calculated in (iii), assuming  $V_c = 0$ .

6. For the simply supported beam shown in Fig. 3 (with the T-section shown), use USD to

- (i) Calculate the shear forces required to cause flexure-crack crack and web-shear crack of the section.
- (ii) Calculate the maximum shear force the section can possibly take with shear reinforcement, as well as the corresponding value of live load  $F$ .
- (iii) Design (with neat sketch) 45° inclined stirrups for the beam subjected to loads calculated in (ii).

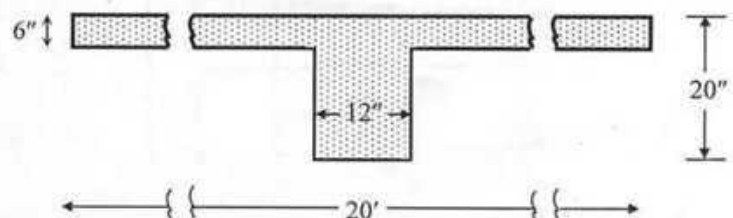
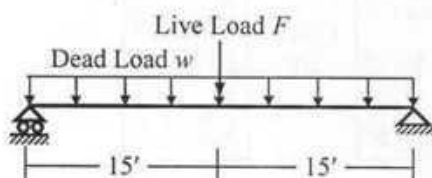


Fig. 3

7. Fig. 4 shows the plan view of a slab-beam system. Use the USD to calculate the
- Maximum steel area ( $A_s$ ) required for Beam B to behave like a rectangular beam (i.e.,  $c = t$ ) and the corresponding ultimate distributed load ( $w_{ul}$ ) on it.
  - Required steel area in Beam B if the distributed load ( $w_u$ ) on it is 1.5 times the distributed load ( $w_{ul}$ ) calculated in (i) (i.e.,  $w_u = 1.5w_{ul}$ ).

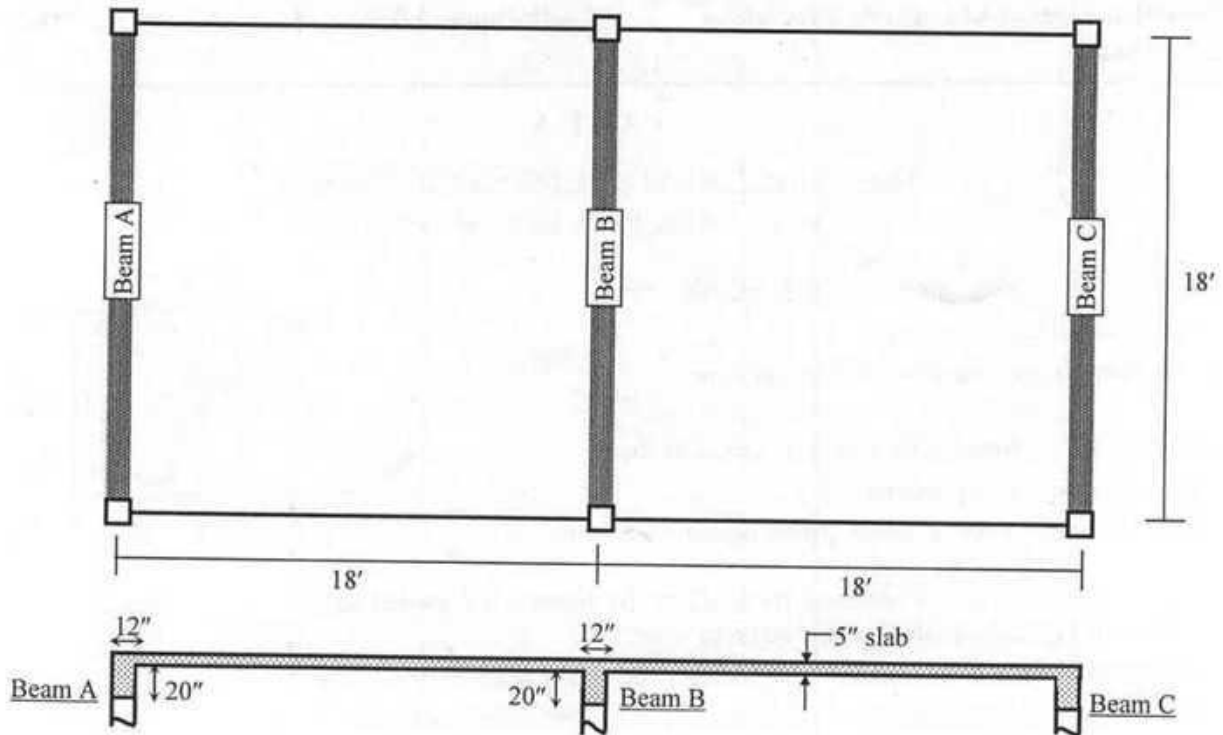


Fig. 4

8. Fig. 4 shows the floor plan of a 5"-thick RC slab. In addition to the slab self-weight, floor loads also include working floor finish = 30 psf and random wall = 60 psf.
- Calculate the allowable bending moment (using WSD) for this slab thickness and the corresponding allowable live load (LL) on the slab.
  - Design the slab (with neat sketch of section) for the given and calculated loads  
[Given: ACI moment coefficients ( $-1/24, +1/14, -1/9$ ) at (exterior support, midspan, interior support)].

9. Fig. 5 shows the side elevation of a RC wall supporting 12' high water.

- Design the wall (by USD) for bending moment
  - Check the wall designed in (i) for shear force
  - Show the wall reinforcements with neat sketch
- [Given: Unit weight of water =  $62.5 \text{ lb/ft}^3$ ].

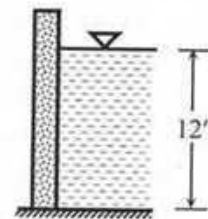


Fig. 5

10. For the cantilever beam  $ab$  shown in Fig. 6, use the WSD to

- Calculate the distance from the end  $b$  where 2 top bars can be cut off (as shown in section  $a$ )
- Check the development length of the beam bars within the 20"-column supporting the beam.

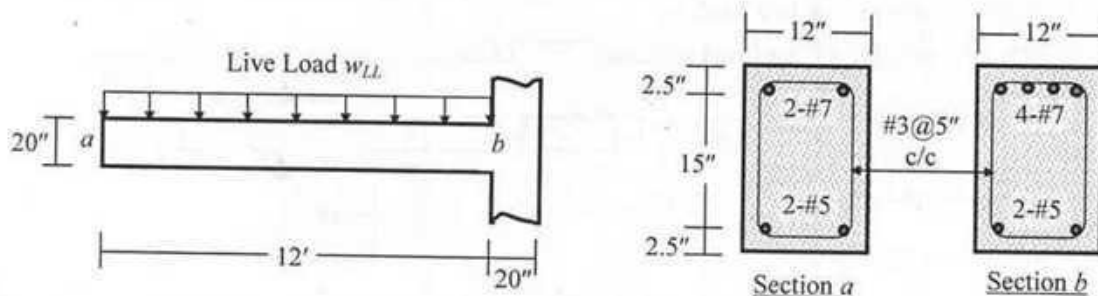


Fig. 6

## PART B

[Answer any 3 (three) of the following 4 questions]

11. (i) What is the balanced stress steel ratio and minimum steel ratio used in RC beam design? Explain why they are used.  
(ii) Show the variations of stress and strain over an RC section as it is stressed gradually from uncracked to cracked and ultimate failure condition.
12. (i) What is balanced steel ratio ( $\rho_b$ )? Why does ACI recommend a maximum steel ratio less than  $\rho_b$ ?  
(ii) Explain the differences between flexural stress distribution over T-beam and rectangular beam (and their effects on design).
13. (i) Explain the effects of Web Reinforcement on the shear resistance of RC beams.  
(ii) Mention the distinctive features of the shear design of deep beams.
14. (i) Narrate the ACI code provisions for choosing the minimum thickness of one-way slabs. Explain why the required thickness of slabs increases with the yield strength of reinforcing steel.  
(ii) What are bar splices? Distinguish between lap splices in tension and compression.

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Design of Concrete Structures I

Course Code: CE 315

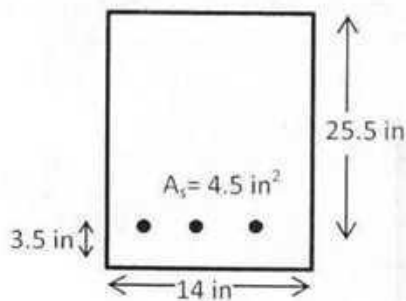
Time : 3 hours

Full Marks : 6x20=120

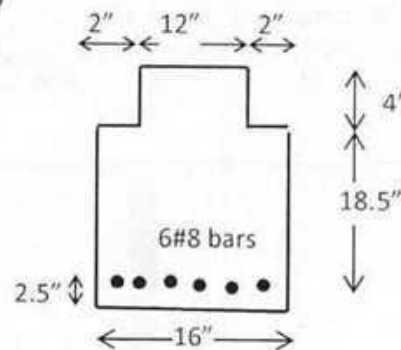
**Section A**

There are **Four** questions in the Section. Answer any **Three**. Numbers on the parenthesis indicates marks.

1. (a) For the beam cross-section in **Fig-1** determine whether failure of the beam will be initiated by crushing of concrete or yielding of steel. Also determine whether the cross-section satisfies ACI CODE requirement for steel ratio. Give  $f'_c = 7500$  psi,  $f_y = 60,000$  psi,  $A_s = 4.5$  in<sup>2</sup>. (10)
- (b) Calculate the working moment capacity of the beam shown in **Fig-2**. Given  $f'_c = 7000$  psi,  $f_y = 60,000$  psi and  $f_c = 2500$ psi. Assume  $n = 9$  (10)

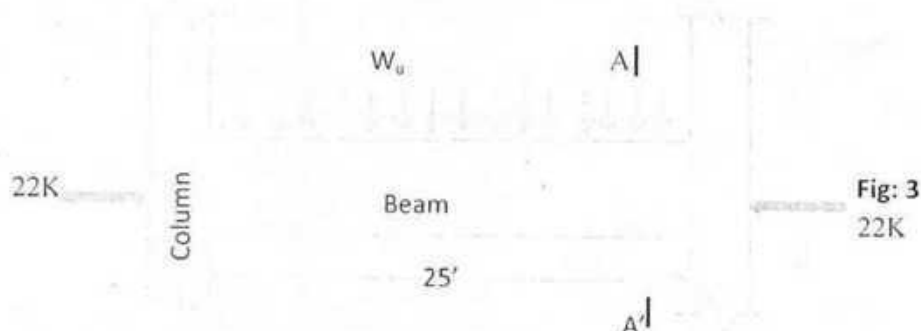


**Fig: 1**



**Fig: 2**

2. (a) Design a continuous T-beam with a length of 18' and spacing between beams is 8'. The beam must be designed to handle a positive moment of 200 k-ft and a negative moment of 300 k-ft, with maximum depth 24 in and slab thickness of 3 in. Use  $f'_c = 5000$  psi,  $f_y = 60$  ksi. (Hint: Check both DRB/SRB for negative moment and T for positive moment) (15)
- (b) What is balanced steel ratio ( $\rho_b$ )? Why does ACI suggest steel ratio lower than ( $\rho_b$ )? (5)
3. The uniformly distributed load on the beam is  $W_{DL} = 1$  k/ft (excluding self-wt.) and  $W_{LL} = 3$  k/ft. The beam has an  $f'_c = 4000$  psi,  $f_y = 60,000$  psi,  $b = 14$  in,  $d = 25.5$  in and concrete clear cover = 1.5 in and the strength of the shear reinforcement is  $f_{sv} = 40$  ksi. Determine the shear reinforcement for the beam shown in **Fig-3**. Draw the stirrup layout with no. of stirrups for the beam. (20)



**Fig: 3**  
22K

4. (a) Write down the equations minimum thickness of one-way slab for different end conditions specified by the ACI. (3)
- (b) Discuss why and how temperature and shrinkage reinforcement is provided in one-way slabs. What are the ACI recommended values for such steel? (5)
- (c) Calculate the steel area using WSD method for resisting the moment developed in the beam in Fig-3 at section A-A'. The moment equation for A-A section is  $-0.09wL^2$ . Given  $n = 9$ ,  $f_s = 24\text{ksi}$ . Show the section with proper sketch. (12)

### Section B

There are **Four** questions in the Section. Answer any **Three**.

5. For the one way slab in Fig-4 the load distribution zone is represented. The slab will be designed for a Hall-room with Live Load 100 psf. The slab is built integrally with its supports (beam). Given  $f'_c = 4000$  psi,  $f_y = 60,000$  psi. Design the slab using USD, following the provision of the ACI code. Provide necessary detailing and cut-off lengths with proper sketch. Assume reasonable values for any missing data. (Use ACI moment factors). (20)
6. (a) What is the basic design difference between one-way and two-way slab? (4)
- (b) For the Fig-4 the load distribution caring zones of the three beams are given. Design the internal beam (B-B') at near support for flexure. The beams are all column supported with end moment factor  $-0.095wL^2$ . Given  $f'_c = 4000$  psi,  $f_y = 60,000$  psi. Provide necessary detailing. (16)

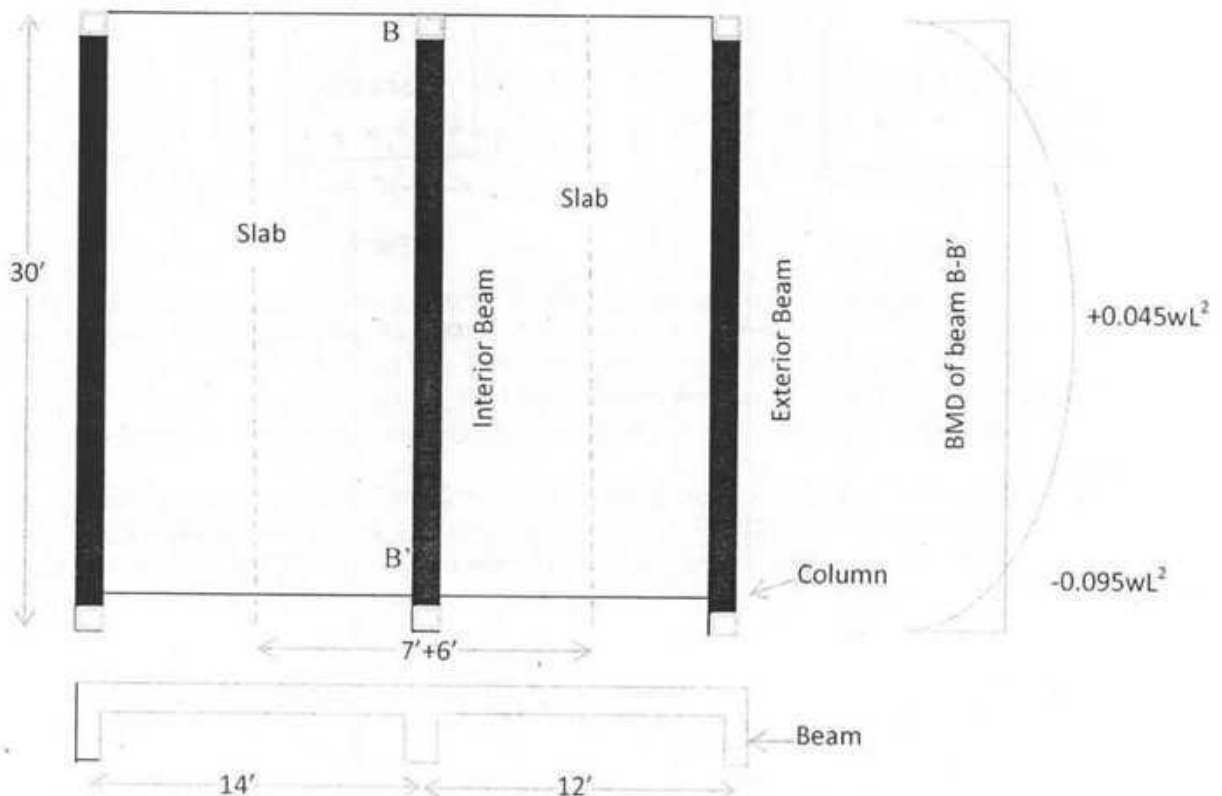


Fig: 4

7. Calculate the development length of 22mm uncoated top bars in USD as in Fig-5. The 20' beam is furnished with six 22 mm bars for negative flexure for which  $3.36 \text{ in}^2$  is adequate. Beam dimensions are given in Fig-5. #3 stirrups are used in the beam @ 4" c/c throughout the length of the beam. The concrete is light weighted. Side clear cover is 1.5" and bottom clear cover is 3". Given  $f'_c = 4000 \text{ psi}$ ,  $f_y = 60,000 \text{ psi}$ . Calculate
- Development length for the top most bars (10)
  - Development length for hooked bars in tension and column width to accommodate the development length in the column. (6)
  - Bar cut-off points and lengths. (4)

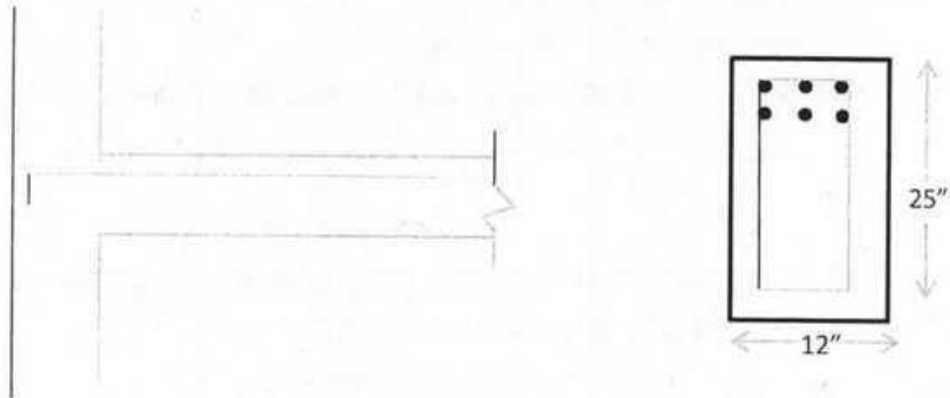


Fig: 5

8. A rectangular reinforced concrete beam has dimensions  $b = 12''$ ,  $d = 20''$ ,  $h = 23''$  and is reinforced with 3#9 bars. Material strengths are  $f'_c = 4000 \text{ psi}$ ,  $f_y = 60,000 \text{ psi}$  and  $f_r = 400 \text{ psi}$ .
- Calculate the moment that will produce the first cracking at the bottom surface of the beam. Also compute the stress at top and bottom concrete corresponding to this cracking moment. (7)
  - Determine the maximum moment that can be carried without stressing the concrete beyond  $0.45 f'_c$  or the steel beyond  $0.4 f_y$ . Also, compute the strains in steel and top concrete corresponding to this moment. (7)
  - Find the nominal flexural strength and design strength of this beam. (6)



## Shear Design

\*  $S = A_v f_y d / (V_{ext} - V_{cr}) = A_v f_y / \{(v_{ext} - v_c) b\}$  for vertical stirrups, and

$S = A_v f_y d (\sin \alpha + \cos \alpha) / (V_{ext} - V_c) = A_v f_y (\sin \alpha + \cos \alpha) / \{(v_{ext} - v_c) b\}$  for inclined stirrups

### Summary of ACI Shear Design Provisions (Vertical Stirrups)

	WSD	USD	Additional Provisions
Design Shear Force	$V_w$	$V_u = V_u / \phi$ [ $\phi = 0.75$ ]	Calculated at $d$ from Support face
Min <sup>m</sup> Section Depth	$V_w / 5\sqrt{f'_c} b_w$	$V_u / 8\sqrt{f'_c} b_w$	$f_y \leq 60$ ksi
Concrete Shear Strength $v_c$	$1.1\sqrt{f'_c}$	$1.9\sqrt{f'_c} + 2500\rho_s (Vd/M)$ OR $2\sqrt{f'_c}$	$\sqrt{f'_c} \leq 100$ psi $Vd/M \leq 1.0$
No Stirrup	$V_w \leq V_c/2$	$V_u \leq V_c/2$	
Max <sup>m</sup> Spacing	$d/2, 24" S = A_v f_y / 50b_w$	$d/2, 24" S = A_v f_y / 50b_w$	To be halved if $V_u \geq 4\sqrt{f'_c} b_w d$ OR $V_w \geq 2\sqrt{f'_c} b_w d$ in WSD

### Effect of Axial Force on Shear Strength

\* Axial Compression

$$v_c = 2\sqrt{f'_c} (1 + N_u / 2000A_g)$$

\* Axial Tension

$$v_c = 2\sqrt{f'_c} (1 + N_u / 500A_g), \text{ but not less than zero (} N_u \text{ is negative for tension). As an alternative } v_c = 0.$$

### Development Length

For tension bars without anchorage

$$* l_d / d_b = (3/40) (f_y / \sqrt{f'_c}) (\alpha \beta \gamma \lambda) / \{(c + K_{tr}) / d_b\} \text{ [where, } \alpha = 1.0 \text{ or } 1.3, \lambda = 1.0 \text{ or } 0.8]$$

For tension bars with anchorage

$$* l_d / d_b \geq 0.02 (\beta \lambda) (f_y / \sqrt{f'_c})$$

For compression bars

$$* l_d / d_b \geq 0.02 (f_y / \sqrt{f'_c}) \quad \text{OR} \quad 0.0003 f_y$$

### Lap Splices

For bars in tension      Lap Length =  $l_d$  [for Class A],      and =  $1.3 l_d$  [for Class B]

For bars in compression      Lap Length =  $0.5 f_y d_b$  [ $f_y \leq 60$  ksi],      and =  $(0.9 f_y - 24) d_b$  [ $f_y > 60$  ksi]

### ACI moment coefficients for one-way slab

At exterior face of interior support =  $-0.091 wL^2$

At interior face of exterior Support =  $-0.05 wL^2$

At mid span of the slab =  $+0.083 wL^2$

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

SET Z

Course Title: Design of Concrete Structures II  
 Time: 3 hours

Credit Hours: 3.0

Course Code: CE 317  
 Full Marks: 100

(Answer any 5 (Five) of the following 7 questions)

Full Marks: 100 [=5×20]

[Given:  $f'_c = 4$  ksi,  $f_y = 60$  ksi,  $f_s = 24$  ksi for all questions]

- 1.(a) Fig.1 shows a two way edge supported slab, whose middle strip mid span and support moment (unfactored) are given below. Calculate the required reinforcements and show them in a neat sketch. Show corner reinforcements also. Draw plan and sections showing the reinforcements. Use WSD method. [10]

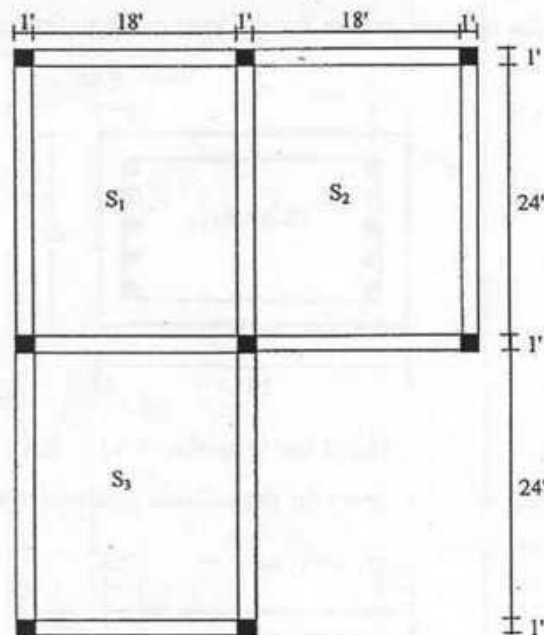


Fig. 1 for Question 1

Given: Slab thickness,  $t = 6''$

Unfactored moments are as follows:

Slab	Moment in short direction (k-ft/ft)		Moment in long direction (k-ft/ft)	
	At Mid span	At support	At Mid span	At support
S <sub>1</sub>	+2.88	-4.75	+1.56	-2.7
S <sub>2</sub>	+3.15	-5.5	+1.48	---
S <sub>3</sub>	+3.28	---	+2.25	-2.8

- 1.(b) Why does ACI recommend to design a rectangular slab supported on all sides as a one way slab if the side ratio of the slab spans is more than 2? Justify your answer with mathematical logic. [05]
- 1.(c) Why is special arrangement of reinforcement needed at the exterior corners of a two-way slab system? Discuss the possible special arrangements. [05]

- 2.(a) A section with the embedded reinforcements of an exterior column of a three storied building is shown in Fig.2. It was found that the column shall be subjected to either of the three combinations of DL, LL and W (all unfactored) as following, [06]

CASE I:	$P_{DL} = 250$ kips $M_{DL} = 60$ k-ft	$P_{LL} = 200$ kips $M_{LL} = 100$ k-ft	
CASE II:	$P_{DL} = 250$ kips $M_{DL} = 60$ k-ft	$P_{LL} = 200$ kips $M_{LL} = 100$ k-ft	$P_W = 50$ kips $M_W = 140$ k-ft
CASE III:	$P_{DL} = 250$ kips $M_{DL} = 60$ k-ft	$P_{LL} = 100$ kips $M_{LL} = 100$ k-ft	$P_W = 50$ kips $M_W = 140$ k-ft

All moments about Y-Y axis.

ACI code recommends load combination to be as follows,

(DL + LL)

OR  $0.75(DL+LL+W)$  and

Load factors to be: for DL= 1.4 and for LL and W=1.7

Check the adequacy of the column section for the load combinations using USD [Relevant charts or figures provided].

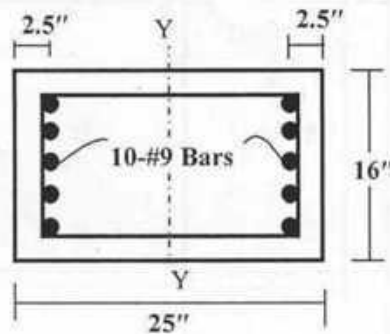


Fig. 2 for Question 2(a)

- (b) Use WSD to draw the interaction diagram for the column section shown in Fig.3. [06]

Given:  $e_b = 9.8''$ ,  $S_{ul} = 2600 \text{ in}^3$ .

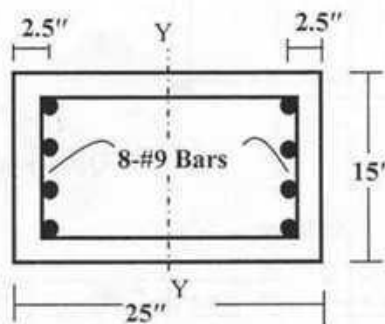


Fig. 3 for Question 2(b)

- (c) Discuss ACI code safety provisions for columns explaining different  $\phi$  and  $\alpha$  values under different conditions. What does the horizontal cut-off in the ACI design strength interaction diagram represent? [04]
- (d) Why are ties provided in columns? Write down the design procedures and rules for placing ties in tied column according to ACI. Make necessary sketches if necessary. [04]

- 3.(a) The plan and section of a rectangular footing is shown in Fig. 4. The 24"×24" column carries working load  $P_{DL} = 250$  kips,  $P_{LL} = 150$  kips. The total thickness of the footing is 30" which is adequate for shears. Calculate the reinforcements necessary for the footing and make a net sketch showing the details of reinforcement. Use USD method. [10]

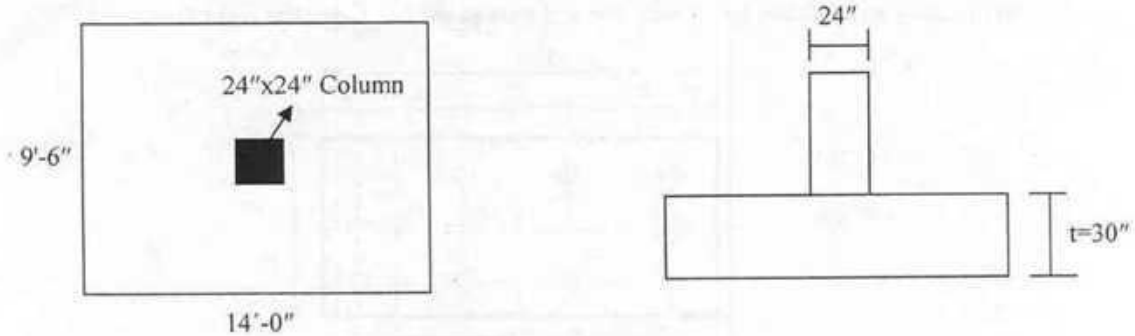


Fig. 4 for Question 3(a)

- (b) Design the dowels for load transfer from a 14"×14" column to a 13'×13' footing with a  $P_o = 750$  k. The column has 8#8 bars. [05]
- (c) For the flat plate structures, when punching resistance of slab-column connection is found inadequate, describe in brief what are the possible ways to increase the punching resistance? [05]
- 4.(a) A combined footing supporting two columns A and B (with working loads as given) is shown in Fig. 5. Effective depth of the footing is 30". Use USD method to [12]
- Check the adequacy against punching shear under column A and B.
  - Design the transverse beam under both the columns.
  - Show the designed reinforcements in a longitudinal section of the footing.

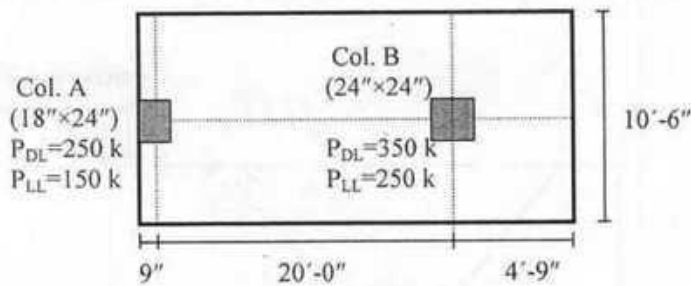


Fig. 5 for Question 4(a)

- 4.(b) The plan of a square footing is shown in Fig. 6. The factored net upward pressure is 3.5 ksf. Check the adequacy of the footing against punching shear, beam shear and moment. Use USD method. [08]

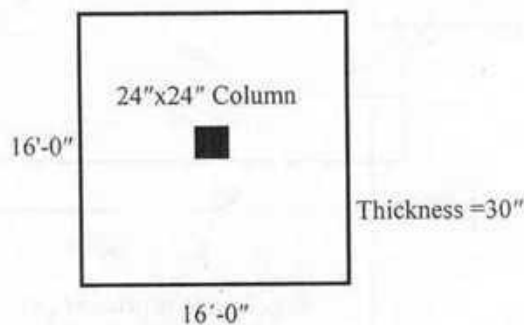


Fig. 6 for Question 4(b)

- 5.(a) The column in Fig. 7 is reinforced with 10-#9 bars distributed around the perimeter as shown. Load  $P_n$  will be applied with eccentricity  $e$  about the strong axis. Determine the load and moment corresponding to a failure point with neutral axis at  $c=18''$  from the right face. [10]

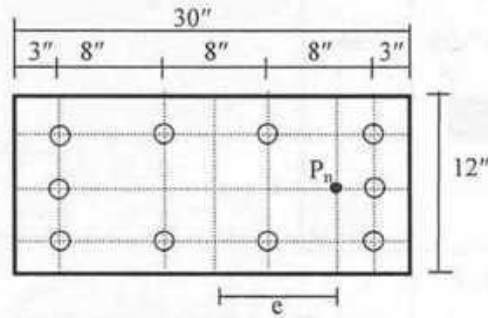


Fig. 7 for Question 5(a)

- (b) A column carries a working  $DL=350$  k and working  $LL=250$  k. Design the column by WSD using reasonable percentage of steel. [05]
- (c) Using the same percentages of reinforcement as in 5(b), design the column (by USD) for working loads in 5(b). [05]
- 6(a) A trial section of a gravity type retaining wall as shown in the Fig.8 was made to support the soil behind the wall and the surcharge on the ground surface. Check the external stability of the section against sliding and overturning. Also check the soil pressure under the base. [10]  
 Given: Unit weight of soil,  $\gamma_s=120$  pcf,  $\phi=30^\circ$ , Base friction coefficient,  $f_{base}=0.5$ , Allowable bearing pressure= 8 ksf.

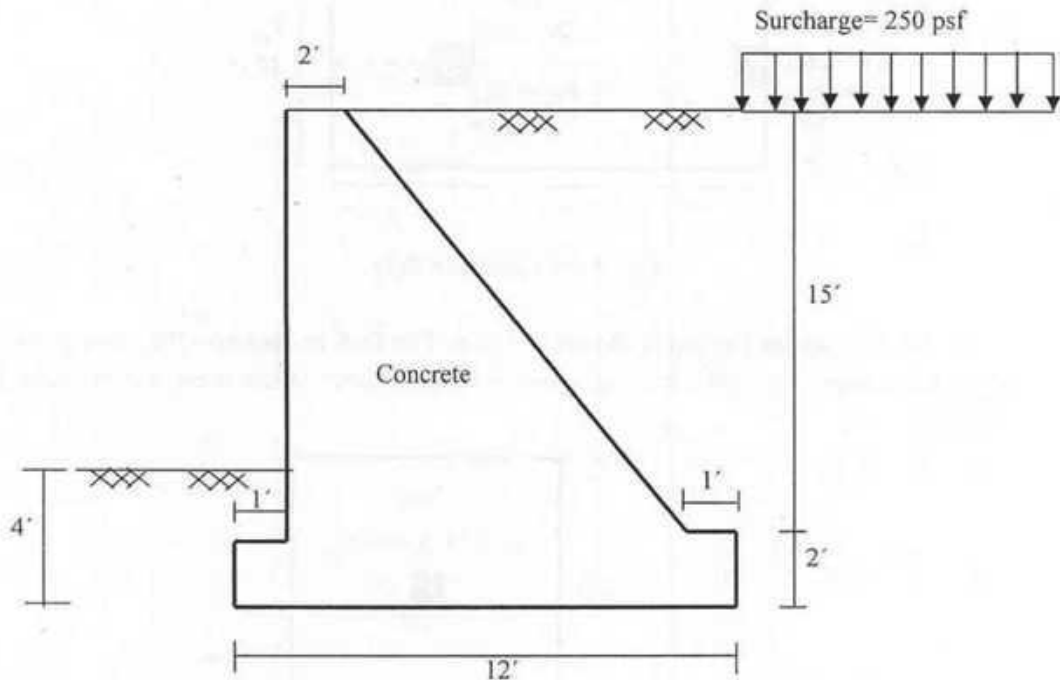


Fig. 8 for Question 6(a)

- (b) A cross section of a retaining wall is shown in Fig. 9. If the vertical component of the reaction is equal to 34k and acts at a distance 9.5 ft from the toe as shown, design the footing of the retaining wall, using WSD method. Given: Unit weight of soil,  $\gamma_s = 120$  pcf. [10]

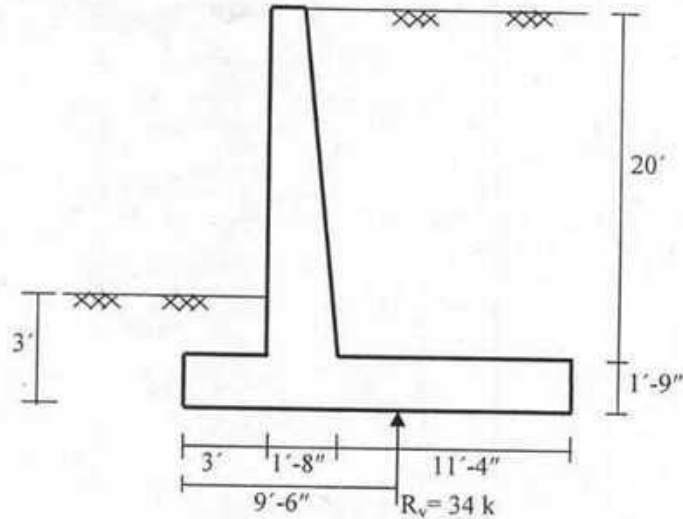


Fig. 9 for Question 6(b)

- 7.(a) What are the limitations in ACI code for using semi-empirical direct design method (DDM) to determine moments in two-way slabs? [05]
- (b) An office building is planned using a flat plate floor system with the column layout as shown in the Fig.10. No beams, drop panels or column capitals are permitted. The columns are 18 inch square and floor to floor height of the building is 12.0 ft. Other design conditions are given below: [15]

FF= 25 psf, Partition wall load= 40 psf and LL=80 psf.

Design an interior panel by USD, following the steps mentioned below:

- (i) Calculation for minimum slab thickness
- (ii) Check for punching shear- around interior column
- (iii) Calculation for design moments (in long direction only)
- (iv) Check for slab thickness- moment consideration
- (v) Calculation for flexural reinforcements (in long direction)
- (vi) Neat sketches for reinforcements ( in long direction only)

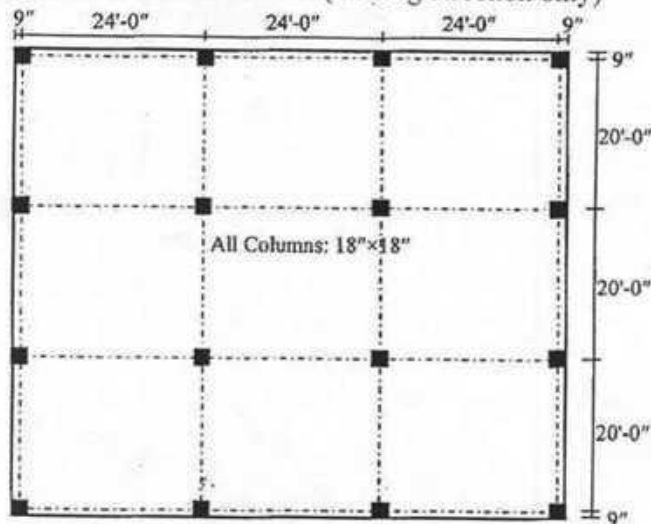


Fig. 10 for Question 7(b)

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012 (Set 2)**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Design of Concrete Structures II  
 Time: 3 hours

Credit Hours: 3.0

Course Code: CE 317  
 Full Marks: 100 (= 10 × 10)

**PART A**

[Answer any 7 (seven) of the following 10 questions]

[Given:  $f_c' = 3$  ksi,  $f_y = 50$  ksi for all questions except Question No. 10]

1. The floor plan in Fig. 1 includes a RC flat slab *FS* supported on 18"-diameter columns, with 5" thick brick walls along all column lines. Floor loads also include working FF = 25 psf, RW = 50 psf.

Use the USD to

- (i) Calculate the
  - (a) Required thickness of the slab *FS* from deflection considerations,
  - (b) Ultimate bending moment capacity for this slab thickness (using maximum steel ratio  $\rho_s = 0.25\rho_b$ ),
  - (c) Corresponding live load (LL) on the slab
- (ii) Check the slab for punching shear around the corner column  $C_3$  and calculate shear reinforcements (showing neat sketches of 45° bent stirrups).

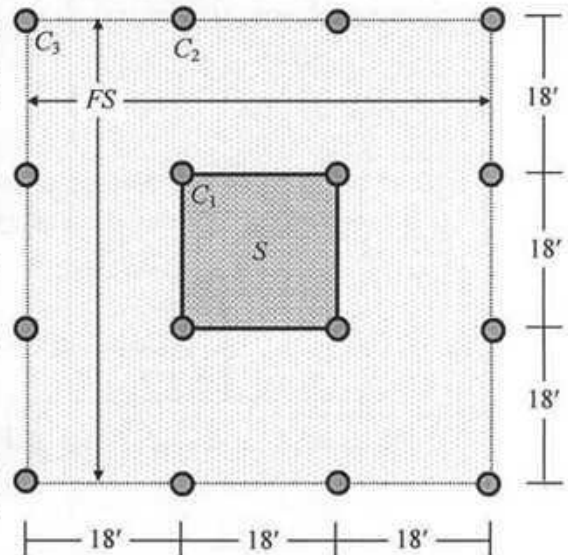


Fig. 1

[Given: Distribution Factors applied to Moment  $M_0$  for exterior slab are (0.00, +0.63, -0.75)].

2. Fig. 1 shows a floor plan consisting of the RC slab *S*, supported on 12" × 15" beams and 18"-diameter columns, with 5" thick brick walls along all column lines.

Floor loads also include working FF = 25 psf, RW = 50 psf.

Use the USD to

- (i) Calculate the
  - (a) Required thickness of the slab *S* from deflection considerations,
  - (b) Ultimate bending moment capacity for this slab thickness (using maximum  $\rho_s = 0.25\rho_b$ ), and
  - (c) Corresponding live load (LL) on the slab.
- (ii) Design the slab with neat sketches of reinforcements

[Given:  $C_{a(D)+} = C_{b(D)+} = 0.018$ ,  $C_{a(L)+} = C_{b(L)+} = 0.027$ ,  $C_{a-} = C_{b-} = 0.045$ ].

3. Fig. 1 shows the floor plan of a 6-storied RC structure, consisting of 5" thick slab *S* (supported on 12" × 15" beams), 6" thick flat-slab *FS* and 5" thick partition walls along all column lines.

Floor loads also include working FF = 25 psf, RW = 50 psf and LL = 40 psf.

Use the WSD

- (i) To design the circular column  $C_1$  (and its spiral reinforcements), if it is subjected to axial force only.
- (ii) Use the section  $C_1$  obtained in (i) to calculate the allowable equal biaxial moments  $M_x = M_y$  (about the *x*- and *y*-axes) on column  $C_3$ , in addition to axial force.

4. For the floor plan shown in Fig. 1 and described in Question 3, use the USD to

- (i) Design a circular column  $C_2$  (and its spiral reinforcements) only for the axial force it is subjected to.
  - (ii) Determine the size and thickness of a square footing supporting the column  $C_2$
- [Given: Allowable bearing capacity of the soil = 3 ksf].

5. Fig. 2 shows the axial force and bending moment on (12" × 12") column  $C_1$  and (18" × 18") column  $C_2$ .

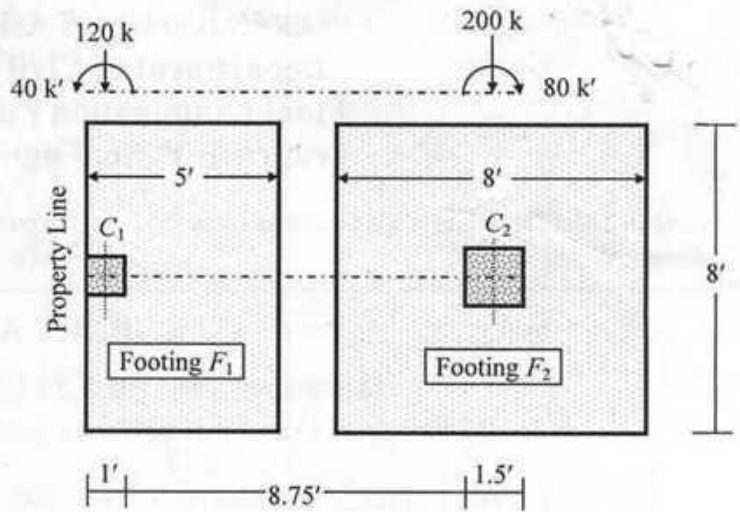


Fig. 2

Calculate the

- Maximum and minimum soil pressure under footing  $F_1$  (supporting  $C_1$ ) and footing  $F_2$  (supporting  $C_2$ )
- Required length, width and thickness (considering punching shear around  $C_2$  only for USD) of a combined footing supporting  $C_1$  and  $C_2$

[Given: Allowable bearing capacity of the soil = 3 ksf].

6. Figures below show two options of transferring a vertical load of  $P = 150$  kip, to the soil underneath; i.e., through a (5' × 10') wall footing [Fig. 3(a)] and a (5' × 10') column footing [Fig. 3(b)].

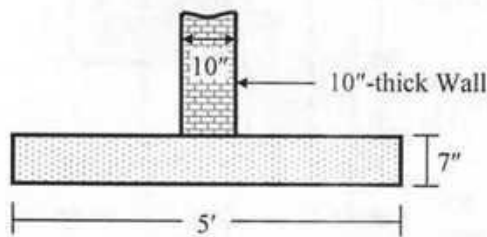


Fig. 3(a)

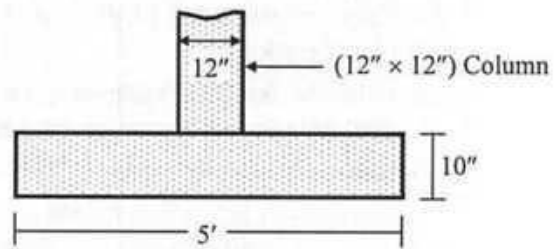


Fig. 3(b)

Use the WSD to calculate and show the reinforcements required (in both directions) for the

- 7"-thick wall footing, (ii) 10"-thick column footing.

7. For the cantilever type retaining wall shown below

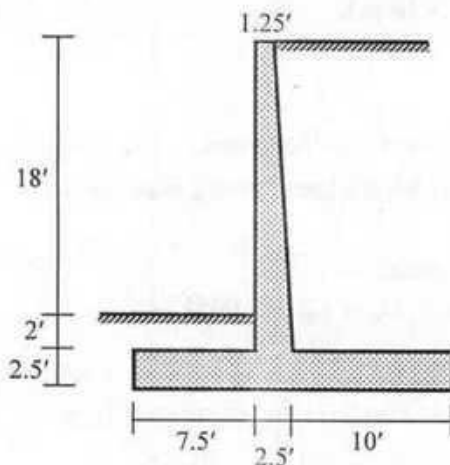


Fig. 4(a)

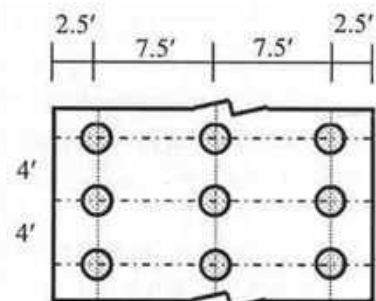


Fig. 4(b)

- Draw the pressure diagrams to be used for the heel and toe of the wall [shown in Fig. 4(a)].
- Use WSD to calculate the maximum force and corresponding length of the pile shown in the pile group arranged as in Fig. 4(b) below the foundation of the wall.

[Given: Unit weight of concrete = 150 lb/ft<sup>3</sup>, Unit weight of soil = 110 lb/ft<sup>3</sup>, Angle of friction ( $\phi$ ) for the soil = 30°, Allowable bearing capacity of the soil = 1.5 ksf].

- Use the USD to design the stem of the retaining wall shown in Fig. 4(a) [described in Question 7],
- Show the reinforcements calculated in (i) (as well as bar cut-off details) with neat sketches.

9. Calculate the factor of safety against sliding and overturning for the retaining wall shown in Fig. 5, if
- (i) Water table is at  $c$ , and surcharge  $w = 200$  psf is at  $a$ , or  $b$  [whichever is more critical]
  - (ii) Surcharge  $w = 0$ , and water table is at surface level  $b$  [There is no drainage facility]
- [Given: Unit weight of brick =  $120 \text{ lb/ft}^3$ , Unit weight of soil =  $110 \text{ lb/ft}^3$ , Angle of friction ( $\phi$ ) for the soil =  $30^\circ$ , Friction factor ( $f$ ) between soil and base of wall =  $0.5$ ].

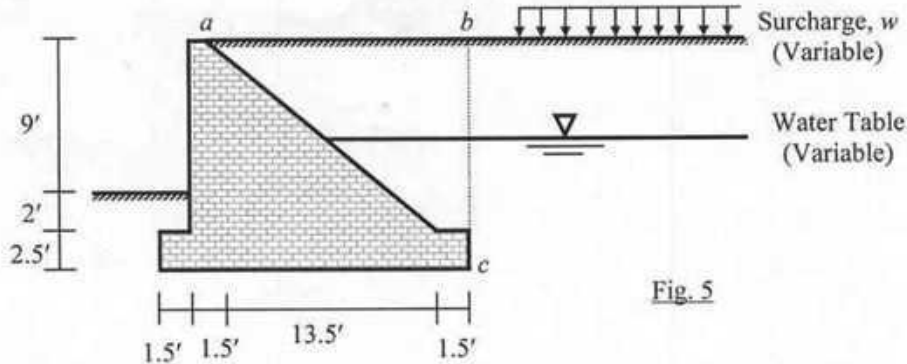


Fig. 5

10. Fig. 6 shows a simply-supported concrete beam subjected to pre-stressing force of 250 kips that reduces to 200 kips after losses. For both sections of the beam (i.e., Section 1 and Section 2),
- (i) Calculate the extreme fiber stresses at midspan of the beam at working condition (i.e., with effective prestress and beam self-weight)
  - (ii) Check the stresses calculated in (i) with the allowable tensile and compressive stresses in concrete
  - (iii) Calculate the cracking moment and corresponding load  $F$  on the beam
- [Given:  $f_c' = 5 \text{ ksi}$ ,  $f_{cr} = 3.5 \text{ ksi}$ ].

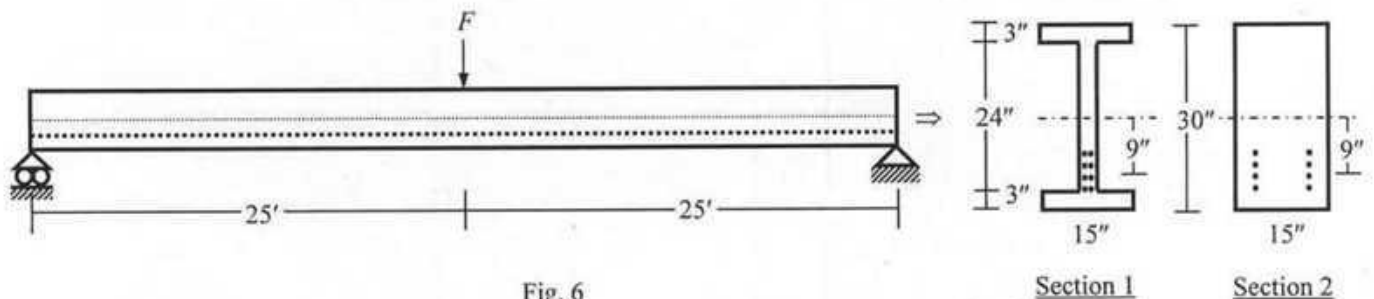


Fig. 6

## PART B

[Answer any 3 (three) of the following 4 questions]

11. (i) Explain why the application of compressive load may increase or decrease the moment capacity of columns.  
(ii) Outline the procedure for the structural design of piles and pile caps.
12. (i) Specify the minimum reinforcements required in the design of wall footings and column footings.  
(ii) What is Transverse Beam in combined footings? Narrate how it is designed.
13. (i) Name different types of retaining walls and explain their relative advantages.  
(ii) Narrate the distinctive features of the concrete and steel used in pre-stressed concrete.
14. (i) What are corner reinforcements in two-way slabs?  
Mention the ACI provisions for corner reinforcements.  
(ii) Define the factors  $\alpha$ ,  $\beta$ , and explain their effect on the structural analysis of flat slabs.

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

**Course Title: Environmental Engineering I**  
**Time: 3 hour**

**Course Code: CE 331**  
**Full marks: 100**

**Answer all the questions below:**  
**(Note: Assume any missing data)**

1. (a) Discuss briefly any chemical disinfection process in water treatment. (10)
- (b) Discuss the chlorine doses in water treatment for disinfection with a typical chlorination curve. (6)
- (c) It is required to supply water to a population of 35,000 at a per capita demand of 150 liters per day. The disinfectant used for chlorination is bleaching powder which contains 30 % of available chlorine. Determine how much of bleaching powder is required monthly at the waterworks, if 0.3 ppm of chlorine dose is required for disinfection. (4)
2. (a) Discuss the coagulation process in conventional water treatment. (6)
- (b) Write explanatory notes on the following: ( any three) (9)  
(i) Life of a tube well and its failure (ii) Water use and re-use (iii) Artificial recharge of groundwater (iv) Rainfall harvesting in Bangladesh (v) Well maintenance
- (c) The discharge of water flowing from a reservoir into a 1m dia steel pipe is  $1.6 \text{ m}^3/\text{sec}$ . If a valve is situated in the pipe-line at a point 2 km from the reservoir , evaluate water hammer pressure developed by the closure of this valve, if
  - I. The closure time is 2.8 sec
  - II. The closure time is 5.5 secThe thickness of the pipe –shell may be taken to be 2.5 cm. (5)
3. (a) Differentiate between : (any three) (9)
  - (i) Naturally developed well & gravel-packed well
  - (ii) Reverse –circulation rotary method & direct rotary method for drilling well
  - (iii) Pressure pipes and gravity pipes.
  - (iv) Dry intake tower and wet intake tower
- (b) Why a well should be completed to the bottom of the aquifer ? (3)
- (c) Why well development is important ? (3)
- (d) Write down the shortcomings of Tara pumps. (5)

4. (a) Define intake structures. Write down the important considerations for selection of site for intake structures. (7)
- (b) Discuss briefly the technologies of removal of hardness or arsenic from water. (7)
- (c) One million gallons of water per day (1 mgd) passes through a sedimentation tank which is 20 ft. wide, 50 ft. long and 10 ft deep. (a) Find the detention time for this basin. (b) what is average velocity of flow through the basin ? (c) If the suspended solids content of the water average 40 ppm, what weight of dry solids will be deposited every 24 hrs assuming 80% removal in basin. (d) What is over flow rate ? (6)
5. (a) Design a tube well of a suitable aquifer for extracting drinking water at a depth from 280 ft to 340 ft. In the following graph the co-ordinates should be identified. (20)  
(Summary of grain size test report, gradation chart & all relevant data are given below).

The necessary equations are given below:

$$1. U_p = \sqrt{(E_w/\rho)}. 1/\sqrt{(1+ E_w/E_p.d/t)} \quad 2. P_h = P_h(\max) (T_C/T) \quad 3. T_C = 2S/U_p$$

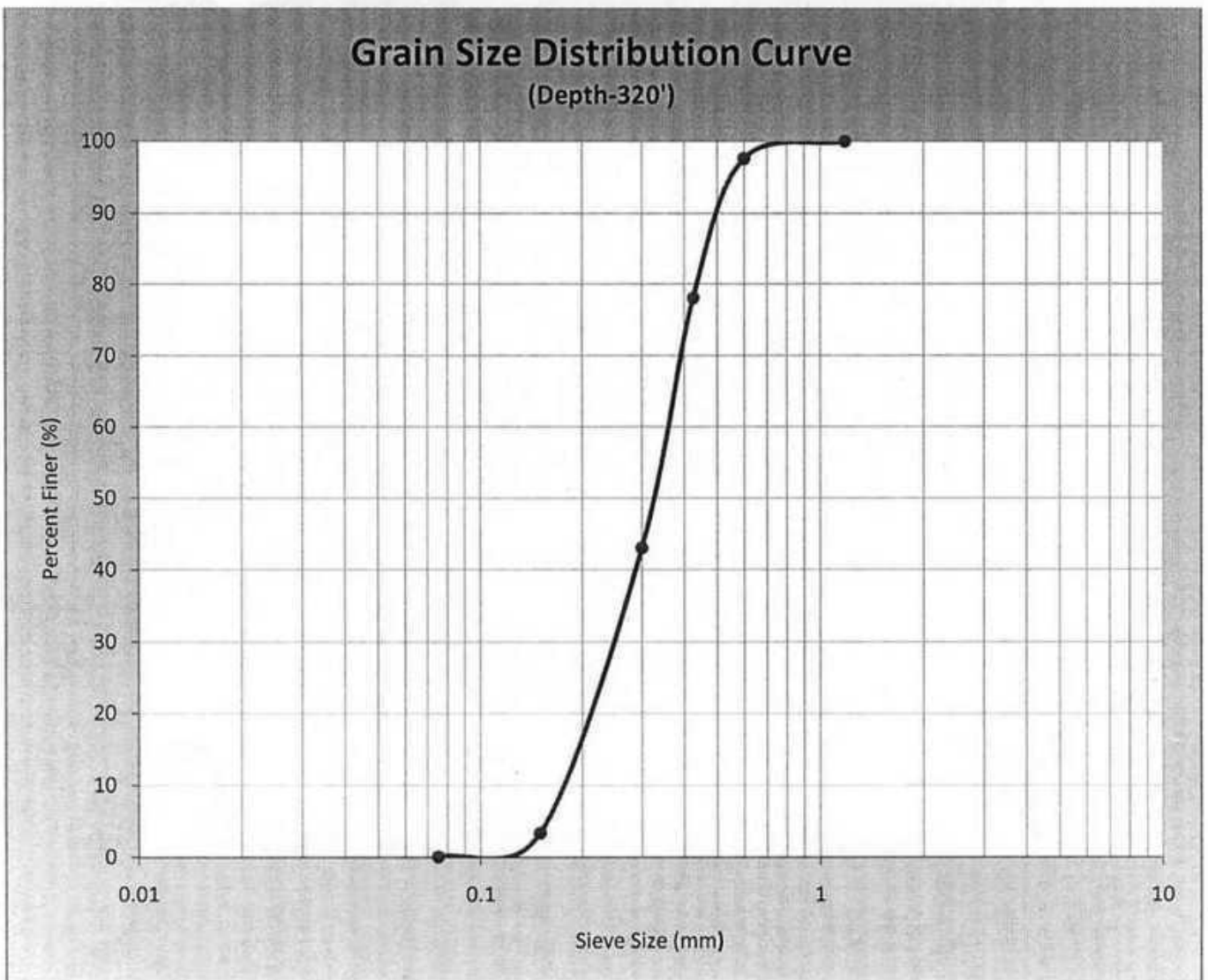
**Summary of Grain Size Test Results:**

Sample depth	D <sub>10</sub>	D <sub>30</sub>	U= D <sub>60</sub> /D <sub>10</sub>	% of Coarse Sand	% of Medium Sand	% of Fine Sand	FM
(ft)	mm	mm		%	%	%	
240	0.17	0.25	1.4	0.5	89.5	20	1.5
260	0.18	0.24	1.46	0.5	89.5	20	1.49
280	0.2	0.3	1.3	4	86	10	1.68
300	0.15	0.24	1.58	12	68	20	1.60
320	0.18	0.25	1.52	2	82	16	1.56
340	0.18	0.27	1.11	10	75	15	1.67
360	0.15	0.22	1.55	1	76	23	1.38
380	0.16	0.21	1.38	0.5	75	24	1.30

**The relevant size of sieves**

Sieve No.	Size (mm)
4	4.75
8	2.36
16	1.18
30	0.6
40	0.425
50	0.3
100	0.15
200	0.075

**Note: Complete and attach the gradation chart with the exam paper.**



**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Environmental Engineering II

Course Code: CE 333

Time: 3.0 hours

Full Marks: 150(=6×25)

**[Answer any 6 (Six) of the following 8 (Eight) questions]**

*[Assume reasonable values for any missing data]*

50/1 (a) Is ROEC a hygienic latrine? Justify your answer. Also briefly explain the advantages and disadvantages of ROEC over simple pit latrine. 8

66/2 (b) In an effort to discourage people from open defecation the local authority in a village offers pre-cast concrete rings of 1.0m diameter and 0.3 m thickness. Design a simple pit latrine for an average family of 8 persons who uses water for cleansing. The ground water table is below 6.0m. The latrine has to serve at least 4 years. 12

(c) Write down the advantages and disadvantages of VIP latrine. 5

2. (a) Residential area (shown in figure 1) is served by sewer P1. At present it has a total of 200 nos 5 storied building with two flats on each floor. The average occupancy is 6 persons per flat. The per capita water demand is 200 liter per day. Design the segment of sewer (P1) between man holes MH1 and MH2 servicing the area using the following data:  
i) pipe length = 300m; ii) per capita waste water generation rate is 70% of water use  
iii) peak factor = 3.0; iv) peak infiltration rate =  $0.25 \text{ m}^3/\text{ha}/\text{day}$ ;  
v) Area = 200 ha [Assume reasonable value for missing data.]  
vi) Manning's roughness coefficient for sewer is 0.013. The nomograph is attached with this question paper. 17

(b) Define the following terms (i) Domestic sewage (ii) Sullage (iii) Sewer and (iv) Trunk Sewer. 4

(c) Write down the conditions where combine sewer system is suitable. 4

3. (a) What do you understand by Small Bore Sewerage System (SBS)? What are the basic components of SBS? State the advantages of SBS over Conventional Sewerage System? 2+2+6

(b) Define self cleansing velocity. Why there is a maximum and minimum limiting velocity specified in designing sanitary sewer system? 2+4

(c) Describe the different steps in activated sludge process with diagram. 9

4. (a) Define the suspended and attach growth processes. Give examples of these treatment processes. 5

- (b) Draw typical bacterial growth pattern and indicate different phases. 5
- (c) Can BOD be greater than COD? Justify your answer. The exerted BOD<sub>5</sub> of wastewater is determined to be 150 ppm at 20°C. Determine its exerted BOD values for 8-day 30°C and 10-day 10°C. Assume  $k_1 (20^\circ\text{C}) = 0.23$  per day.  $k_1 (T \text{ degree Celsius}) = k_1 (20 \text{ degree Celsius}) \Theta^{(T-20)}$ ;  $\Theta = 1.082$  (for 10 degree Celsius) and  $\Theta = 1.087$  (for 30 degree Celsius) 4+6
- (d) Explain Marai's theorem for efficiency of pond system. 5
- 22/5. (a) Define Oxygen deficit and critical oxygen deficit. 2
- (b) Differentiate between (i) Aerobic and Anaerobic process 3
- (c) Discuss the form of biological processes in a trickling filter with diagram. 12
- (d) Compute the recirculation ratio to obtain 90% BOD removal (20 degree Celsius), using a depth of 5 feet and a hydraulic loading of 15 mgad at 20 degree Celsius. What efficiency would be expected at 27 degree Celsius? 8
- 60/6. (a) A city discharges 1.5 m<sup>3</sup>/s of sewage into a stream whose minimum rate, of flow is 8.4 m<sup>3</sup>/s. The velocity of stream is 3.1 km/h. The temperature of the sewage is 20°C and that of the water of stream is 14°C. The 20°C BOD<sub>5</sub> of the sewage is 210 mg/l and that of the stream water is 2 mg/l. The sewage contains no DO while the stream is 95% saturated with dissolved oxygen. The values of K<sub>1</sub> and K<sub>2</sub> at 20°C are 0.3/d and 0.7/d respectively. Use the temperature coefficient of 1.135 for K<sub>1</sub> and 1.024 for K<sub>2</sub>. Determine - The critical oxygen deficit, critical (minimum) DO and its location. 15
- (b) Describe pattern of pollution and self-purification of a stream and its effect on biological life with diagram. 5
- (c) What are the advantages and disadvantages of disposal for sewage effluent on land by irrigation? 5
- 50/7. (a) Using the enclosed hydraulic elements diagram, determine the velocity and discharge in a 24 inch diameter circular sewer when flowing half full and when the depth of flow is equal to 9 inch. Given,  $n = 0.013$ , and slope  $S = 0.015$ . (Attach the diagram page with your script) 13
- (b) Write down the design principles for simplified sewerage system. 6
- (c) What are the requirements for an ideal drain section? 6
- 0/8. (a) Show the interrelationship between water, sanitation and health education with the help of a diagram. 4
- (b) Discuss the functions of pour-flush latrine. 6
- (c) Discuss the off-site, on-site, wet, dry, permeable and confined sanitation systems. 15

Formulae:

$$1. \text{BOD}_5 = L_0 - L_t = L_0 (1 - 10^{-k_1 t})$$

$$2. k_1 (\text{T degree Celsius}) = k_1 (20 \text{ degree Celsius}) \Theta^{(T-20)}$$

$$3. L_e/L_f = 1 / \{1 + 2.5 (D^{0.67}/Q^{0.5})\}$$

$$4. L_f = (L_i + RL_e)/(1+R)$$

$$5. L_e/L_i = 1 / [(1+R) \{1 + 2.5 (D^{0.67}/Q^{0.5})\} - R]$$

$$6. E_T = E_{20} 1.035^{(T-20)}$$

$$7. D_t = \frac{K_1 L_a}{K_2 - K_1} (e^{-K_1 t} - e^{-K_2 t}) + D_a e^{-K_2 t}$$

$$8. t_c = \frac{1}{K_2 - K_1} \ln \left\{ \frac{K_2}{K_1} \left( 1 - \frac{D_a (K_2 - K_1)}{K_1 L_a} \right) \right\}$$

$$9. D_c = \frac{K_1}{K_2} L_a e^{-K_1 t_c}$$

$$10. V = 1.486 (R^{2/3} S^{1/2}) / n$$

$$11. D = (2.16 Q n / \sqrt{S})^{3/8}$$

Table: Equilibrium concentrations (mg/l) of DO as a function of temperature and chloride

Temperature, °C	Chloride concentration, mg/L				
	0	5,000	10,000	15,000	20,000
0	14.62	13.79	12.97	12.14	11.32
1	14.23	13.41	12.61	11.82	11.03
2	13.84	13.05	12.28	11.52	10.76
3	13.48	12.72	11.98	11.24	10.50
4	13.13	12.41	11.69	10.97	10.25
5	12.80	12.09	11.39	10.70	10.01
6	12.48	11.79	11.12	10.45	9.78
7	12.17	11.51	10.85	10.21	9.57
8	11.87	11.24	10.61	9.98	9.36
9	11.59	10.97	10.36	9.76	9.17
10	11.33	10.73	10.13	9.55	8.98
11	11.08	10.49	9.92	9.35	8.80
12	10.83	10.28	9.72	9.17	8.62
13	10.60	10.05	9.52	8.98	8.46
14	10.37	9.85	9.32	8.80	8.30
15	10.15	9.65	9.14	8.63	8.14
16	9.95	9.46	8.96	8.47	7.99
17	9.74	9.26	8.78	8.30	7.84
18	9.54	9.07	8.62	8.15	7.70
19	9.35	8.89	8.45	8.00	7.56
20	9.17	8.73	8.30	7.86	7.42
21	8.99	8.57	8.14	7.71	7.28
22	8.83	8.42	7.99	7.57	7.14
23	8.68	8.27	7.85	7.43	7.00
24	8.53	8.12	7.71	7.30	6.87
25	8.38	7.96	7.56	7.15	6.74
26	8.22	7.81	7.42	7.02	6.61
27	8.07	7.67	7.28	6.88	6.49
28	7.92	7.53	7.14	6.75	6.37
29	7.77	7.39	7.00	6.62	6.25
30	7.63	7.25	6.86	6.49	6.13

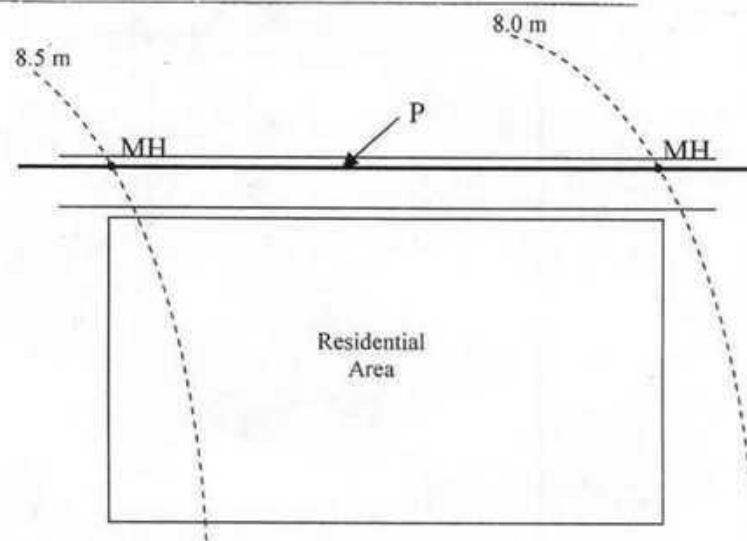


Figure 1: For question 2. (a)

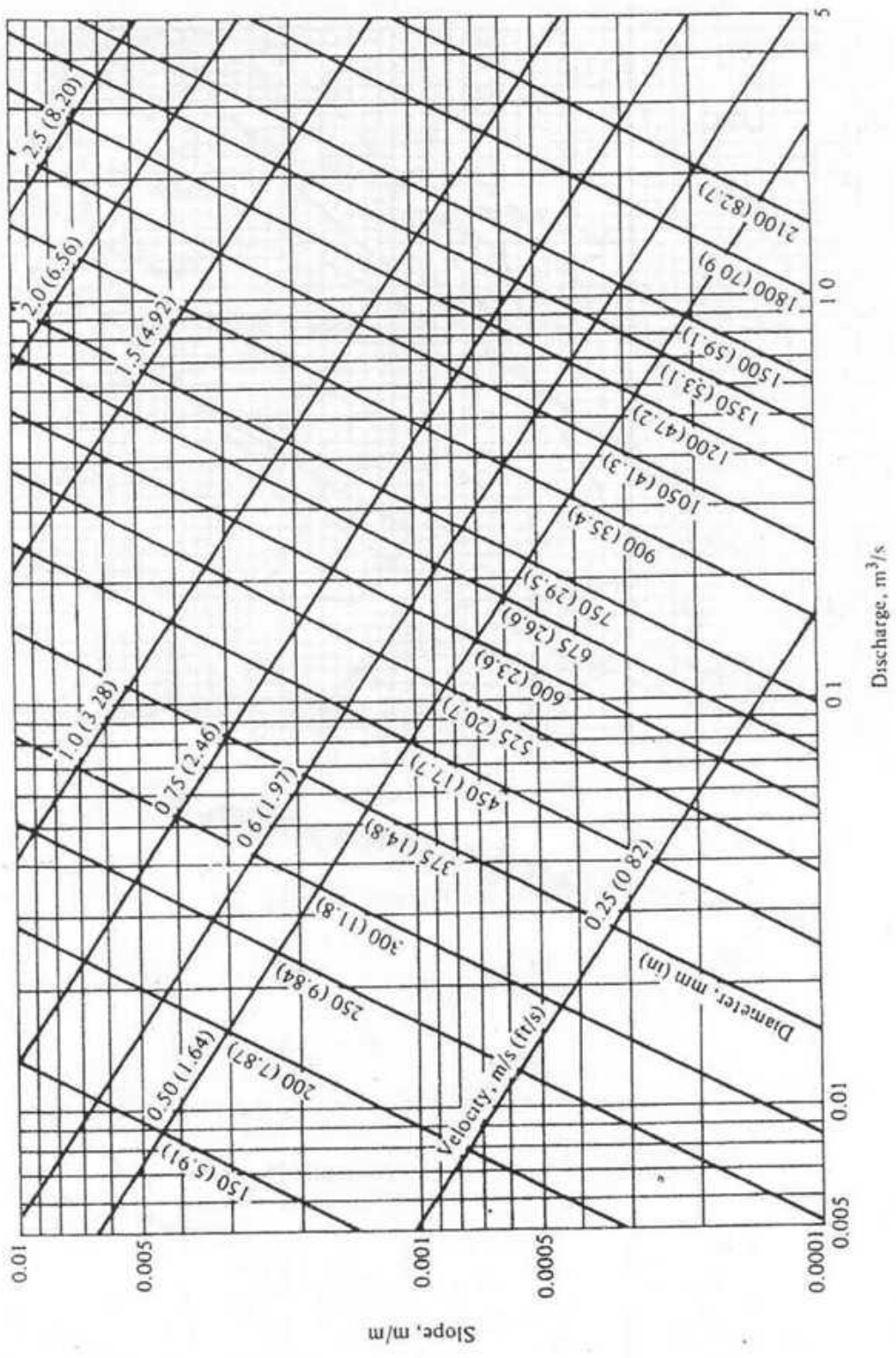


Figure 2: Nomograph for solution of Manning's equation for  $n = 0.013$

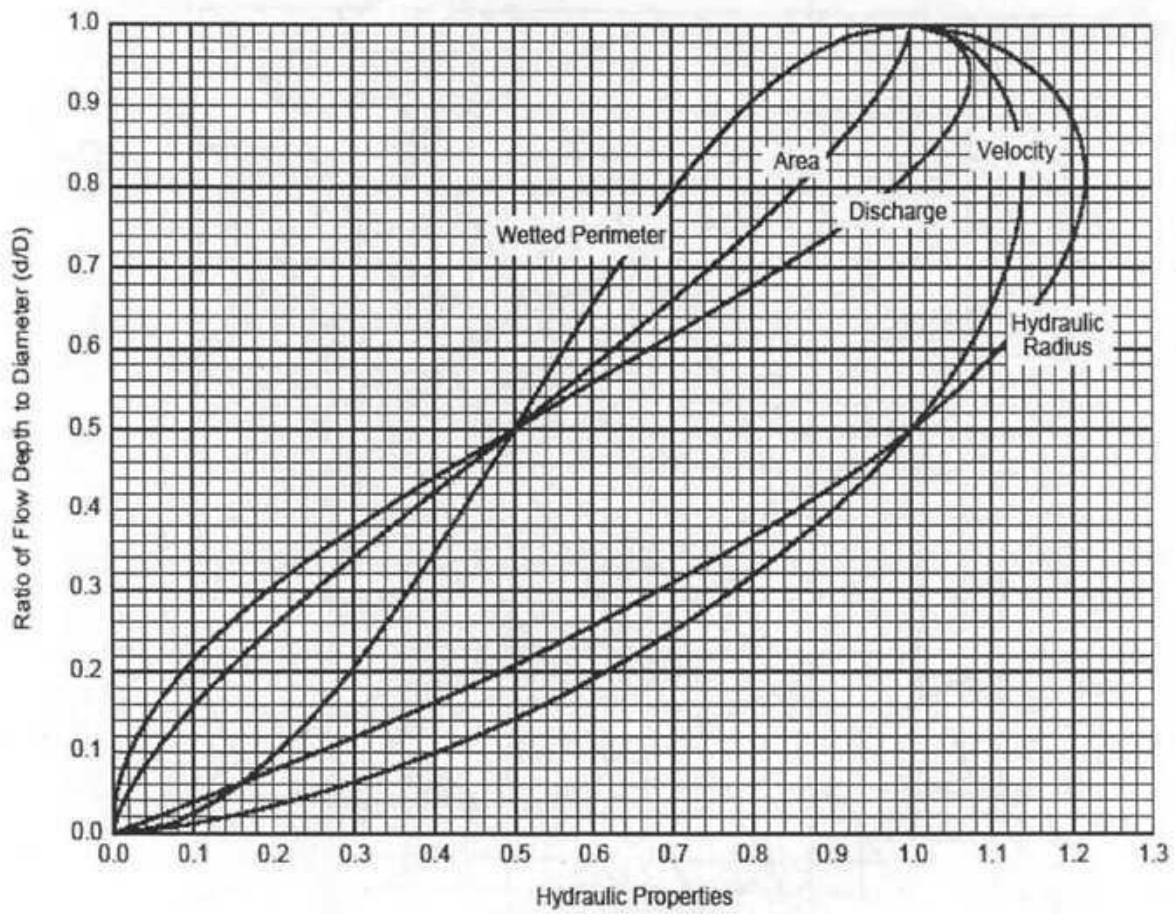


Figure 3: Hydraulic Element Diagram

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

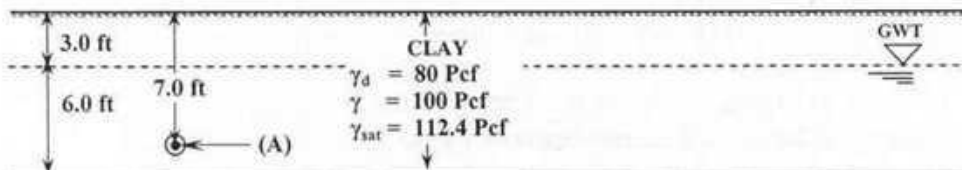
Course Title: Geotechnical Engineering I  
 Time: 3 hours

Course Code: CE 341  
 Full Marks: 100

**Section A**

**There are 5 questions. Answer any 4 questions. (4x10=40 marks)**

1. a) Define: (i) Effective unit weight, (ii) Degree of saturation, (iii) Hydraulic gradient 3  
 b) Derive the expression relating degree of saturation (S), void ratio (e), water content (w) and specific gravity ( $G_s$ ). 4  
 c) Discuss on the effects of compaction on soil properties. 3
  
2. a) Define: (i) Effective size, (ii) Plasticity Index, (iii) Void ratio 3  
 b) Derive the expression of equivalent coefficient of permeability ( $k_{H(eq)}$ ) for flow in the horizontal direction for three layers of soil with horizontal stratification. 4  
 c) Describe the role of moisture content in soil compaction. 3
  
3. a) Define: (i) OCR, (ii) Compression index, (iii) OMC 3  
 b) Discuss on different states of soil and limiting water contents (Atterberg's limits). 2  
 c) Name three shear strength tests and their applicability for different types of soil. 3  
 d) Write short notes on coefficients of earth pressure at-rest. 2
  
4. a) Write the Bernoulli's equation for soil media 3  
 b) What is Darcy's Law and mention about its validity for all three types of flow (laminar, transition and turbulent)? 2  
 c) Derive the expression of the coefficient of passive earth pressure as a function of angle of internal friction ( $\phi$ ) for cohesionless soil. 5
  
5. a) Define: (i) Uniformity coefficient, (ii) Coefficient of consolidation, (iii) Liquid limit 3  
 b) Calculate the time required to complete 60% consolidation for a 5 m deep saturated clay layer which is subjected to one-way drainage. Given that a sample from the mid depth from the clay layer was found to complete 60% of primary consolidation settlement in 3 days during one dimensional oedometer test. 3  
 c) Pre-consolidation pressure for a soil sample obtained from location A is found to be 700 psf. Find whether it is a normally consolidated or over-consolidated soil. 4

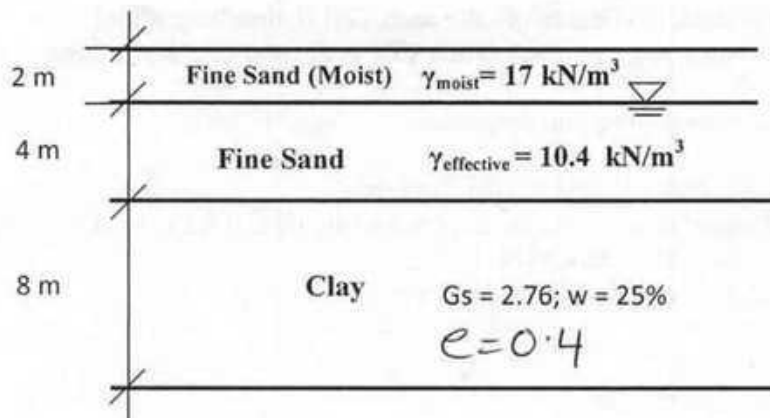


Section B

There are eight questions. Answer any 6 questions.

(6x10 = 60 marks)

6. A clay stratum of thickness 8 m is located at a depth of 6 m below the ground surface. It is overlain by fine sand. The water table is located at a depth of 2 m below the ground surface. For fine sand, effective unit weight is  $10.4 \text{ kN/m}^3$ . The moist unit weight of sand located above water table is  $17 \text{ kN/m}^3$ . For clay layer,  $G_s = 2.76$  and water content ( $w$ ) is 25%. Compute the effective stress, the total stress and the pore water pressure at the bottom of the clay layer.



7. A concentrated load, 18 kN, acts on the surface of a soil mass. Using Boussinesq analysis  $[\sigma_z = \frac{3Qz^3}{2\pi(r^2+z^2)^{5/2}}]$ , find the vertical stresses for the following points:

- 4 m below the surface on the axis of loading;
- 4 m below the surface and 3 m (radial distance) away from the load and
- 8 m below the surface and 3 m (radial distance) away from the load.

8. Classify the following soils:

(a) The properties of a subgrade soil (A) are found as follows:

Percent finer than 0.075 mm = 15%

Percent finer than 0.425 mm = 25%

Percent finer than 0.6 mm = 32%

Percent finer than 4.75 mm = 75%

Liquid limit = 52% & Plastic limit = 35%

(b) The properties of a subgrade soil (B) are found as follows:

Percent of soil material in the pan = 4%

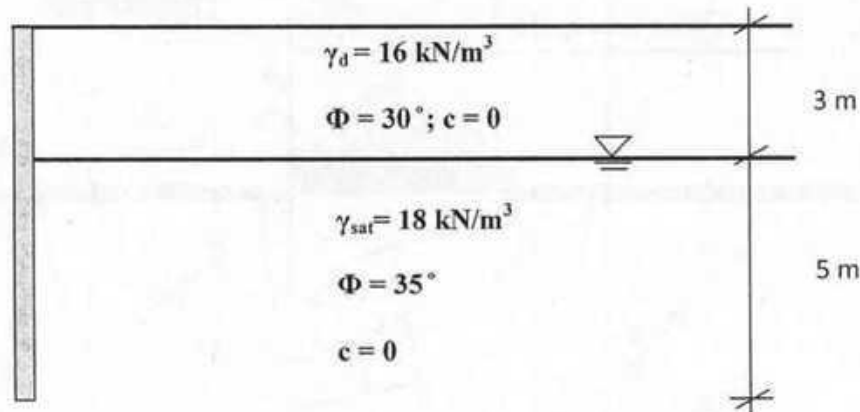
60% of the total soil material having a diameter less than 4.75 mm

30% of the total soil material having a diameter less than 1.18 mm

10% of the total soil material having a diameter less than 0.3 mm

Liquid limit = 33% & Plastic limit = 0%

9. Find the magnitude and the location of the active force (per unit width) on the retaining wall, shown below, for the Rankine state.



10. The following table gives data obtained from a direct shear test conducted on samples of compacted sand. The cross-section of the shear box is 60 mm x 60 mm. Plot the Mohr Coulomb failure envelop and determine the values of the shear strength parameters for the data given in the table.

Normal Load (kN/m <sup>2</sup> )	Shear Load (kN/m <sup>2</sup> )
110	95
225	195
340	294

11. The following observations were made in a Standard Proctor Test.

Trial No.	1	2	3	4	5	6
Mass of wet soil (kg)	1.7	1.89	2.03	1.99	1.96	1.92
Water content (%)	7.7	11.5	14.6	17.5	19.7	21.2

Volume of Mold = 950 cc;  $G_s = 2.65$ .

Determine maximum dry density and optimum moisture content.

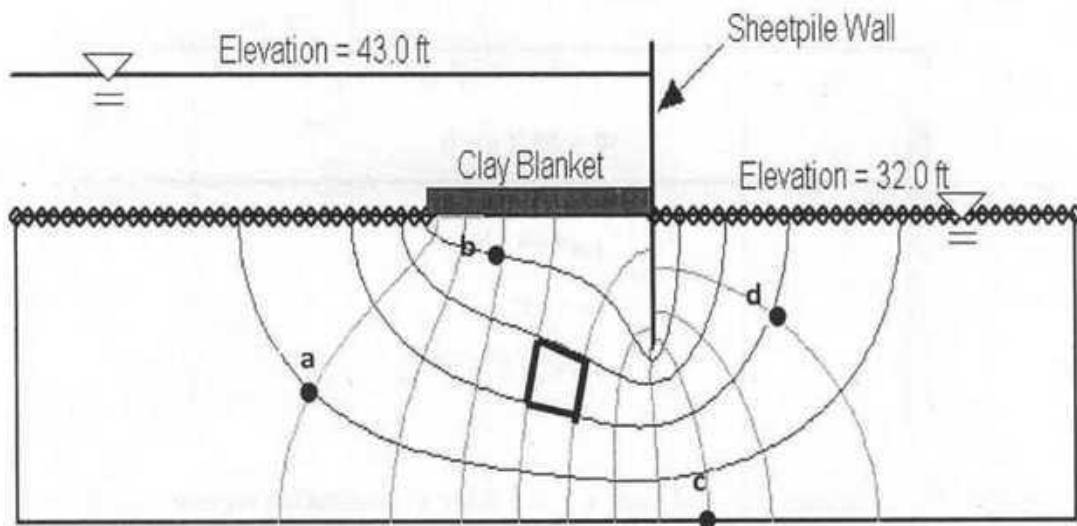
12. Calculate the following for the seepage flow shown below:

(a) Heights of water in the piezometer, if installed at a and b.

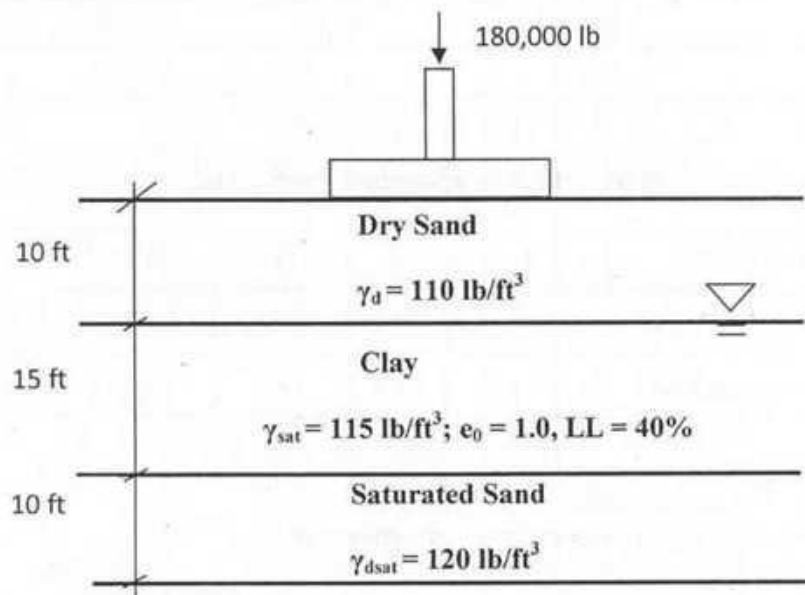
(b) Hydraulic gradient,  $i$  for the flow element highlighted in the figure. The flow element is an approximate square having 6 ft of each side.

(c) Flow rate through the flow channels between point a and point b.

$$k = 5 \times 10^{-4} \text{ cm/s}$$



13. Calculate the primary consolidation settlement for the 15 ft thick clay layer (as shown below) due to the load carried by a square footing of size 5 ft x 5 ft. The clay is normally consolidated. Use the average method to calculate the average increase of pressure in the clay layer.



Given that:  $C_c = 0.009(LL - 10)$ ; Stress increase at the top of the clay layer,  $\Delta\sigma_t = 0.055 * \sigma_{\text{applied}}$

Stress increase at the middle of the clay layer,  $\Delta\sigma_m = 0.028 * \sigma_{\text{applied}}$

Stress increase at the bottom of the clay layer,  $\Delta\sigma_b = 0.02 * \sigma_{\text{applied}}$

Average Stress increase,  $\Delta\sigma = (2 \Delta\sigma_t + 4 \Delta\sigma_m + 3 \Delta\sigma_b) / 9$

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Transportation Engineering I  
 (Transport & Traffic Design)

Course Code: CE 351

Time: 3 Hours

Full Marks: 100

There are SEVEN questions. Answer any FIVE.

1. (a) Define traffic engineering. Why traffic engineering is so essential now-a-days? (5)  
 (b) What are the different causes of traffic congestion? Classify the roadway types according to function-wise and usage-wise. (6)  
 (c) What are the objectives of speed studies? (4)  
 (d) The following travel times were observed for 6 vehicles traversing a 0.75 mile segment of highway: (5)

Vehicle	1	2	3	4	5	6
Time (min)	1.5	1.7	1.2	1.6	2.5	2.1

Calculate the space and time mean speeds of the vehicles.

2. (a) Draw a typical Road Junction with different elements. (7)  
 (b) What are the factors that affect the road user characteristics? (5)  
 (c) Write short notes on PIEV and pedestrian characteristics. (8)
3. (a) Define ADT, AADT and Design Hourly Volume. (3)  
 (b) Write short notes on (4)  
 i) Contra flow  
 ii) Tidal flow  
 iii) PCE  
 (c) What are the advantages and disadvantages of automatic counting method? (3)  
 (d) Following data was collected while conducting spot speed studies at certain section of a road within the urban area. (10)

Speed Range (mph)	No of vehicle observed	Speed Range (mph)	No of vehicle observed
0-5	0	25-30	156
5-10	10	30-35	105
10-15	35	35-40	16
15-20	110	40-45	3
20-25	250	45-50	0

Determine average speed, modal speed and pace of the traffic stream. Also find the upper and lower values of speed limits for regulation and design speed for checking the geometric design.

4. (a) What are the causes of delay? Differentiate between recurrent delay and non-recurrent delay (4)  
 (b) Write down the objectives of Origin and Destination (O-D) surveys. Show the diagrammatic representation of basic movements of traffic. (4)

- (c) What are the key locations of a road to provide street light? (2)  
 (d) A local street with 30 ft pavement width having a reflectance of 20%, carries a maximum of 300 vph at night time in both directions. Design Lighting system of the road considering fluorescent light source with mounting height of 30 ft and a maintenance factor of 0.8. Draw the lighting layout. Use attached Figure and Tables. (10)

5. (a) Differentiate between parallel parking and angle parking. (3)  
 (b) What are the general requirements of traffic control devices? (3)  
 (c) Write short notes on (4)  
 i) VMS  
 ii) All-red period  
 iii) Color and pattern convention of road markers  
 (d) Design a two-phase signal and draw the bar diagram of an isolated cross-junction for the following data. Given amber and red-amber are respectively 3 sec and 2 sec. (10)

	N - S	E - W				
Inter-green (sec)	9	6				
Lost time (sec)	3	2				
			N	S	E	W
Arrival flow	(PCU/hr)		550	650	900	800
Saturation flow	(PCU/hr)		2200	2300	2800	3000

6. (a) What are the goals for transportation planning? (3)  
 (b) Write down the responsibilities of the following ministries involved in the transportation control and management system in Bangladesh (9)  
 i) Ministry of Communication  
 ii) Ministry of Civil Aviation and Tourism  
 iii) Ministry of Shipping  
 (c) Sketch a cloverleaf interchange and show the direction of flows. (4)  
 (d) For a particular road section on curves velocity of traffic and radius of curve are given as 60 mph and 510 ft respectively. What is the rate of super-elevation of curves? Assume side friction factor as 0.15 (4)
7. (a) Illustrate the functional classification of highways in a figure with respect to access function and movement function. (3)  
 (b) Describe the purpose of providing pavement crowns, shoulders and guardrails. Also mention the design and limiting values of these components of highways. (4)  
 (c) Why widening of curve is required? What are the guidelines for providing islands? (3)  
 (d) For a particular two lane highway following data are given, calculate the passing sight distance required with figure. (10)

Given,

- Average speed of passing vehicle = 50 mph  
 Average speed of passed vehicle = 40 mph  
 Perception reaction time = 2.5 sec  
 Average acceleration rate = 1.5 mph/sec  
 Time for preliminary delay = 3 sec  
 Average time while passing vehicle occupies the opposite lane = 10 sec  
 Clearance Distance = 220 ft

TABLE 1 RECOMMENDED AVERAGE ILLUMINATION (LUMENS/FT<sup>2</sup>)

Pedestrian traffic <sup>(1)</sup>	Vehicular traffic <sup>(2)</sup> (vph)			
	Very light (<150 vph)	Light (150 - 500 vph)	Medium (500 - 1,200 vph)	Heavy (>1,200 vph)
Heavy	-	0.8	1.0	1.2
Medium	-	0.6	0.8	1.0
Light	0.2	0.4	0.6	0.8

Notes: (1) Heavy: As on main business street  
 Medium: As on secondary business streets  
 Light: As on local streets  
 (2) Night hour flow in both directions

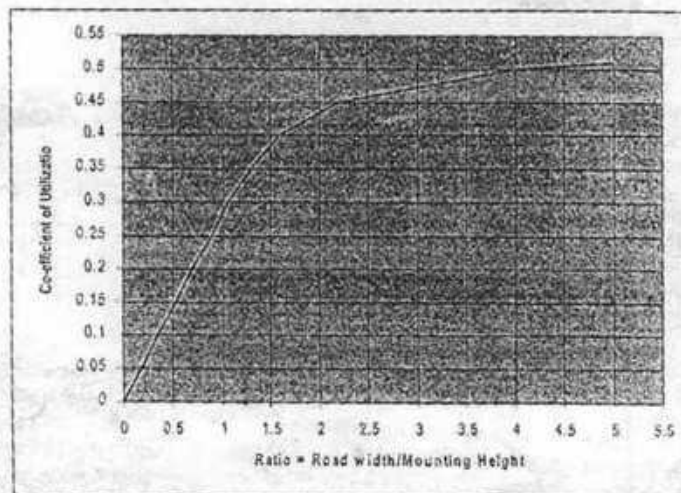
TABLE 2 ADJUSTMENT FACTORS FOR RECOMMENDED AVERAGE ILLUMINATION VALUES

Surface Reflectance	Adjustment Factors
3% or less	1.5
10%	1.0
20% or more	0.75

TABLE 3 LIGHTING SOURCE CHARACTERISTICS

Source Types	Expected Life (hrs)	Lighting Efficiency (Lumens/Watt)	Wattage (Watt)
Tungsten	1000	8 - 14	Up to 1000
Fluorescent	6000	50 - 75	Up to 250
Sodium	6000	100 - 120	Up to 160
Mercury	7500	20 - 60	Up to 400

FIGURE 1 CO-EFFICIENT OF UTILIZATION CURVES (FOR LIGHT DISTRIBUTION TYPE III)



Note: Due to poor maintenance, the actual co-efficient of utilization is reduced by a factor usually 0.8 (i.e. taken as 80%).

TABLE 4 RECOMMENDED ARRANGEMENT OF STREET LIGHTING

Type of Arrangement	Pavement Width
One side	Width ≤ 30ft
Both sides - Staggered	30ft > Width ≤ 60ft
Both sides - Opposite	Width > 60ft

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course title: Open Channel Flow

Course code: CE 361

Time: 3 hours

Total Marks: 100

Answer any **FIVE** out of **SEVEN** questions. Each question has **20** marks. The figures in the right margin indicate full marks.

**1.**

- a) Define the following terms: 6  
    a. Manning's coefficient    b. Normal depth    c. Chezy's C
- b) State the characteristics of uniform flow in an open channel. 3
- c) Water flows at a velocity of 1 m/s in an open channel under uniform flow condition. The longitudinal slope of the channel is 0.0016 and  $n=0.02$ . Compute the normal depth of flow when the channel is trapezoidal with  $b=6$  m and  $s=2$ . 5
- d) A rectangular channel has a bottom width of 5 m and Manning's coefficient  $n=0.025$ . The channel lies on a slope of 1 in 1000. Determine the critical slope when discharge is  $20 \text{ m}^3/\text{s}$ . 6

**2.**

- a) An open channel with concrete lining ( $d_{50}=1.5\text{mm}$ ) is laid on a slope of 0.1%. The channel is trapezoidal with bottom width of 3.5m and side slope  $s=2$ . If the depth of flow is 2.1m, find the uniform flow  $Q$ , Chezy's coefficient 'C' and friction factor 'f'. 6
- b) Differentiate between 'section factor' and 'conveyance' for uniform flow in an open channel. 4
- c) An unlined irrigation channel ( $n=0.025$ ) is trapezoidal and has a bottom width of 7m, side slopes of 1:1, and depth of flow of 2m. The longitudinal slope of the canal is 0.0005. It is proposed to line the canal with concrete ( $n=0.013$ ). Compute the discharge when only sides are lined with concrete. 6
- d) List the factors that affect the Manning's coefficient 'n'. 4

3.

- a) What is a lined channel? What are the reasons for lining a channel? 5
- b) A lined channel ( $n=0.015$ ) is to be laid on a slope of 1 in 2500. The side slope of the channel is to be maintained at 1.5:1. Determine the dimensions of a trapezoidal section with rounded corners to carry a discharge of  $m^3/s$  when the maximum permissible velocity is 2 m/s. 7
- c) Define a best hydraulic section. Why do you think it is not always possible to find a best hydraulic section? 4
- d) Show that the best hydraulic triangular section is one half of a square. 4

4.

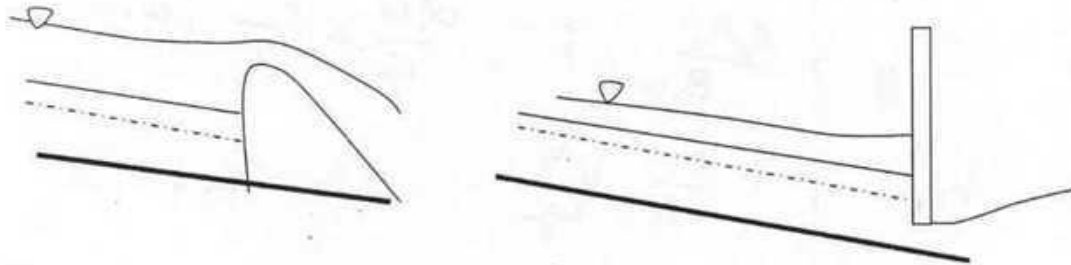
- a) Define the following terms: 6
- a. Maximum permissible velocity
  - b. Non-silting velocity
  - c. Freeboard
- b) A trapezoidal channel is to be laid on a slope of 1 in 1000 and carry a discharge of  $20 m^3/s$ . It is to be excavated in earth containing slightly rounded coarse non-cohesive particles with  $d_{75} = 3$  cm and  $n = 0.025$ . Determine the section dimensions of the channel using the method by Lane. 6
- c) What is 'angle of repose'? Why critical shear stress is important for channel design? 4
- d) A horizontal trapezoidal channel having bottom width  $b = 5.5$  m,  $s = 2$  carries a discharge of  $130 m^3/s$  at a depth of 1.1 m. Compute the downstream depth that will form a hydraulic jump. Find the energy loss in the hydraulic jump. 4

5.

- a) Write down the characteristics of 'Gradually Varied flow'. 4
- b) Derive the following equation for gradually varied flow in an open prismatic channel. State the assumptions you made to derive the equation. 6
- $$dy/dx = (S_o - S_f)/(1 - Fr^2)$$
- c) In terms of the above equation, how do you explain 'backwater curve' and "drawdown curve"? 3
- d) A rectangular channel with  $b = 4$  m, and  $n = 0.015$  carries a discharge of  $18 m^3/s$ . Identify the flow profiles produced in the channel for the following changes in the channel bottom slope:  
 $S_o = 0.004$  to  $S_o = 0.009$  7

6.

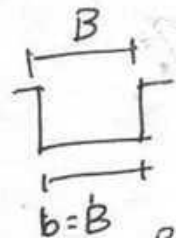
- a) Sketch the possible water surface profiles in the following cases: 6
- a. Horizontal slope – Mild slope --- Critical slope
  - b. Steep slope --- Critical slope --- Mild slope
  - c. Mild slope --- Milder slope – Steep slope
- b) A trapezoidal channel having  $b=5\text{m}$ ,  $s=2$ ,  $n=0.02$  and  $S_0=0.002$  carries a discharge of  $48.67\text{ m}^3/\text{s}$ . A dam constructed across the channel raises the water level to a depth of  $5\text{ m}$  immediately upstream of it. How far upstream or downstream from the dam will the depth be  $4.75\text{m}$ ? Use the direct step method. 6
- c) Define 'tailwater depth'. Using sketches, describe the importance of 'tailwater depth' in hydraulic jump with respect to downstream water depth  $y_2$ . 5
- d) What do you understand by 'control section'? Indicate control sections in the following figures. 3



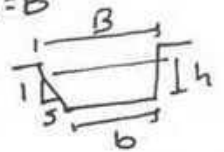
7.

- a) When does a hydraulic jump take place in an open channel? Write down some of the practical applications of a hydraulic jump. 4
- b) The depth and velocity at the foot of an overflow spillway are  $0.5\text{m}$  and  $15.50\text{m/s}$  respectively. What tailwater depth is needed to form a hydraulic jump? If a jump is formed, determine the type of jump, the height of jump, the length of jump, and the energy loss in the jump as a percentage of the initial energy. 6
- c) A rectangular channel is  $1.5\text{ m}$  wide, and inclined at an angle of  $4.0$  degree with the horizontal. The channel carries a discharge of  $0.75\text{ m}^3/\text{s}$  at a vertical depth ( $h_1$ ) of  $0.05\text{ m}$ . If a hydraulic jump occurs in this channel, compute the sequent depth, length of jump and height of jump. 6
- d) State the differences between steady jump, weak jump and strong jump. 4

1.  $A = bh$  ;  $P = b + 2h$  ;  $B = b$



2.  $A = (b + sh)h$  ;  $P = ~~b~~ b + 2\sqrt{1 + s^2}h$



$B = b + 2sh$  ;

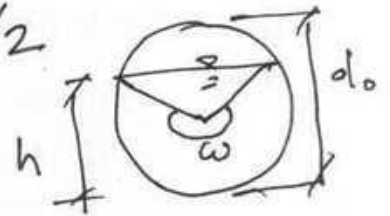
3.  $A = sh^2$  ;  $P = (2\sqrt{1 + s^2}) * h$  ;  $B = 2sh$



4.  $h = d_o [1 - \cos(\frac{\omega}{2})] / 2$

$A = (\omega - \sin \omega) d_o^2 / 8$

$P = \omega d_o / 2$



5.  $Q^2/g = \frac{A_c^3}{B_c}$  ;  $\frac{dQ}{g} = \frac{A_c^3}{B_c}$  (when  $d \neq 1.0$ )

6.  $h_f = f \frac{L}{D} \frac{V^2}{2g}$  ;  $n = \frac{d^{5/6}}{21.1}$

7.  $Re = \frac{VD}{\nu}$  (d in meters)

8.  $C = \sqrt{89/f}$

9.  $C = \frac{1}{n} R^{1/6}$

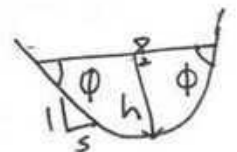
10.  $\tau_o = \gamma R S_o$

11.  $u_* = \sqrt{\frac{\tau_o}{\rho}} = \sqrt{g R S_o}$

12.  $S_o = \frac{11.6 \nu}{u_*^2}$

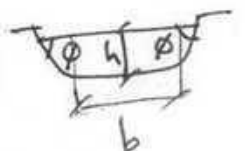
13.  $A = h^2 (\phi + \cot \phi)$

$P = 2h (\phi + \cot \phi)$



14.  $A = bh + h^2 (\phi + \cot \phi)$

$P = b + 2h (\phi + \cot \phi)$



15. Best Hydraulic Sections

	A	P	B	D
Rectangle	$2h^2$	$4h$	$2h$	$h$
Triangle	$h^2$	$2\sqrt{2}h$	$\frac{\sqrt{2}b}{2h}$	$h/2$
Trapezoid	$\sqrt{3}h^2$	$2\sqrt{3}h$	$4\sqrt{3}h/3$	$3h/4$
Circle	$\pi h^2/2$	$\pi h$	$2h$	$\pi h/4$

16. For a trapezoidal ~~section~~ best hydraulic section:

$$A = (2\sqrt{1+s^2} - s)h^2$$

$$b = 2(\sqrt{1+s^2} - s)h$$

$$P = 2h(\sqrt{1+s^2} * 2 - s)$$

17. Erodeable channel:

$$\Rightarrow \tau_0 = \gamma R s_0.$$

$$\Rightarrow K = \frac{\tau_s}{\tau_b} = \sqrt{1 - \frac{\sin^2 \phi}{\sin^2 \psi}}$$

where  
 $\psi$  = angle of repose  
 $\phi$  = side slope angle.

$\Rightarrow$  permissible shear stress =  $0.4 d_{75}$   
 ( $d_{75}$  in inches)

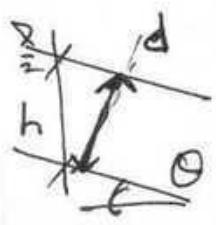
$$\Rightarrow \bar{S}_F = (S_{F1} + S_{F2})/2$$

$$\Rightarrow x_2 = x_1 + \frac{E_2 - E_1}{S_0 - \bar{S}_F}$$

18.  $\frac{y_2}{y_1} = \frac{1}{2} (\sqrt{1 + 2G^2} - 1)$

19.  $G^2 = K_1^2 Fr_1^2$  where  $K_1 = 10$   
 ( $\theta$  is in deg)

20.  $h = d \cos \theta$  (5)



21.  $\frac{y_2}{y_1} = \frac{1}{2} \left( \sqrt{1 + 8Fr_1^2} - 1 \right)$  ←

or,  $\frac{y_1}{y_2} = \frac{1}{2} \left( \sqrt{1 + 8Fr_2^2} - 1 \right)$  ←

Horizontal rectangular channel

22.  $h_L = \frac{(y_2 - y_1)^3}{4y_1 y_2}$

23.  $\frac{L_j'}{y_1} = 9.75 (Fr_1 - 1)^{1.01}$

24.  $\frac{E_2}{E_1} = \frac{(1 + 8Fr_1^2)^{3/2} - 4Fr_1^2 + 1}{8Fr_1^2 (2 + Fr_1^2)}$

25.  $\frac{h_3 \text{ (submerged)}}{h_E \text{ (tailwater)}} = \left[ 1 + 2Fr_1^2 \left( 1 - \frac{h_E}{h_g} \right) \right]^{1/2}$

26.  $Fr^2 = \frac{Q^2 B}{g A^3}$

$Fr = 1$  (critical flow condition)

27.  $\bar{z}$  for different sections

Rectangle -  $h/2$

triangle -  $h/3$

trapezoid -  $\frac{h}{6} \left( \frac{3b + 2sh}{b + sh} \right)$

28. Specific force  $F = \frac{Q^2}{gA} + \bar{z} A$

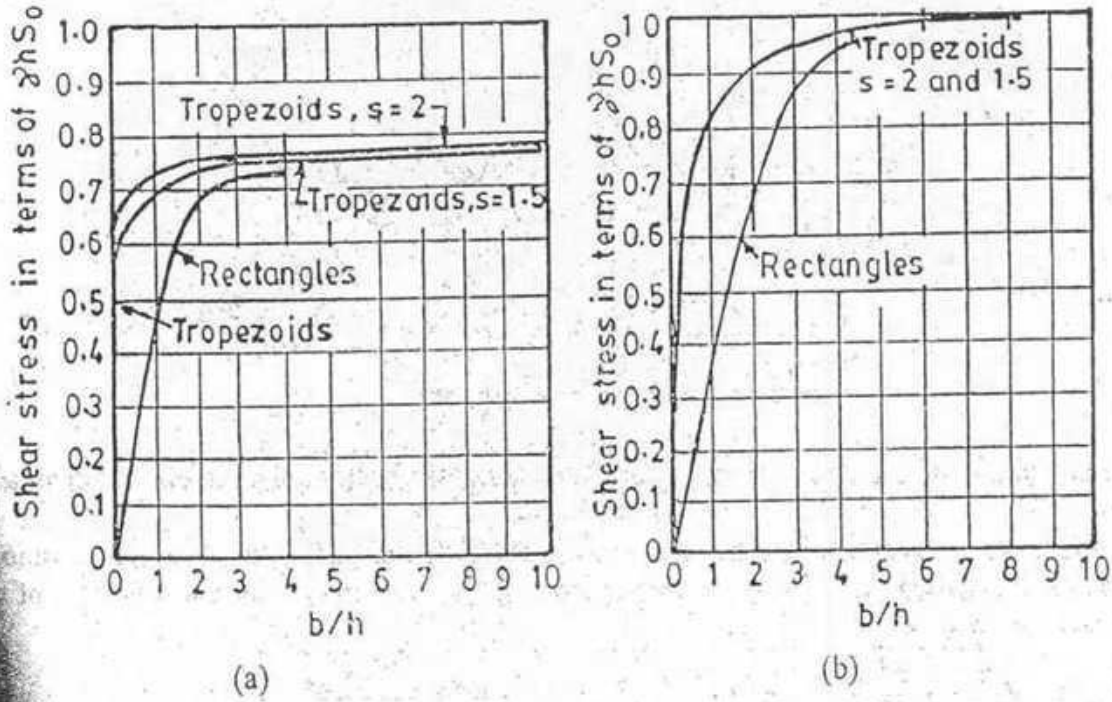
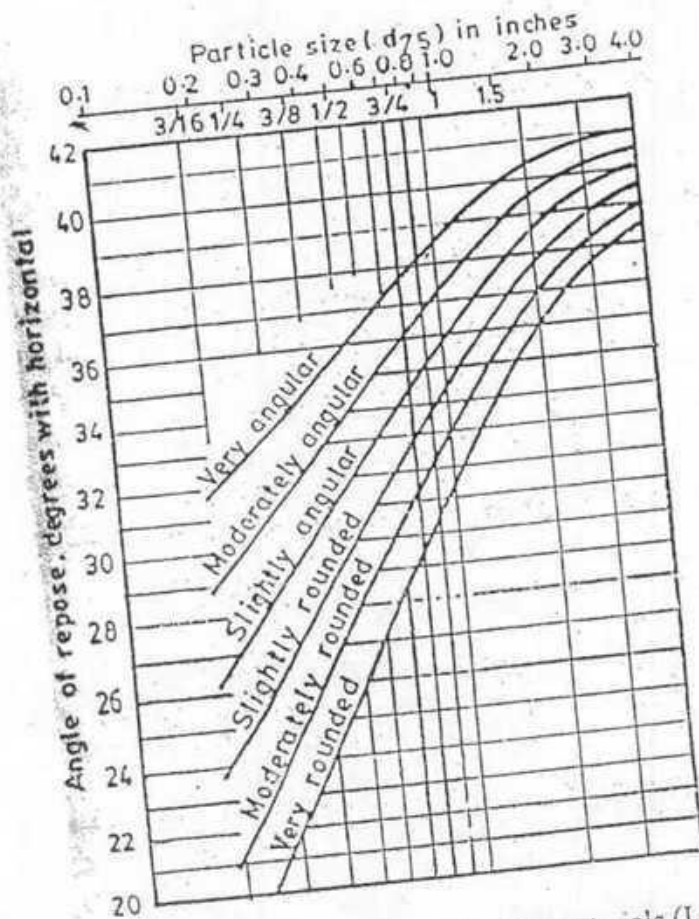


Fig. 5. 4 Maximum shear stresses on (a) sides and (b) bottom of trapezoidal channels

Stress Ratio



5.6 Angle of repose of non-cohesive materials (Lane, 1955)

7 The size of the sediment particles. The

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course title: Engineering Hydrology (SECTION A)

Course code: CE 363

Time: 3 hours

Total Marks: 150

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**Section A**

Answer any **THREE** out of **FOUR** questions. Each question has **25** marks. The figures in the right margin indicate full marks.

1. a) Briefly describe the following terms (**any two**): (6)
  - i. Pan coefficient
  - ii. Energy balance method
  - iii. Factors affecting evaporation
- b) Calculate the evaporation rate from an open water source, if the net radiation is  $300 \text{ W/m}^2$  and the air temperature is  $30 \text{ deg C}$ . Assume zero sensible heat, ground heat flux, heat stored in water body and advected energy. The density of water at  $30 \text{ deg C}$  is  $996 \text{ kg/m}^3$ . (5)
- c) A reservoir has an average surface area of  $20 \text{ km}^2$  during March 1980. In that month, the mean rate of inflow =  $10 \text{ m}^3/\text{s}$ , outflow =  $15 \text{ m}^3/\text{s}$ , monthly rainfall =  $10 \text{ cm}$  and change in storage =  $16 \text{ million m}^3$ . Assuming seepage losses to be  $1.8 \text{ cm}$ , estimate the evaporation in that month. (4)
- d) How does vapor pressure and wind speed affect the evaporation process? (6)
- e) State the difference between actual and potential evapotranspiration. (4)
  
2. a) State the differences between recording and non-recording gauges? (5)
- b) Describe two methods for estimating missing rainfall data. (6)
- c) List the different types of hydrologic data. (4)
- d) In a catchment area (Figure 1, attached at the end of the question paper), four rainfall stations are situated inside the catchment and one station is outside in its neighbourhood. Also given are the annual precipitation recorded by the five stations in 1980. Determine the average annual precipitation by the Thiessen polygon method. Consider each square as  $1 \text{ sq km}$ . (10)
  
3. a) Briefly write down what you know about the Intensity-Duration-Frequency (IDF) curve. (5)
- b) What are differences between frontal and cyclonic weather system? (5)
- c) Define the following terms:
  - i. Normal precipitation
  - ii. Return period(5)

d) Estimate the average depth of precipitation over the following catchment based on the isohyetal map given below. The isohytes are given in **mm** and area should be calculated in **sq. km**. Consider each square as 1 sq. km (Figure 2). (10)

4. a) Briefly describe different characteristics of rainfall. (5)  
 b) List the causes responsible for inconsistency in rainfall record. (4)  
 c) Discuss briefly on the climate of Bangladesh. (6)  
 d) Annual rainfall depth data are available below (Table 1) for three consistent gauges (E, F, G) and one inconsistent gauge H. Gauge H was relocated permanently at the end of 1981. Therefore rainfall data for gauge H for the period 1979-1981 must be adjusted to the rainfall characteristics at the new location. (10)

Table 1

Year	Annual rainfall (in)			
	E	F	G	H
1979	22	26	23	28
1980	21	26	25	33
1981	27	31	28	38
1982	25	29	29	31
1983	19	22	23	24
1984	24	25	26	28
1985	17	19	20	22
1986	21	22	23	26

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**Section B**  
**Answer any THREE**

5. (a) What are the factors that affect the shape of a flood hydrograph? Describe the different methods of base flow separation. (10)

(b) The following are the ordinates of the hydrograph of flow from a catchment area of 780 km<sup>2</sup> due to a 6-hr rainfall. Derive the ordinates of 6-hr unit hydrograph for the basin. Make suitable assumptions regarding base flow. (15)

Time (hr)	6	12	18	24	30	36	42	48
Discharge (cumec)	40	64	215	360	405	350	270	205

Time (hr)	54	60	66	72	78
Discharge (cumec)	145	100	70	50	42

6. (a) What are the assumptions of a unit hydrograph? (3)  
 (b) Explain the procedure of deriving a synthetic unit hydrograph for a catchment by using Snyder's method. (10)

(c) The ordinates of 4-hr UH are given below. Derive the ordinates of an 8-hr UH using S-curve method. (12)

Time (hr)	0	4	8	12	16	20	24	28
4-hr UH ordinates (cumec)	0	24	82	159	184	151	103	64
Time (hr)	32	36	40	44				
4-hr UH ordinates (cumec)	36	17	6	0				

7. (a) The following data were collected for a 24m wide stream at a gauging station. Compute the discharge. (10)

Distance from one end of Water surface (m)	depth, d (m)	Immersion of current meter at 0.6d below water surface	
		REV	SEC
3	1.4	12	50
6	3.3	29	53
9	5.0	35	56
12	9.0	42	59
15	5.4	32	51
18	3.8	33	53
21	1.8	18	50

Calibration equation of current meter:  $v = 0.3N + 0.05$ ,  $N$  = revolutions per seconds,  $v$  = velocity, m/s.

(b) The inflow and outflow hydrographs for a reach of a river are given below. Determine the best values of the Muskingum coefficients  $k$  and  $x$  for the reach. (15)

Time (hr)	Inflow (cumec)	Outflow (cumec)
0	20	20
12	191	30
24	249	120
36	164	176
48	110	164
60	82	135
72	62	116
84	48	90
96	32	68
108	28	52

8. (a) Describe different methods to estimate the magnitude of a flood peak.

(7)

(b) Annual maximum recorded floods in a tributary of the river Brahmaputra for the period 1939 to 1968 is given below which fits well the Gumbel extreme value distribution. Estimate the flood discharge with recurrence interval of (i) 100 years and (ii) 150 years. Also find 95% confidence limits for these estimates.

(18)

Year	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Flood (cumec)	14570	8440	14000	22620	4820	29300	24200	12450	7270	6230

Year	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
Flood (cumec)	18300	9680	6480	3680	11430	21240	8500	9720	5810	19650

Year	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Flood (cumec)	37300	7220	20860	18700	7650	6090	4390	10340	12880	42450

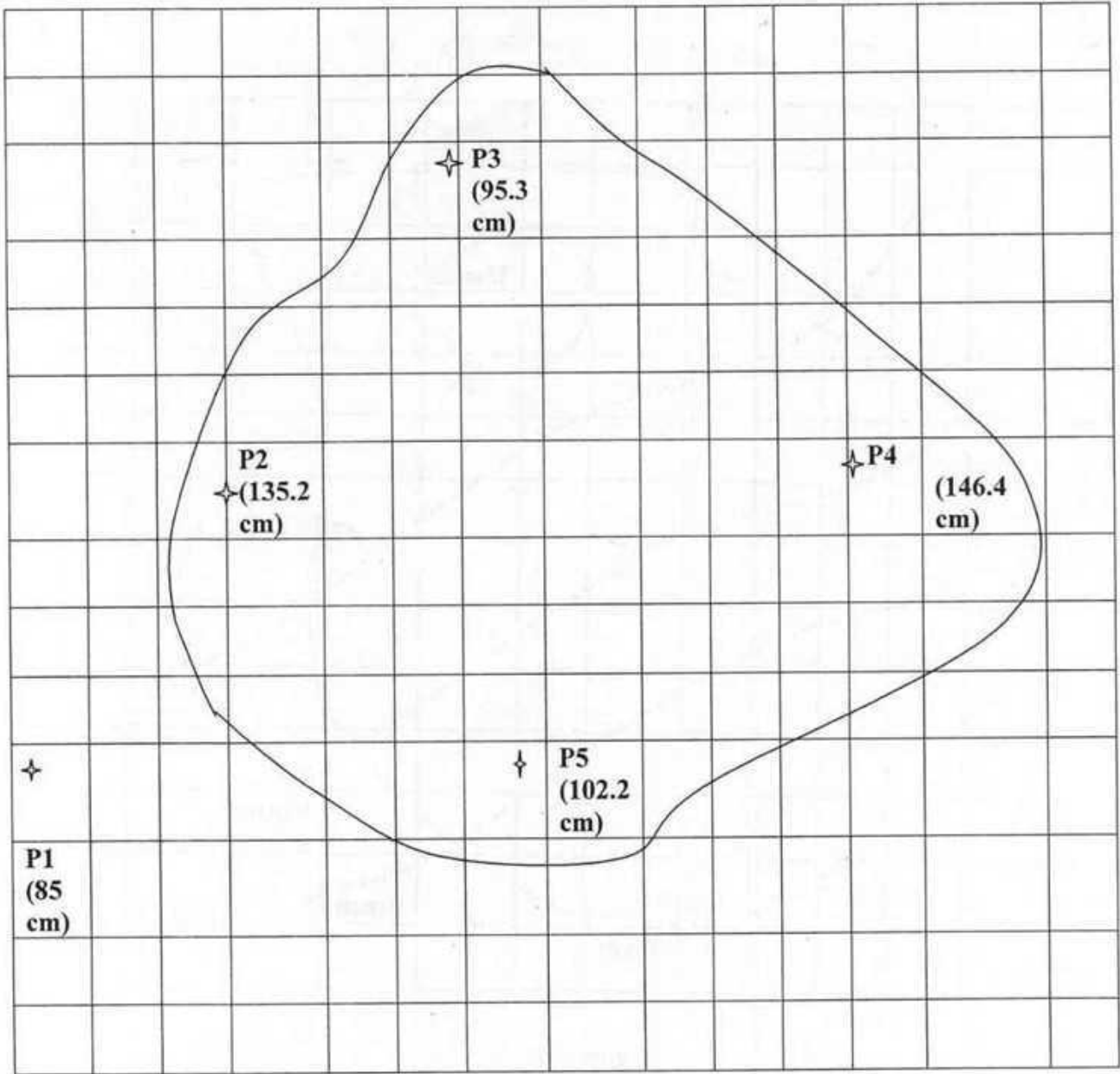


Figure 1.0

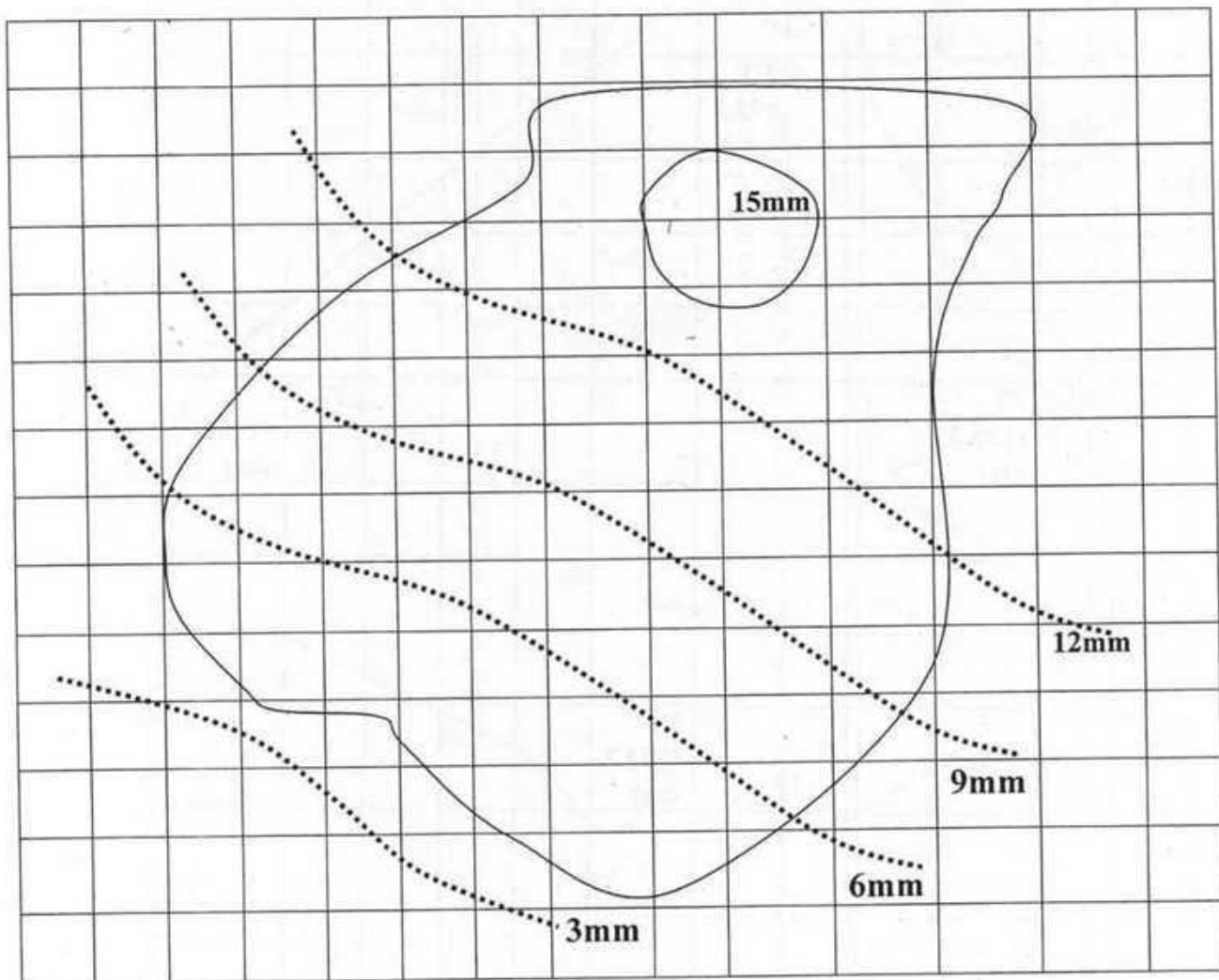


Figure 2.0

$$x_T = \bar{x} + K \sigma_{n-1} \quad \sigma_{n-1} = \sqrt{\frac{\sum (x - \bar{x})^2}{N-1}}$$

$$K = \frac{y_T - \bar{y}_n}{S_n} \quad y_T = -\left[ \ln \cdot \ln \frac{T}{T-1} \right]$$

$$T = 1/P \quad P = \frac{m}{N+1}$$

$$H_n = H_a + H_e + H_g + H_s + H_i$$

$$E = \frac{H_n - H_g - H_s - H_i}{l_v \rho_w (1 + \beta)}$$

$$E = \frac{H_n - H_g - H_a - H_i - H_s}{l_v \rho_w}$$

$$l_v = 2.501 \times 10^6 - 2370T \quad \text{where } T \text{ is in deg C.}$$

$$x_{1/2} = x_T \pm f(c) S_e$$

$$S_e = \text{probable error} = b \frac{\sigma_{n-1}}{\sqrt{N}}$$

$$b = \sqrt{1 + 1.3K + 1.1K^2}$$

c in per cent	50	68	80	90	95	99
f(c)	0.674	1.00	1.282	1.645	1.96	2.58

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

$N$  = sample size

$N$	0	1	2	3	4	5	6	7	8	9
10	0.4952	0.4996	0.5035	0.5070	0.5100	0.5128	0.5157	0.5181	0.5202	0.5220
20	0.5236	0.5252	0.5268	0.5283	0.5296	0.5309	0.5320	0.5332	0.5343	0.5353
30	0.5362	0.5371	0.5380	0.5388	0.5396	0.5402	0.5410	0.5418	0.5424	0.5430
40	0.5436	0.5442	0.5448	0.5453	0.5458	0.5463	0.5468	0.5473	0.5477	0.5481
50	0.5485	0.5489	0.5493	0.5497	0.5501	0.5504	0.5508	0.5511	0.5515	0.5518
60	0.5521	0.5524	0.5527	0.5530	0.5533	0.5535	0.5538	0.5540	0.5543	0.5545
70	0.5548	0.5550	0.5552	0.5555	0.5557	0.5559	0.5561	0.5563	0.5565	0.5567
80	0.5569	0.5570	0.5572	0.5574	0.5576	0.5578	0.5580	0.5581	0.5583	0.5585
90	0.5586	0.5587	0.5589	0.5591	0.5592	0.5593	0.5595	0.5596	0.5598	0.5599
100	0.5600									

TABLE 7.4 REDUCED STANDARD DEVIATION  $S_n$  IN GUMBEL'S EXTREME VALUE DISTRIBUTION

$N$  = sample size

$N$	0	1	2	3	4	5	6	7	8	9
10	0.9496	0.9676	0.9833	0.9971	1.0095	1.0206	1.0316	1.0411	1.0493	1.0565
20	1.0628	1.0696	1.0754	1.0811	1.0864	1.0915	1.0961	1.1004	1.1047	1.1086
30	1.1124	1.1159	1.1193	1.1226	1.1255	1.1285	1.1313	1.1339	1.1363	1.1388
40	1.1413	1.1436	1.1458	1.1480	1.1499	1.1519	1.1538	1.1557	1.1574	1.1590
50	1.1607	1.1623	1.1638	1.1658	1.1667	1.1681	1.1696	1.1708	1.1721	1.1734
60	1.1747	1.1759	1.1770	1.1782	1.1793	1.1803	1.1814	1.1824	1.1834	1.1844
70	1.1854	1.1863	1.1873	1.1881	1.1890	1.1898	1.1906	1.1915	1.1923	1.1930
80	1.1938	1.1945	1.1953	1.1959	1.1967	1.1973	1.1980	1.1987	1.1994	1.2001
90	1.2007	1.2013	1.2020	1.2026	1.2032	1.2038	1.2044	1.2049	1.2055	1.2060
100	1.2065									

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination, Fall 2012**  
**Program: B.Sc Engineering (Civil)**

Course Title: Engineering Hydrology (SECTION B)  
 Time: 3 hours

Course Code.: CE 363  
 Full Marks: 150

**Section A (Answer any THREE)**  
 (Assume any reasonable data if not given)

1. (a) Explain the following (any Three) (9)
- i) Consistency test for rainfall records
  - ii) Estimating the missing rainfall data
  - iii) Pan coefficient
  - iv)  $\Phi$ -index
  - v) Initial loss to reduce the water volume available for runoff

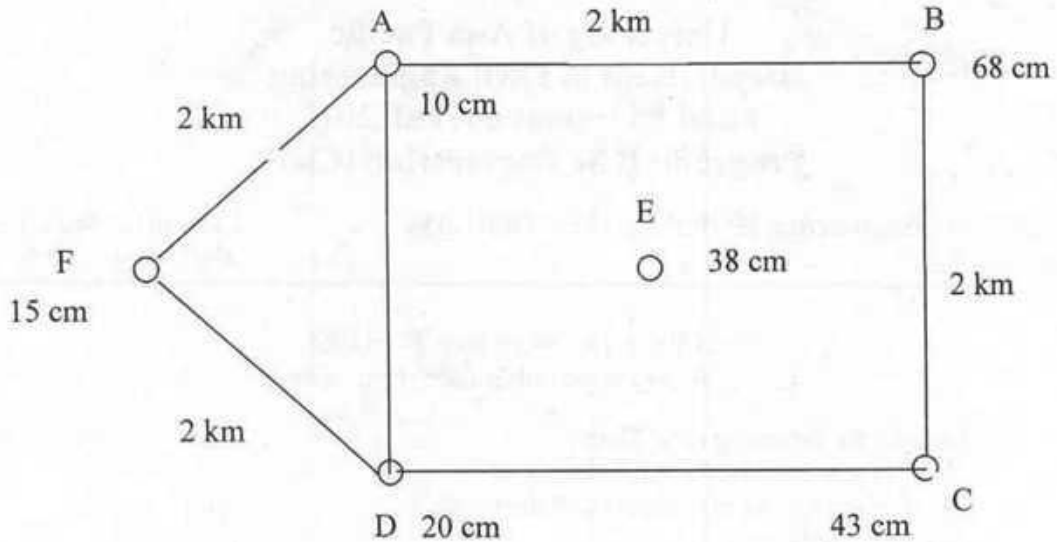
- (b) Distinguish between the following (any Two) (8)
- i) Recording and non-recording rain gauges
  - ii) Infiltration capacity and infiltration rate
  - iii) Field capacity and wilting point

(c) Rainfall of magnitude 3.8cm and 2.8cm occurring on two consecutive 4-h durations on a catchment of area 27 km<sup>2</sup> produced the following hydrograph of flow at the outlet of the catchment. Estimate the rainfall excess and  $\Phi$ -index. (8)

Time (h)	-6	0	6	12	18	24	30	36	42
Observed Flow (m <sup>3</sup> /s)	6	5	13	26	21	16	12	9	7

Time (h)	48	54	60	66
Observed Flow (m <sup>3</sup> /s)	5	5	4.5	4.5

2. (a) A reservoir had an average area of 20 km<sup>2</sup>. In a particular month the mean rate of inflow = 10 m<sup>3</sup>/s, outflow = 15 m<sup>3</sup>/s, monthly rainfall = 10 cm and increase in storage = 16 million m<sup>3</sup>. Assuming the seepage losses to be 1.8 cm, estimate the evaporation in that month. (10)
- (b) Find the mean precipitation for the area shown below by Thiessen polygon method. The area is composed of a square plus an equilateral triangular plot of side 2 km. Rainfall readings are in cm at the various stations indicated. (15)



3. (a) Discuss the factors that affect the process of evaporation? (10)
- (c) Estimate the daily potential evapotranspiration for the following data by Penman's formula: (15)
- i) Slope of the saturation vapour pressure vs. temperature at the mean air temperature =  $1.00 \text{ mm}^\circ\text{C}$
  - ii) Mean temperature =  $19^\circ\text{C}$
  - iii) Relative humidity = 75%
  - iv) Wind velocity at 2 m height = 85 km/day
  - v) Saturated vapour pressure  $e_w = 16.5 \text{ mm of Hg}$
  - vi) Net radiation = 1.99 mm of water per day
  - vii) Psychrometric constant =  $0.49 \text{ mm of Hg}^\circ\text{C}$
4. (a) A catchment area has five rain gauge stations. In a year the annual rainfall recorded by the gauges are as follows:
- | Station      | A  | B   | C   | D  | E  |
|--------------|----|-----|-----|----|----|
| Rainfall(cm) | 88 | 104 | 138 | 78 | 56 |
- For a 10% error in the estimation of the mean rainfall, calculate the minimum number of additional stations required to be established in the catchment. (10)
- (b) Rain gauge station D was inoperative for part of a month during which a storm occurred. The storm rainfall recorded in the three surrounding stations A, B and C were 8.5, 6.7 and 9.0 cm, respectively. If the average annual rainfall for the stations are 75, 84, 70 and 90 cm, respectively, estimate the storm rainfall at station D. (10)
- (c) Sketch the schematic diagram of energy budget method of estimating evaporation from a lake. (5)

### Section B

Answer any **THREE**. Each question has **25** marks. The figures in the right margin indicate full marks.

5. a) Describe Horton's infiltration curve and equation. (4)  
 b) Differentiate between the two: (6)  
     i.  $\phi$ -index and W-index.  
     ii. Saturation overland flow and Hortonian overland flow  
 c) Describe the different components of a hydrograph with a figure. (3)  
 d) Calculate the streamflow hydrograph for a storm of 6 inches excess rainfall, with 2 inches in the first half hour, 3 inches in the second half hour and 1 inch in the third half hour. Use the half hour unit hydrograph given below and assume a baseflow of 500 cfs. (12)

Time (0.5 h)	Excess precipitation (in)	Unit hydrograph ordinates (cfs/in)
1	2	404
2	3	1079
3	1	2343
4		2506
5		1460
6		453
7		381
8		254
9		173

6. a) Briefly discuss about the three types of streams: perennial, ephemeral and intermittent. Draw figures. (5)  
 b) Describe how the following factors affect a streamflow hydrograph: (5)  
     i. Shape of the basin   ii. Drainage density   iii. Land use  
 c) Describe different baseflow separation methods using figures wherever possible. (5)  
 d) A 3-h unit hydrograph for a basin has the following ordinates (Table 1). Using the **s-curve** method, determine the 12- h unit hydrograph. (10)
7. a) Define attenuation and time lag using a hydrograph. (4)  
 b) Describe prism and wedge storage in a channel and the role of 'x' in the Muskingum method of channel routing. (6)

**Table 1**

Col 1	Col 2 (3-h UH)
0	0
3	12
6	75
9	132
12	180
15	210
18	183
24	156
27	135
30	144
33	96
36	0

c) A reservoir for detaining flood flows has an outlet structure including a 3 ft diameter rein-forced concrete pipe as the outlet structure. The headwater discharge relation for the outlet pipe is given in **col 2** and **col 3** of Table 2.0. Use the level pool routing method (Goodrich equation) to calculate reservoir outflow from the inflow hydrograph given in **col 6** and **col 7** of Table 2. Assume the reservoir is initially empty. (15)

$$\frac{2S_{j+1}}{\Delta t} + Q_{j+1} = (I_j + I_{j+1}) + \left(\frac{2S_j}{\Delta t} - Q_j\right)$$

Here  $I_j$  and  $I_{j+1}$  are inflows,  $S_j$  is storage and  $Q_j$  is outflow from previous time step and  $S_{j+1}$  and  $Q_{j+1}$  are two unknowns.

**Table 2.0**

1	2	3	4	5	6	7
index j	elevation	discharge	storage	$(2S/\Delta t)+Q$	time (min)	inflow 'I' (cfs)
	h-ft	Q-cfs	S-ft <sup>3</sup>	cfs; $\Delta t=10\text{min}$		
1	0	0	0		0	0
2	0.5	3	21780		10	60
3	1	8	43560		20	120
4	1.5	17	65340		30	180
5	2	30	87120		40	240
6	2.5	43	108900		50	300
7	3	60	130680		60	360
8	3.5	78	152460		70	300
9	4	97	174240		80	220
10	4.5	117	196020		90	140
11	5	137	217800		100	0

8. a) What is Intensity-Duration-Frequency (IDF) curve? How is it used in peak flood estimation? (4)
- b) List the different techniques of stream flow measurement. (4)
- c) Briefly explain the concept of 'return period' and 'confidence limit' in flood frequency analysis. (5)
- d) Flood frequency computations for the river Turag was completed using Gumbel's method and following results were obtained. Estimate the flood magnitude in this river with a return period of 500 years. (12)

Return period T (years)	Peak flood ( $m^3/s$ )
50	30,000
100	35,300

$$x_T = \bar{x} + K \sigma_{n-1} \quad \sigma_{n-1} = \sqrt{\frac{\Sigma(x - \bar{x})^2}{N-1}}$$

$$K = \frac{y_T - \bar{y}_n}{S_n} \quad y_T = -\left[ \ln \cdot \ln \frac{T}{T-1} \right]$$

$$T = 1/P \quad P = \frac{m}{N+1}$$

$$H_n = H_a + H_e + H_g + H_s + H_i$$

$$E = \frac{H_n - H_g - H_s - H_i}{l_v \rho_w (1 + \beta)}$$

$$E = \frac{H_n - H_g - H_a - H_i - H_s}{l_v \rho_w}$$

$$l_v = 2.501 \times 10^6 - 2370T \quad \text{where } T \text{ is in deg C.}$$

$$x_{1/2} = x_T \pm f(c) S_e$$

$$S_e = \text{probable error} = b \frac{\sigma_{n-1}}{\sqrt{N}}$$

$$b = \sqrt{1 + 1.3K + 1.1K^2}$$

c in per cent	50	68	80	90	95	99
f(c)	0.674	1.00	1.282	1.645	1.96	2.58

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

$N$  = sample size

$N$	0	1	2	3	4	5	6	7	8	9
10	0.4952	0.4996	0.5035	0.5070	0.5100	0.5128	0.5157	0.5181	0.5202	0.5220
20	0.5236	0.5252	0.5268	0.5283	0.5296	0.5309	0.5320	0.5332	0.5343	0.5353
30	0.5362	0.5371	0.5380	0.5388	0.5396	0.5402	0.5410	0.5418	0.5424	0.5430
40	0.5436	0.5442	0.5448	0.5453	0.5458	0.5463	0.5468	0.5473	0.5477	0.5481
50	0.5485	0.5489	0.5493	0.5497	0.5501	0.5504	0.5508	0.5511	0.5515	0.5518
60	0.5521	0.5524	0.5527	0.5530	0.5533	0.5535	0.5538	0.5540	0.5543	0.5545
70	0.5548	0.5550	0.5552	0.5555	0.5557	0.5559	0.5561	0.5563	0.5565	0.5567
80	0.5569	0.5570	0.5572	0.5574	0.5576	0.5578	0.5580	0.5581	0.5583	0.5585
90	0.5586	0.5587	0.5589	0.5591	0.5592	0.5593	0.5595	0.5596	0.5598	0.5599
100	0.5600									

TABLE 7.4 REDUCED STANDARD DEVIATION  $S_n$  IN GUMBEL'S EXTREME VALUE DISTRIBUTION

$N$  = sample size

$N$	0	1	2	3	4	5	6	7	8	9
10	0.9496	0.9676	0.9833	0.9971	1.0095	1.0206	1.0316	1.0411	1.0493	1.0565
20	1.0628	1.0696	1.0754	1.0811	1.0864	1.0915	1.0961	1.1004	1.1047	1.1086
30	1.1124	1.1159	1.1193	1.1226	1.1255	1.1285	1.1313	1.1339	1.1363	1.1388
40	1.1413	1.1436	1.1458	1.1480	1.1499	1.1519	1.1538	1.1557	1.1574	1.1590
50	1.1607	1.1623	1.1638	1.1658	1.1667	1.1681	1.1696	1.1708	1.1721	1.1734
60	1.1747	1.1759	1.1770	1.1782	1.1793	1.1803	1.1814	1.1824	1.1834	1.1844
70	1.1854	1.1863	1.1873	1.1881	1.1890	1.1898	1.1906	1.1915	1.1923	1.1930
80	1.1938	1.1945	1.1953	1.1959	1.1967	1.1973	1.1980	1.1987	1.1994	1.2001
90	1.2007	1.2013	1.2020	1.2026	1.2032	1.2038	1.2044	1.2049	1.2055	1.2060
100	1.2065									

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Semester Final Examination Fall 2012**  
**Program : B.Sc Engineering (Civil)**

Course Title: Project Planning and Management  
 Time: 3:00 hrs

Course Code: CE 401  
 Full Marks: 100

There are SEVEN Questions answer any FIVE  
 (Graph sheet would be supplied)

1. (a) The manager of an oil refinery must decide on the optimal mix of two possible blending processes of which the inputs and outputs per production run are as follows:

Process	Inputs (units)		Outputs	
	Crude1	Crude2	Petrol (superior)	Petrol (ordinary)
A	10	3	10	16
B	12	15	12	12

The availability of the two varieties of crude is limited to the extent of 400 and 450 units respectively per day. The market demand indicates that atleast 200 units and 240 units of superior and ordinary quality of petrol is required every day. The profitability analysis indicate that process A contributes Tk. 180 per day while the process B contributes Tk. 240 in a day. Determine the number of production runs of process A and process B to maximize the company's profit. Formulate this as an LP model. (10)

- (b) The following table contains figures on the annual usage and unit costs for a random sample of 12 items. Develop an A-B-C classification for these items. (10)

Item Name	Annual usage	Unit cost
1	1100	TK 4000
2	9000	720
3	1900	600
4	1000	710
5	2500	250
6	2500	192
7	5000	200
8	500	100
9	200	210
10	1000	35
11	3000	100
12	9000	300

2. (a) Objective function:

(14)

$$\text{Maximize } Z = 3x_1 + 5x_2$$

Constrains:

$$-3x_1 + 4x_2 \leq 12$$

$$2x_1 - x_2 \geq -2$$

$$2x_1 + 3x_2 \geq 12$$

$$x_1 \leq 4$$

$$x_2 \geq 2$$

$$x_1 \geq 0$$

Handwritten notes:  
 $x_1(-4, 0)$   
 $x_2(0, 3)$

- Find the optimum value of  $X_1$  and  $X_2$  by graphical method.
- Find maximum profit
- Find the range of optimality for coefficient of  $X_1$  and  $X_2$  in the objective function

(b) Assign the tasks to the employees such that each employee will be assigned by only one job to minimize the total cost. Find at least two multiple solutions if there is any. (6)

		Tasks				
		1	2	3	4	5
Employees	A	10	9	9	18	10
	B	13	9	9	18	11
	C	3	2	4	18	10
	D	18	9	12	17	11
	E	11	11	14	12	13

Handwritten note: 47, 22

3 (a) A chemical company produces two products, X and Y. Each unit of product X requires 3 hours on operation (I) and 4 hours on operation (II) while each unit of product Y requires 4 hours on operation I and 5 hours on operation II. Total available time for operation I and II is 20 hours and 26 hours, respectively. The production of each unit of product Y also results in 2 units of a byproduct Z at no extra cost. Product X sells at a profit of Tk. 10 per unit while Y sells at a profit of Tk. 20 per unit.

Byproduct Z brings a unit profit of Tk. 6 if sold; incase it cannot be sold the destruction cost id Tk. 4 per unit. Forecasts indicate that not more than 5 units of Z can be sold. Determine the quantities of X and Y to be produced, keeping Z is in mind so that the profit earned is maximum. Formulate the above as LP problem. (10)

(b) Discuss different qualitative forecasting methods. Why is the Delphi Method superior than other methods? (6)

(c) Discuss the importance of MRP in detail. (4)

4. (a) Discuss the activities associated with different stages of Project life cycle. (4)  
 (b) Judy Kramer, the project manager for the St. John's Hospital Project, Project activity status are shown below: (16)

Activity	Description	Activity Predecessor	Time (Weeks)
A	Select Admin Staff	-----	3
B	Site selection and survey	-----	4
C	Select medical equipment	-----	4
D	Prepare final construction plan	A	5
E	Bring utilities to sites	B	2
F	Interview for nursing and staff	C	6
G	Purchase and deliver equipment	D,E	3
H	Construct hospital	F,G	1

- A. Draw the AON network diagram  
 B. Find the project completion time  
 C. Find the critical path  
 D. Find ES/EF and LS/LF for each of the activity  
 E. If you reduce the time required for activity F & G by 1 week each, find the project completion time and critical path as well.
5. (a) Suppose you have 1,00,000/- for investment and Project A and Project B is offering the repayment schedule as shown in the following cash flow: (12)

Year	Cash flow of Project A	Cash flow of Project B
0 (investment)	1,00,000/-	1,00,000/-
1	50,000/-	20,000/-
2	30,000/-	20,000/-
3	20,000/-	20,000/-
4	10,000/-	40,000/-
5	10,000/-	50,000/-
6		60,000/-

You can earn a total 1,20,000/- in 5 years from project A and earn a total of 2,10,000/- in 6 years from project B as shown in the above table. Find the NPV, BCR and Discounted Pay Back Period for each of the project. Also make comments on the result in respect to investment decision. Consider 10% annual interest/discount rate.

- (b) What do you mean by money inflation? Discuss its consequences in investment decision. (4)  
 (c) Discuss the relation between NPV and IRR of a project for different values of discount rate. (4)
6. (a) A museum of natural history opened a gift shop two years ago. Managing inventories has become a problem. Low inventory turnover is squeezing profit margins and causing cash flow problem. One of the top selling SKUs in the container group at the museum's gift shop is a bird feeder. sales are 18 units per week, and the supplier charges \$60 per unit. The cost of placing an order with a supplier is 45\$. Annual holding cost is 25 percent of feeder's value, and the museum operates 52 weeks per year. Management chose a 390 unit lot size so that new orders could be placed less frequently. What is the annual cycle inventory cost of the current policy of using a 390 unit lot size? Would a lot size of 460 is better. Calculate the EOQ and its total annual cycle-inventory cost. How frequently will orders be placed if the EOQ is used? (10)

(b) The Polish General's Pizza Parlor is a small restaurant catering to patrons with a taste for European pizza. One of its specialties Polish Prize pizza. The management must forecast weekly demand for these special pizzas so that he can order pizza shells weekly. Recently, demand has been as follows: (10)

Week	Pizzas	Week	Pizzas
June 2	50	June 23	56
June 9	65	June 30	55
June 16	52	July 7	60

- i. Forecast the demand for pizza for June 23 to July 14 by using the simple moving average method with  $n=3$ . Then repeat the forecast by using the weighted moving average method with  $n=3$  and weights of 0.50, 0.30 and 0.20, with 0.50 applying to the most recent demand.
- ii. Calculate the MAD for each method and make comments.

7. (a) A firm's sales for a product line during the 12 quarters of the previous three years were as follows:

Quarter	Sales	Quarter	Sales
1	600	7	2600
2	1550	8	2900
3	1500	9	3800
4	1500	10	4500
5	2400	11	4000
6	3100	12	4900

The firm wants to forecast each quarter of the fourth year, that is, quarters 13, 14, 15 and 16. Find them. (10)

- (b) There are following seven jobs and they must pass through Machine 1 and Machine 2. Operating time for both the machines is shown below for each of the job. (8)

Job	Operations Time for machine 1	Operations Time for machine 2
A	9	6
B	8	5
C	7	7
D	6	3
E	1	2
F	2	6
G	4	7

- i. Schedule (job sequence and show the arrangement in diagram for machine 1 & 2) the seven jobs through two machines in sequence to minimize the flow time using Johnson's rule.
- ii. Find the job completion time.
- iii. Find the slack time or idle time for machine 1 & 2, separately.

- (c) What is safety stock? Explain. (2)

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Professional Practice and Communication  
Time: 120 minutes

Course Code: CE 403  
Full Marks:  $(12\frac{1}{2} \times 8) = 100$

Answer any 8 (eight) questions

1.
  - a. In what type of procurement Two Stage Tendering Methods is used? [3]
  - b. Explain two types of Two Stage Tendering Method briefly.  $[3\frac{1}{2} + 3\frac{1}{2}]$
  - c. What are the items of Tender Evaluation Report [2½]
2.
  - a. What is Price Adjustment Factor (PAF)? [2]
  - b. What are the conditions of applicability of PAF? [2]
  - c. Explain the equation of PAF. [4]
  - d. Contract price of stone chips is Tk. 120 and price of that at the time of execution (as per BBS) is Tk. 150 and the price 28 days before receiving tenders was Tk. 135. What will be adjusted unit price of that item? Use usual value of coefficient.  $[4\frac{1}{2}]$
3.
  - a. Define Ethics. [2]
  - b. What are the factors on which acquiring and maintaining ethical values depend?  $[3\frac{1}{2}]$
  - c. Write down the fundamental canons of ethics. [7]
4.
  - a. Define Industrial Relation. [1]
  - b. What are the objectives of Industrial Relation? [9]
  - c. Write short note on collective bargaining?  $[2\frac{1}{2}]$
5.
  - a. What is unemployment? [1]
  - b. Explain through equation that "steady state rate of employment depends on the rate of job separation and rate of job finding" using the following notations:  
L=Total labor force, E=Number of employed labor force, U=Number of unemployed labor force, s=Rate of job separation, f=Rate of job finding [9]
  - c. What is the difference between DPM and RFQ Method of procurement?  $[2\frac{1}{2}]$
6.
  - a. Explain five steps in preparing effective business messages.  $[9\frac{1}{2}]$
  - b. What are three types of listening? Define each. [3]

- 7.
- a. What is Green Economy? [3]
  - b. How does a Green Economy help eradicate poverty? [6½]
  - c. "Sustainable development require that we see the world as a system—a system that connects space; and a system that connects time." – Explain. [3]
- 8.
- a. What is Communication? [1½]
  - b. When a communication is considered to be effective? [1]
  - c. Explain the principles or "Seven C's" of effective written or oral communication. [10]
- 9.
- a. What are different ways of delivering the oral message? Briefly explain each. [2½]
  - b. Write down all different parts of a business letter following correct format and sequence on the left and explain each part on the right side. [10]
- 10.
- a. Define Sustainable Development? [1]
  - b. What are the pillars of Sustainable Development? [1½]
  - c. How the social issues in a locality can impact globally? [3]
  - d. Discuss the link of social issues with economic and environmental issues. [7]

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012 (Set 2)**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Structural Engineering III  
 Time: 3 hours

Credit Hours: 3.0

Course Code: CE 411  
 Full Marks: 100 (= 10 × 10)

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

1. Determine the size of stiffness matrices ( $\mathbf{K}$ ) of the 2D frame and 3D frame shown in Fig. 1  
 (i) with and without considering the boundary conditions,  
 (ii) if axial deformations are neglected.

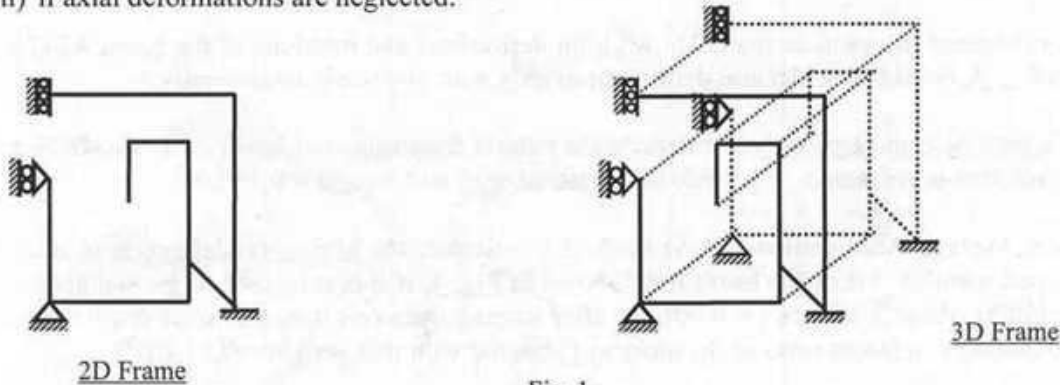


Fig. 1

2. Ignore the zero-force members and formulate the stiffness matrix, load vector and write down the boundary conditions of the truss  $abcdef$  shown in Fig. 2.

$S_x = \text{constant} = 5000 \text{ kN/m}$

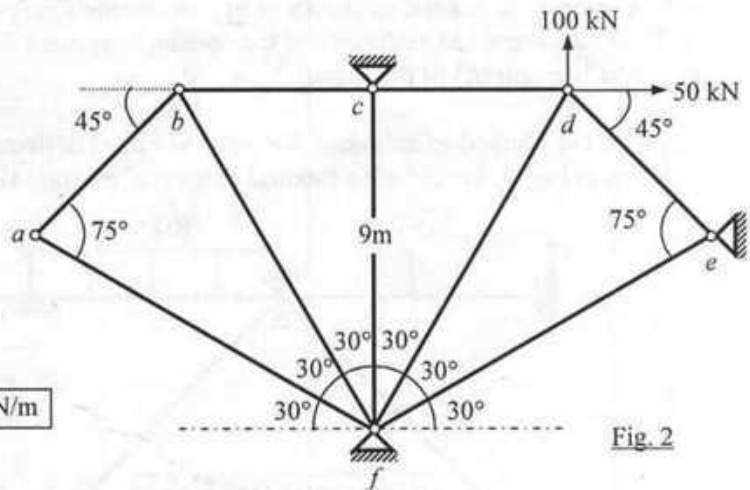
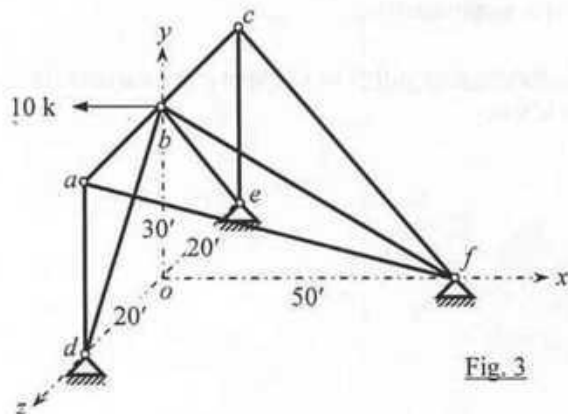


Fig. 2

3. If truss  $abcdef$  shown in Fig. 2 is supported at joint  $e$  on a horizontal spring of stiffness  $k_h = 2500 \text{ kN/m}$  and vertical spring of stiffness  $k_v = 5000 \text{ kN/m}$  (instead of the hinge support shown at joint  $e$ ), formulate its stiffness matrix and load vector, ignoring the zero-force members.
4. Ignore zero-force members to form the stiffness matrix, load vector and write down the boundary conditions of the 3D truss  $abcdef$  shown in Fig. 3 [Given:  $S_x = \text{constant} = 1000 \text{ k/ft}$ ].



Nodal Coordinates (m)

$a(0, 30, 20), b(0, 30, 0), c(0, 30, -20)$

$d(0, 0, 20), e(0, 0, -20), f(50, 0, 0)$

Fig. 3

5. Assemble the stiffness matrix, load vector and calculate the unknown joint deflections and rotations of the beam ABC loaded as shown in Fig. 4, considering both axial and flexural deformations.

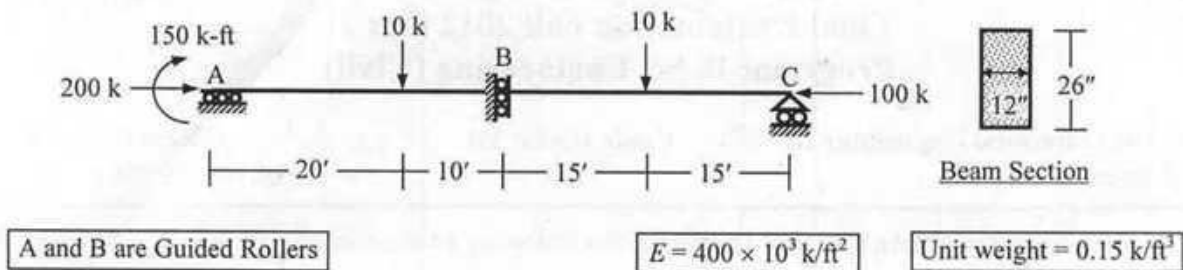


Fig. 4

6. Use Stiffness Method to calculate the unknown joint deflections and rotations of the beam ABC loaded as shown in Fig. 4, considering flexural deformations only with geometric nonlinearity.
7. Consider flexural deformations only to calculate the natural frequencies of beam ABC shown in Fig. 4, using the consistent-mass matrix, if it made of a material with unit weight =  $0.15 \text{ k/ft}^3$ .
8. Use Constant Average Acceleration (CAA) Method to calculate the horizontal deflection at node A of the 5% damped member AB of the beam ABC shown in Fig. 4, if it is subjected to ground acceleration  $a_g = 15 \text{ Cos}(600t) \text{ (ft/sec}^2\text{)}$ , at time  $t = 0.001 \text{ sec}$  after starting from rest (i.e., no initial displacement and velocity), assuming consistent mass of the member [Material with unit weight =  $0.15 \text{ k/ft}^3$ ].
9. For the beam ABC loaded as shown in Fig. 4, use the Energy Method to calculate the required  
 (i) Plastic moment ( $M_p$ ) capacity of the section to prevent development of plastic hinge mechanism,  
 (ii) Yield strength ( $f_y$ ) of the material.
10. Use Stiffness Method to calculate the unknown joint deflections and rotations of the frame *abcde* loaded as shown in Fig. 5, considering flexural deformations only (if the force  $P = 0$ ).

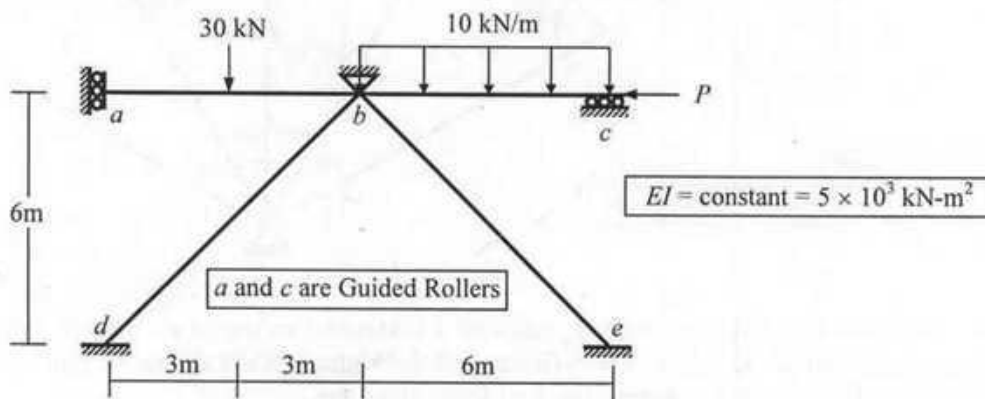


Fig. 5

11. Use Stiffness Method to calculate the force  $P$  needed to cause buckling of frame *abcde* shown in Fig. 5, considering flexural deformations only with geometric nonlinearity.
12. Use consistent-mass matrix (considering flexural deformations only) to calculate the natural frequencies of the frame *abcde* shown in Fig. 5, if it weighs  $3.0 \text{ kN/m}$ .

13. Use the bending moment diagram to calculate the force  $P$  needed to develop plastic hinge mechanism in the reinforced concrete beam ABCD loaded as shown in Fig. 6 [Given:  $f'_c = 3$  ksi,  $f_y = 50$  ksi].

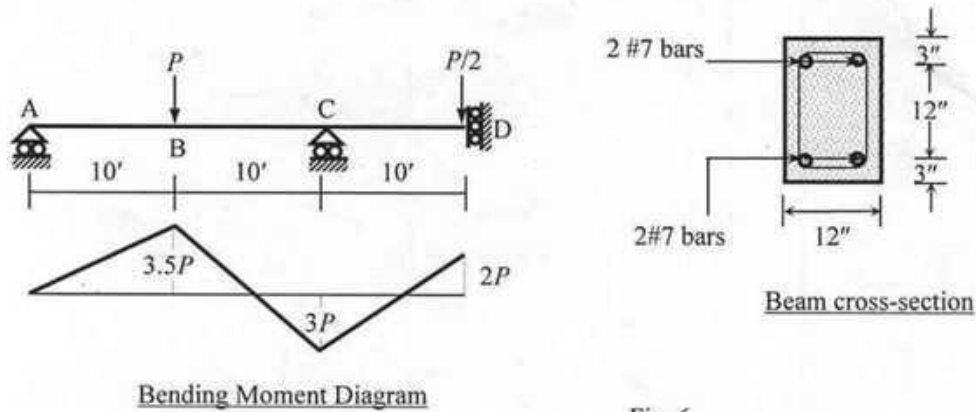


Fig. 6

14. Briefly explain

- (i) how the effect of support settlement can be incorporated in the structural analysis of beams,
- (ii) why the stiffness matrix and mass matrix of a structure are both symmetric (use equations with shape function  $\psi$ ),
- (iii) the main advantage and disadvantage of using the energy method to obtain the collapse load of a structure,
- (iv) the main advantage and disadvantage of using lumped-mass matrix in structural dynamics,
- (v) the effect of foundation flexibility on the structural response to wind vibration.

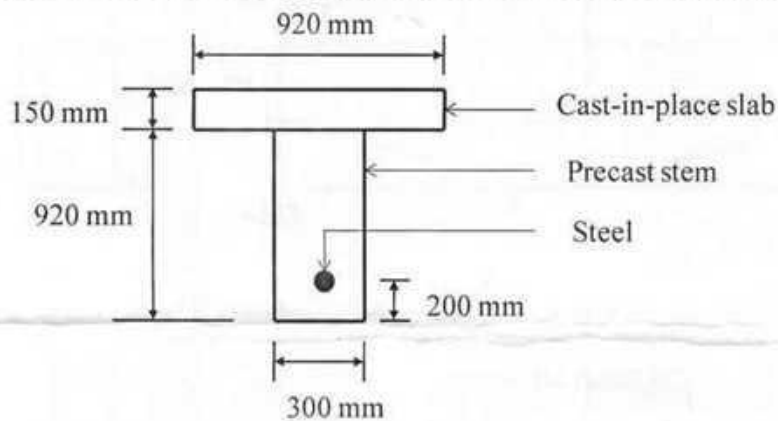
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Structural Engineering V  
 Time: 2 Hours

Course Code: CE 415  
 Full Marks: 50

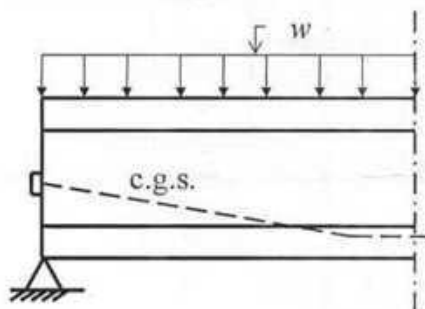
[There are seven questions. Answer any **Five**. ( $5 \times 10 = 50$ )]  
 [Symbols carry their conventional meanings.]

1. (a) The midspan section of a composite beam is shown in the following figure. The precast stem is posttensioned with an initial prestressing force of 2450 kN. The effective prestress after losses is 2150 kN. Moment due to the weight of precast section is 270 kN-m at midspan. The top slab is to be cast-in-place above the stem producing a moment of 135 kN-m at midspan. The composite section is to carry a maximum live load moment of 750 kN-m. Compute stresses in the section at various stages. (07)

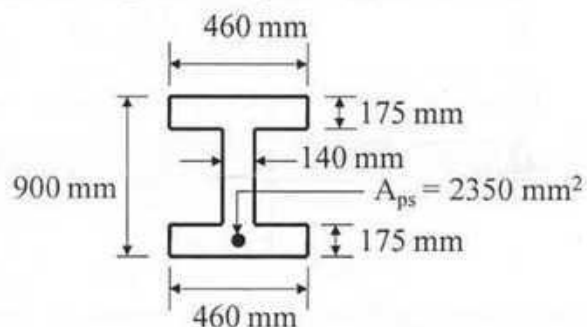


- (b) Explain, with a neat sketch, the variation of steel stress with load in a prestressed concrete beam. (03)

2. (a) An I-shaped beam is prestressed with an effective prestress of 1100 MPa as shown in the following figure. The cgs of the strands which supply the prestress is 115 mm above the bottom of the beam. Material properties are:  $f_{pu} = 1860$  MPa,  $f'_c = 48$  MPa. Find the ultimate resisting moment of the section for design following the ACI Code. (07)

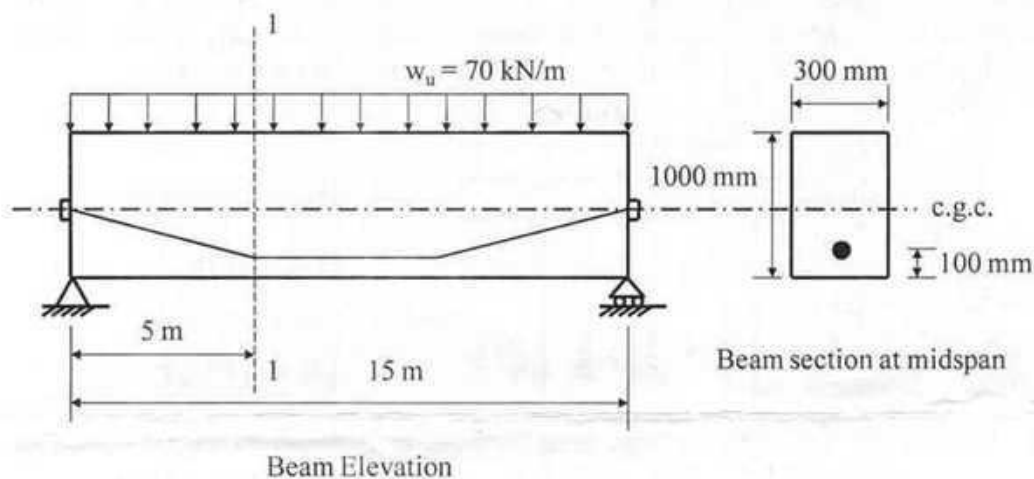


Beam Elevation

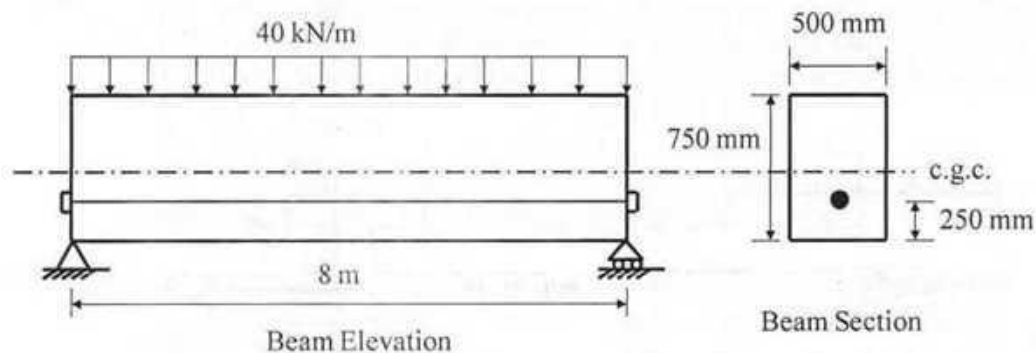


Beam Section

- (b) Explain stress distribution in concrete according to elastic theory. (03)
3. (a) Make a preliminary design for section of a prestressed concrete beam to resist a total moment of 435 kN-m and girder moment of 55 kN-m. The overall depth of the beam is 920 mm. Assume thickness of web and flange as 100 mm. The effective prestress for steel is 860 MPa, and allowable stress for concrete under working load is -11 MPa. (05)
- (b) For the preliminary section of (a) above, make a final design allowing no tension in concrete. Given:  $f_b = -12.5$  MPa,  $f_o = 1035$  Mpa. (05)
4. Check shear strength for the following beam at (a) a section  $h/2$  distance apart from support and (b) at section 1-1. Given that this section is adequate for  $w_u = 70$  kN/m,  $f_c = 40$  MPa.  $F_c = 1989$  kN,  $A_{ps} = 1800$  mm<sup>2</sup>. Assume reasonable values for missing data, if any. (10)

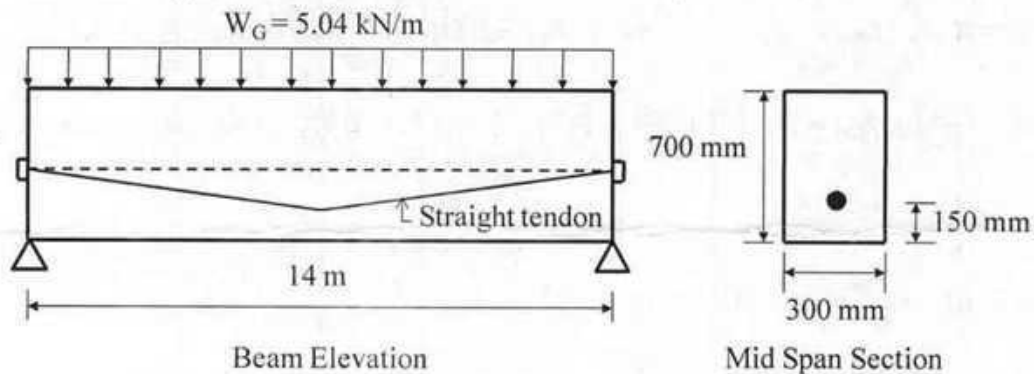


5. (a) A prestressed concrete rectangular beam 500 mm by 750 mm has a simple span of 8 m (07) and is loaded by a uniform load of 40 kN/m **excluding self-weight** as shown in the following figure. The prestressing tendon is located as shown and produces an effective prestress of 1620 kN. Compute fiber stresses in the concrete at the mid-span section using the first concept.

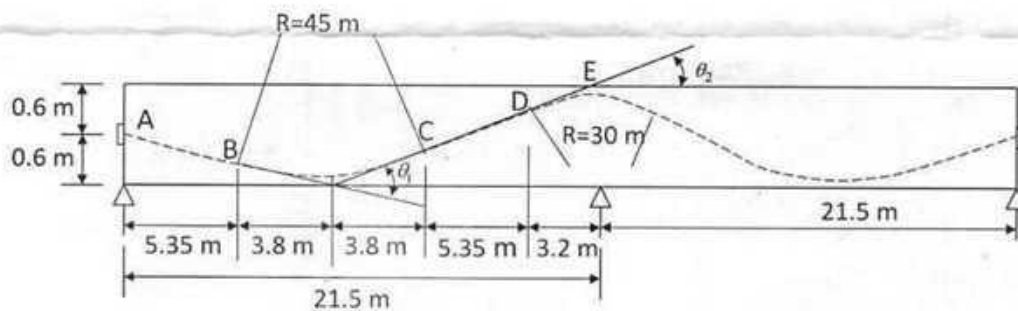


- (b) Write down applications and limitations of prestressed concrete. (03)
6. (a) Write down the name of different types of loss that occur in a prestressed concrete beam. (05)

- (b) A pretensioned concrete member 14.0 m long is eccentrically prestressed with  $900 \text{ mm}^2$  of steel wires which are anchored to the bulkheads with a stress of 1000 MPa. Compute the loss of prestress at the mid span section due to the elastic shortening of concrete at the transfer of prestress. Assume  $n=7$ . (20)



- 7.(a) Explain the difference between the behavior of a prestressed- and of a reinforced-concrete-beam section. (03)
- (b) A prestressed concrete beam is continuous over two spans, as shown in the following figure, and its curved tendon is to be tensioned from both ends. Compute the percentage of loss due to friction, from one end to the center of the beam (A to E). The coefficient of friction between the cable and the duct is 0.4, and the average 'wobble' or length effect is 0.0026 per meter. Use exact method. (07)



## Annexure - I: Formulas

- $CR = K_{cr} \frac{E_s}{E_c} (f_{cir} - f_{cds}); \quad RE = [K_{re} - J(SH + CR + ES)]C; \quad F_2 = F_1 e^{-\mu\alpha - KL}$
- $ES = \left(\frac{E_s}{E_{ci}}\right) \times f_{cir} = n \times \left(\frac{F_o}{A} + \frac{F_o e^2}{l} - \frac{M_G e}{l}\right) \quad [F_o = 0.9F_l \text{ (Pretensioned member)}]$
- $f_{cir} = \left(\frac{F_o}{A} + \frac{F_o e^2}{l} - \frac{M_G e}{l}\right); \quad f = \frac{F}{A} \pm \frac{Fey}{l} \pm \frac{My}{l}; \quad w_b = \frac{8Fh}{L^2}$
- $ES = \Delta f_s = \frac{nF_l}{A_c + nA_s}; \quad ANC = \Delta f_s = \frac{\Delta_a E_s}{L}; \quad n = \frac{E_s}{E_{ci}}$
- $f_{ps} = f_{pu} \left(1 - 0.5\rho_p \frac{f_{pu}}{f'_c}\right);$
- $\rho_p = \frac{A_{ps}}{bd}; \quad w_p = \rho_p \frac{f_{ps}}{f'_c} \leq 0.3;$
- $T' = A_{ps} f_{ps}; \quad C' = 0.85 f'_c b a;$
- $M_u = \phi A_{ps} f_{ps} \left(d - \frac{a}{2}\right); \quad A_{pf} = \frac{0.85 f'_c (b - b_w) h_f}{f_{ps}}$
- $M_u = \phi \left[A_{pw} f_{ps} \left(d - \frac{a}{2}\right) + 0.85 f'_c (b - b_w) h_f \left(d - \frac{h_f}{2}\right)\right];$
- $e = \frac{M_G}{F_o} + k_b; \quad F = \frac{M_T}{(e + k_t)}$
- $A_c = \frac{Fh}{f_t c_b}; \quad A_c = \frac{F_o h}{f_b c_t};$
- $A_c = \frac{F_o}{f_b} \left(1 + \frac{e - \left(\frac{M_G}{F_o}\right)}{k_t}\right);$
- $k_t = \frac{r^2}{c_b}; \quad k_b = \frac{r^2}{c_t}$
- $V_{ci} = 0.05 \sqrt{f'_c} b_w d + V_d + \frac{V_i M_{cr}}{M_{max}} \geq 0.14 \sqrt{f'_c} b_w d$
- $M_{cr} = \left(\frac{l}{y_t}\right) (0.5 \sqrt{f'_c} + f_{pe} - f_d)$
- $V_{cw} = (0.29 \sqrt{f'_c} + 0.3 f_{pc}) b_w d + V_p$
- $\frac{M}{V} = \frac{lx - x^2}{l - 2x}$

4-2

University of Asia Pacific  
Department of Civil Engineering  
Final Examination Fall 2012

Program: B.Sc Engineering (Civil)

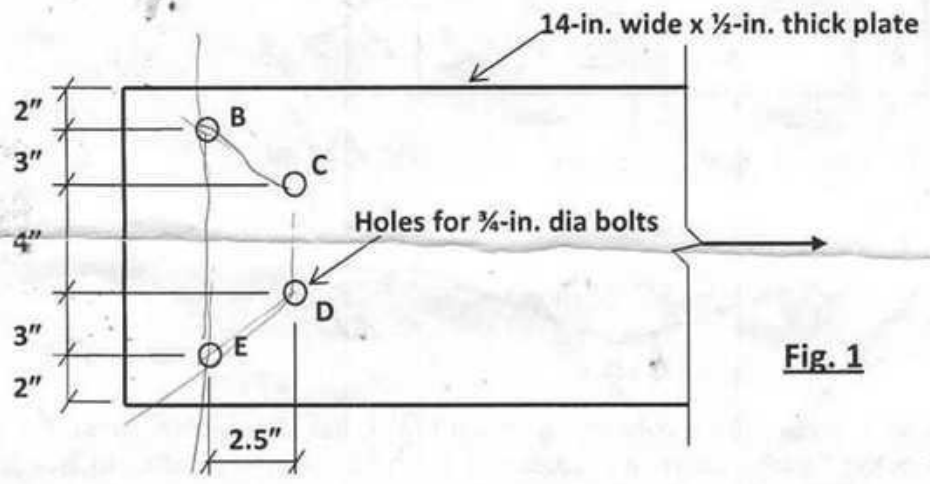
Course Title: Structural Engineering VI (Design of Steel Structures) Course Code: CE 417  
Time: 2 hours Full Marks: 50

The figures in the margin indicate full marks.

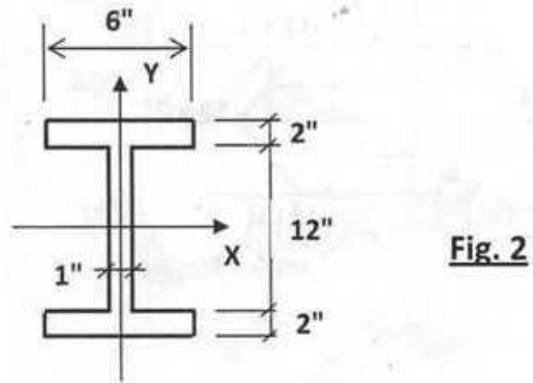
Assume reasonable values for any missing data. Annexures are provided to facilitate design.

There are EIGHT questions. Answer any SIX questions

1. Calculate all the probable net widths and the controlling net area for the 14-inch wide by 1/2-inch thick plate with staggered holes to be used as a tension member as shown in Fig.1. Holes are for 3/4-in. diameter bolts. 8 1/3



2. Compute the yield moment and plastic moment capacities and shape factor for major axis (X-axis) bending of the I-section shown in Fig. 2. Given:  $F_y = 50$  ksi. 8 1/3



$$\frac{336 + 304}{16} \approx 40$$

- 1.2 + 2.2 =
3. Select the lightest W section for a beam to carry a uniformly distributed live load of 2.4 kips/ft and a dead load, including the weight of the beam, of 1.2 kips/ft on a 32-ft simply supported span. Assume that the beam will be braced to satisfy compact-section requirements. What will be the least spacing of lateral bracings to satisfy the compact section requirements? Also check whether the deflection criterion is satisfied or not for live load only. Given:  $F_y = 65$  ksi. See Annexures-1 & 2. 8 1/3
  4. Write the equation for the stress-strain behaviour in tension of the 16x1 inch plate with the residual stress shown in Fig. 3 at an imposed tensile strain of 0.0014 in./in. What is the tangent modulus at this strain? Given:  $F_y = 36$  ksi;  $E = 30000$  ksi. 8 1/3

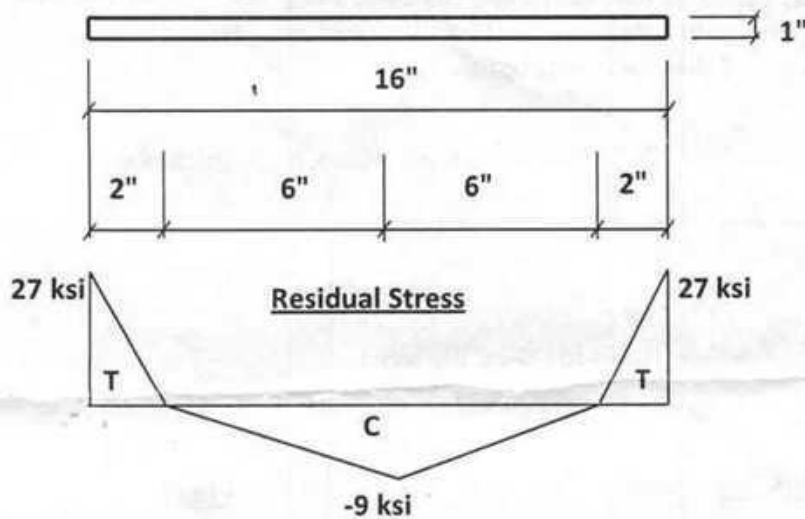


Fig. 3

5. The webless H section for a column, shown in Fig. 4, has the residual stress distribution as shown in the figure. Determine values of  $L/r_x$  and  $L/r_y$  corresponding to  $I_{x,eff}$  and  $I_{y,eff}$  (effective moments of inertia about x and y axes) respectively, if a column with the given section buckles at an imposed uniform compressive strain of  $-0.0012$  in./in. Given:  $F_y = 36$  ksi and  $E = 30000$  ksi. 8 1/3

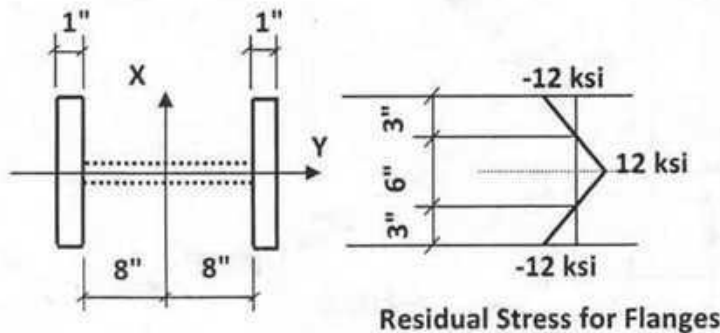


Fig. 4

6. A W10x54 section is used for a 18 ft. long column. The section has an area of  $15.8 \text{ in}^2$  and a radius of gyration,  $r_y = 2.56 \text{ in.}$  about the weak axis Y. If  $K=1$  for both X and Y axes, using AISC/ASD method, check whether an axial load of 200 kip is safe for the column or not. Given:  $F_y = 36 \text{ ksi}$  and  $E = 29000 \text{ ksi}$ . See Annexure-3. 8 1/3
7. A W14x38 section, with an area of  $11.2 \text{ in}^2$  and a radius of gyration  $r_y = 1.55 \text{ in.}$  about the weak axis Y, is to be used for a 10 ft. long column. If  $K=1$  for both X and Y axes, using AISC/LRFD method, determine whether the column will be able to carry an axial dead load of 60 kip along with a live load of 150 kip. Given:  $F_y = 36 \text{ ksi}$  and  $E = 29000 \text{ ksi}$ . See Annexure-4. 8 1/3
8. Determine the effective length coefficients for the columns of the frame shown in Fig. 5. The moments of inertia in  $\text{in}^4$  for the columns and beams are shown in the figure. Annexure-5 provides necessary nomographs. 8 1/3

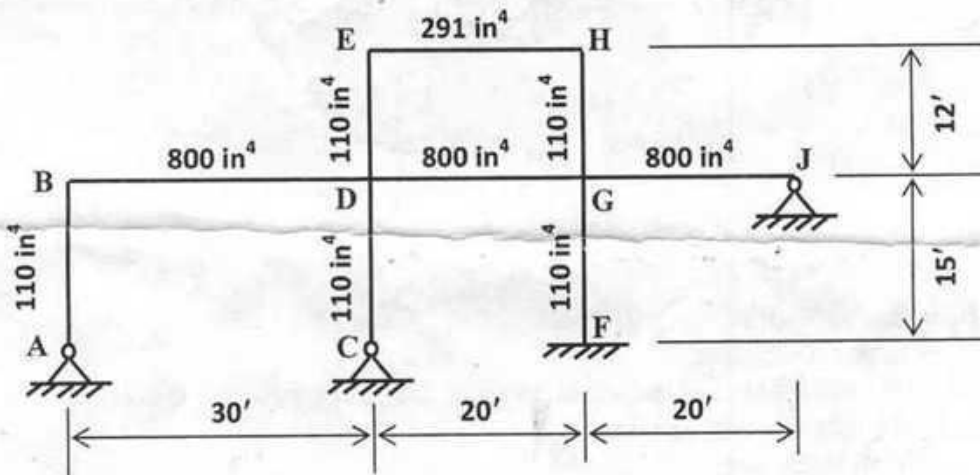


Fig. 5

1, 2,

## ANNEXURE-1

### Specification Formulas

AISC/ASD. The allowable bending stress  $F_b$  for channels and I-shaped members of steels with  $F_y \leq 65$  ksi, supported against lateral buckling and bent about the major axis, are as follows:

$$\text{Compact section:} \quad F_b = 0.66F_y \quad (5-16a)$$

$$\text{Noncompact section:} \quad F_b = 0.60F_y \quad (5-16b)$$

If  $65/\sqrt{F_y} \leq b_f/2t_f \leq 95/\sqrt{F_y}$ :

$$F_b = \begin{cases} F_y \left( 0.79 - 0.002 \frac{b_f}{2t_f} \sqrt{F_y} \right) & \text{(rolled shapes)} \quad (5-16c) \\ F_y \left( 0.79 - 0.002 \frac{b_f}{2t_f} \sqrt{\frac{F_y}{k_c}} \right) & \text{(built-up members)} \quad (5-16d) \end{cases}$$

where

$$k_c = \begin{cases} 1 & \text{if } \frac{h}{t} \leq 70 \\ \frac{4.05}{(h/t)^{0.46}} & \text{if } \frac{h}{t} > 70 \end{cases}$$

Notation in Eqs. (5-16) is as follows:

$b_f$  = flange width

$t_f$  = flange thickness

$h$  = distance between adjacent lines of fasteners, or clear distance between flanges if welds are used

$t$  = web thickness

Lateral support may be continuous, as for a beam which is the direct support of a floor, or by bracing members. Lateral-support spacing for beams designed for  $F_b = 0.66F_y$  must not exceed the smaller of the values of  $L_c$  given by the following:

$$L_c = \frac{76b_f}{\sqrt{F_y}} \quad (5-17a)$$

$$L_c = \frac{20,000}{F_y d/A_f} \quad (5-17b)$$

DEFLECTION CRITERIA FOR LIVE LOAD STRESS  $F_b$ :

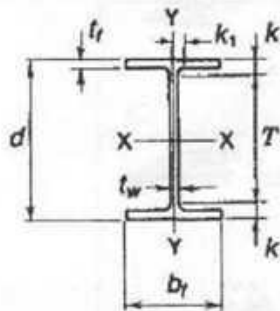
$$\frac{L}{d} \leq \frac{480}{F_b}$$

ANNEXURE-2

ALLOWABLE STRESS DESIGN SELECTION TABLE									
For shapes used as beams									
$F_y = 50 \text{ ksi}$			$S_x$	Shape	Depth $d$	$F_y$	$F_y = 36 \text{ ksi}$		
$L_c$	$L_u$	$M_R$					$L_c$	$L_u$	$M_R$
Ft	Ft	Kip-ft	In. <sup>3</sup>		In.	Ksi	Ft	Ft	Kip-ft
8.1	8.5	464	176	W 24x 76	23 3/4	—	9.5	11.8	348
9.3	20.2	481	175	W 16x100	17	—	11.0	28.1	347
13.1	28.2	476	173	W 14x109	14 3/8	58.6	15.4	40.6	343
7.5	10.9	470	171	W 21x 83	21 3/8	—	8.8	15.1	339
9.9	15.3	457	166	W 18x 86	18 3/8	—	11.7	21.5	329
13.0	28.7	432	157	W 14x 99	14 1/2	48.5	15.4	37.0	311
9.3	18.0	429	155	W 16x 89	16 3/4	—	10.9	25.0	307
7.4	8.5	424	154	W 24x 68	23 3/4	—	9.5	10.2	305
7.4	8.6	415	151	W 21x 73	21 1/4	—	8.8	13.4	299
9.9	13.7	402	146	W 18x 76	18 1/4	64.2	11.6	19.1	289
13.0	24.5	383	143	W 14x 90	14	40.4	15.3	34.0	283
7.4	8.9	385	140	W 21x 68	21 1/8	—	8.7	12.4	277
9.2	15.8	380	134	W 16x 77	16 1/2	—	10.9	21.9	265
5.8	6.4	366	131	W 24x 62	23 3/4	—	7.4	8.1	259
7.4	8.1	349	127	W 21x 62	21	—	8.7	11.2	251
6.8	11.1	349	127	W 18x 71	18 1/2	—	8.1	15.5	251
9.1	20.2	338	123	W 14x 82	14 1/4	—	10.7	28.1	244
10.9	26.0	325	118	W 12x 87	12 1/2	—	12.8	36.2	234
6.8	10.4	322	117	W 18x 65	18 3/8	—	8.0	14.4	232
9.2	13.0	322	117	W 16x 67	16 3/8	—	10.8	19.3	232
5.0	5.3	314	114	W 24x 55	23 3/8	—	7.0	7.5	226
9.0	18.8	308	112	W 14x 74	14 1/8	—	10.6	25.9	222
5.9	8.7	305	111	W 21x 57	21	—	6.9	9.4	220
6.8	8.6	297	108	W 18x 60	18 1/4	—	8.0	13.3	214
10.8	24.0	294	107	W 12x 79	12 3/8	62.6	12.8	33.3	212
9.0	17.2	293	103	W 14x 68	14	—	10.6	23.9	204
8.7	8.7	270	98.3	W 18x 55	18 1/8	—	7.9	12.1	195
10.8	21.9	268	97.4	W 12x 72	12 1/4	52.3	12.7	30.5	193
5.8	6.8	260	94.5	W 21x 50	20 3/8	—	6.9	7.8	187
8.4	10.3	254	92.2	W 16x 57	16 3/8	—	7.5	14.3	183
9.0	15.5	254	92.2	W 14x 61	13 3/8	—	10.6	21.5	183
8.7	7.9	244	88.9	W 18x 50	18	—	7.9	11.0	176
10.7	20.0	238	87.9	W 12x 65	12 1/8	43.0	12.7	27.7	174
4.7	5.9	234	81.6	W 21x 44	20 3/8	—	6.6	7.0	182
6.3	9.1	223	81.0	W 16x 50	16 1/4	—	7.5	12.7	180
5.4	8.8	217	78.8	W 18x 46	18	—	6.4	9.4	156
9.0	17.5	215	78.0	W 12x 58	12 1/4	—	10.6	24.4	154
7.2	12.7	213	77.8	W 14x 53	13 3/8	—	8.5	17.7	154
6.3	8.2	200	72.7	W 16x 45	16 1/8	—	7.4	11.4	144
9.0	15.9	194	70.6	W 12x 53	12	55.9	10.6	22.0	140
7.2	11.5	193	70.3	W 14x 48	13 3/4	—	8.5	16.0	139

$d$  we 5

ANNEXURE-2 (Contd.)

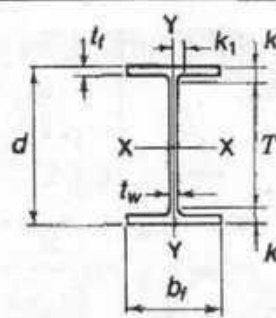


W SHAPES  
Dimensions

Designation	Area A	Depth d		Web			Flange			Distance			
				Thickness $t_w$	$\frac{t_w}{2}$	Width $b_f$	Thickness $t_f$	T	k	$k_1$			
											In. <sup>2</sup>	In.	In.
W 24x492 <sup>a</sup>	144.0	29.65	29%	1.970	2	1	14.115	14%	3.540	3 <sup>9</sup> / <sub>16</sub>	21	4 <sup>9</sup> / <sub>16</sub>	1 <sup>9</sup> / <sub>16</sub>
x450 <sup>a</sup>	132.0	29.09	29%	1.810	1 <sup>13</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	13.955	14	3.270	3 <sup>1</sup> / <sub>2</sub>	21	4 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>
x408 <sup>a</sup>	119.0	28.54	28 <sup>1</sup> / <sub>2</sub>	1.650	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>16</sub>	13.800	13 <sup>3</sup> / <sub>4</sub>	2.990	3	21	3 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>
x370 <sup>a</sup>	108.0	27.99	28	1.520	1 <sup>1</sup> / <sub>2</sub>	3 <sup>4</sup> / <sub>16</sub>	13.660	13 <sup>3</sup> / <sub>8</sub>	2.720	2 <sup>3</sup> / <sub>4</sub>	21	3 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>16</sub>
x335 <sup>a</sup>	98.4	27.52	27 <sup>1</sup> / <sub>2</sub>	1.380	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>16</sub>	13.520	13 <sup>1</sup> / <sub>2</sub>	2.480	2 <sup>1</sup> / <sub>2</sub>	21	3 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>4</sub>
x306 <sup>a</sup>	89.8	27.13	27 <sup>1</sup> / <sub>2</sub>	1.260	1 <sup>1</sup> / <sub>4</sub>	5 <sup>1</sup> / <sub>16</sub>	13.405	13 <sup>3</sup> / <sub>8</sub>	2.280	2 <sup>1</sup> / <sub>4</sub>	21	3 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>
x279 <sup>a</sup>	82.0	26.73	26 <sup>3</sup> / <sub>4</sub>	1.160	1 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	13.305	13 <sup>1</sup> / <sub>4</sub>	2.090	2 <sup>1</sup> / <sub>16</sub>	21	2 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>16</sub>
x250 <sup>a</sup>	73.5	26.34	26%	1.040	1 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	13.185	13 <sup>1</sup> / <sub>8</sub>	1.890	1 <sup>7</sup> / <sub>8</sub>	21	2 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>
x229	67.2	26.02	26	0.960	1	1 <sup>1</sup> / <sub>2</sub>	13.110	13 <sup>1</sup> / <sub>8</sub>	1.730	1 <sup>3</sup> / <sub>4</sub>	21	2 <sup>1</sup> / <sub>2</sub>	1
x207	60.7	25.71	25 <sup>3</sup> / <sub>4</sub>	0.870	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>16</sub>	13.010	13	1.570	1 <sup>1</sup> / <sub>16</sub>	21	2 <sup>3</sup> / <sub>4</sub>	1
x192	56.3	25.47	25 <sup>1</sup> / <sub>2</sub>	0.810	1 <sup>3</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	12.950	13	1.460	1 <sup>7</sup> / <sub>16</sub>	21	2 <sup>1</sup> / <sub>4</sub>	1
x176	51.7	25.24	25 <sup>1</sup> / <sub>4</sub>	0.750	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>16</sub>	12.890	12 <sup>7</sup> / <sub>8</sub>	1.340	1 <sup>1</sup> / <sub>16</sub>	21	2 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>
x162	47.7	25.00	25	0.705	1 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	12.955	13	1.220	1 <sup>1</sup> / <sub>4</sub>	21	2	1 <sup>1</sup> / <sub>16</sub>
x146	43.0	24.74	24 <sup>3</sup> / <sub>4</sub>	0.650	5 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	12.900	12 <sup>7</sup> / <sub>8</sub>	1.090	1 <sup>1</sup> / <sub>16</sub>	21	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>
x131	38.5	24.48	24 <sup>1</sup> / <sub>2</sub>	0.605	5 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	12.855	12 <sup>7</sup> / <sub>8</sub>	0.960	1 <sup>1</sup> / <sub>16</sub>	21	1 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>16</sub>
x117	34.4	24.26	24 <sup>1</sup> / <sub>4</sub>	0.550	5 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	12.800	12 <sup>3</sup> / <sub>4</sub>	0.850	3 <sup>1</sup> / <sub>8</sub>	21	1 <sup>3</sup> / <sub>8</sub>	1
x104	30.6	24.06	24	0.500	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>4</sub>	12.750	12 <sup>3</sup> / <sub>4</sub>	0.750	3 <sup>1</sup> / <sub>4</sub>	21	1 <sup>1</sup> / <sub>2</sub>	1
W 24x103 <sup>b</sup>	30.3	24.53	24 <sup>1</sup> / <sub>2</sub>	0.550	5 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	9.000	9	0.980	1	21	1 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>16</sub>
x 94	27.7	24.31	24 <sup>1</sup> / <sub>4</sub>	0.515	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>4</sub>	9.065	9 <sup>1</sup> / <sub>2</sub>	0.875	3 <sup>1</sup> / <sub>8</sub>	21	1 <sup>3</sup> / <sub>8</sub>	1
x 84	24.7	24.10	24 <sup>1</sup> / <sub>8</sub>	0.470	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>4</sub>	9.020	9	0.770	3 <sup>1</sup> / <sub>4</sub>	21	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>
x 76	22.4	23.92	23 <sup>1</sup> / <sub>8</sub>	0.440	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>4</sub>	8.990	9	0.680	1 <sup>1</sup> / <sub>16</sub>	21	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>
x 68	20.1	23.73	23 <sup>1</sup> / <sub>4</sub>	0.415	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>4</sub>	8.965	9	0.585	5 <sup>1</sup> / <sub>16</sub>	21	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>
W 24x 62	18.2	23.74	23 <sup>3</sup> / <sub>4</sub>	0.430	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>4</sub>	7.040	7	0.590	5 <sup>1</sup> / <sub>16</sub>	21	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>
x 55	16.2	23.57	23 <sup>1</sup> / <sub>8</sub>	0.395	3 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>16</sub>	7.005	7	0.505	1 <sup>1</sup> / <sub>2</sub>	21	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>

ANNEXURE-2 (Contd.)

W SHAPES  
Properties



Nominal Wt. per Ft	Compact Section Criteria				$r_T$	$\frac{d}{A_f}$	Elastic Properties						Plastic Modulus		Designation
	$\frac{b_f}{2t_f}$	$F_y$	$\frac{d}{t_w}$	$F_y^m$			Axis X-X			Axis Y-Y			$Z_x$	$Z_y$	
							$I$	$S$	$r$	$I$	$S$	$r$			
							Lb.	Ksi	Ksi	In.	In. <sup>4</sup>	In. <sup>3</sup>	In.	In. <sup>4</sup>	
492	2.0	—	15.1	—	3.80	0.59	19100	1290	11.5	1670	237	3.41	1550	375	W 24×492 <sup>a</sup>
450	2.1	—	16.1	—	3.76	0.64	17100	1170	11.4	1490	214	3.36	1410	337	×450 <sup>a</sup>
408	2.3	—	17.3	—	3.71	0.69	15100	1060	11.3	1320	191	3.33	1250	300	×408 <sup>a</sup>
370	2.5	—	18.4	—	3.67	0.75	13400	957	11.1	1160	170	3.28	1120	267	×370 <sup>a</sup>
335	2.7	—	19.9	—	3.63	0.82	11900	864	11.0	1030	152	3.23	1020	238	×335 <sup>a</sup>
306	2.9	—	21.5	—	3.60	0.89	10700	789	10.9	919	137	3.20	922	214	×306 <sup>a</sup>
279	3.2	—	23.0	—	3.57	0.96	9600	718	10.8	823	124	3.17	835	193	×279 <sup>a</sup>
250	3.5	—	25.3	—	3.53	1.06	8490	644	10.7	724	110	3.14	744	171	×250 <sup>a</sup>
229	3.8	—	27.1	—	3.51	1.15	7850	588	10.7	651	99.4	3.11	676	154	×229
207	4.1	—	29.6	—	3.48	1.26	6820	531	10.6	576	88.8	3.08	606	137	×207
192	4.4	—	31.4	—	3.46	1.35	6260	491	10.5	530	81.8	3.07	559	126	×192
178	4.8	—	33.7	58.2	3.44	1.46	5680	450	10.5	479	74.3	3.04	511	115	×178
162	5.3	—	35.5	52.5	3.45	1.58	5170	414	10.4	443	68.4	3.05	468	105	×162
146	5.9	—	38.1	45.6	3.43	1.76	4580	371	10.3	391	60.5	3.01	418	93.2	×146
131	6.7	—	40.5	40.3	3.40	1.98	4020	329	10.2	340	53.0	2.97	370	81.5	×131
117	7.5	—	44.1	33.9	3.37	2.23	3540	291	10.1	297	46.5	2.94	327	71.4	×117
104	8.5	58.5	48.1	28.5	3.35	2.52	3100	258	10.1	259	40.7	2.91	289	62.4	×104
103	4.6	—	44.6	33.2	2.33	2.78	3000	245	9.95	119	26.5	1.99	280	41.5	W 24×103 <sup>b</sup>
94	5.2	—	47.2	29.6	2.33	3.06	2700	222	9.87	109	24.0	1.98	254	37.5	× 94
84	5.9	—	51.3	25.1	2.31	3.47	2370	196	9.79	94.4	20.9	1.95	224	32.6	× 84
76	6.6	—	54.4	22.3	2.29	3.91	2100	176	9.69	82.5	18.4	1.92	200	28.6	× 76
68	7.7	—	57.2	20.2	2.26	4.52	1830	154	9.55	70.4	15.7	1.87	177	24.5	× 68
62	6.0	—	55.2	21.7	1.71	5.72	1550	131	9.23	34.5	9.80	1.38	153	15.7	W 24× 62
55	6.9	—	59.7	18.5	1.68	6.66	1350	114	9.11	29.1	8.30	1.34	134	13.3	× 55

### ANNEXURE-3

The AISC/ASD formulas for allowable stress  $F_a$  on axially loaded compression members are

$$F_a = \begin{cases} \frac{F_y \left[ 1 - \frac{1}{2} \left( \frac{KL/r}{C_c} \right)^2 \right]}{\frac{5}{3} + \frac{3}{8} \frac{KL/r}{C_c} - \frac{1}{8} \left( \frac{KL/r}{C_c} \right)^3} & \frac{KL}{r} \leq C_c \quad (4-17) \\ \frac{12\pi^2 E}{23(KL/r)^2} = \frac{149,000}{(KL/r)^2} & \frac{KL}{r} \geq C_c \quad (4-18) \end{cases}$$

where  $K$  is the effective-length coefficient (Art. 4-5) and

$$C_c = \pi \sqrt{\frac{2E}{F_y}}$$

### ANNEXURE-4

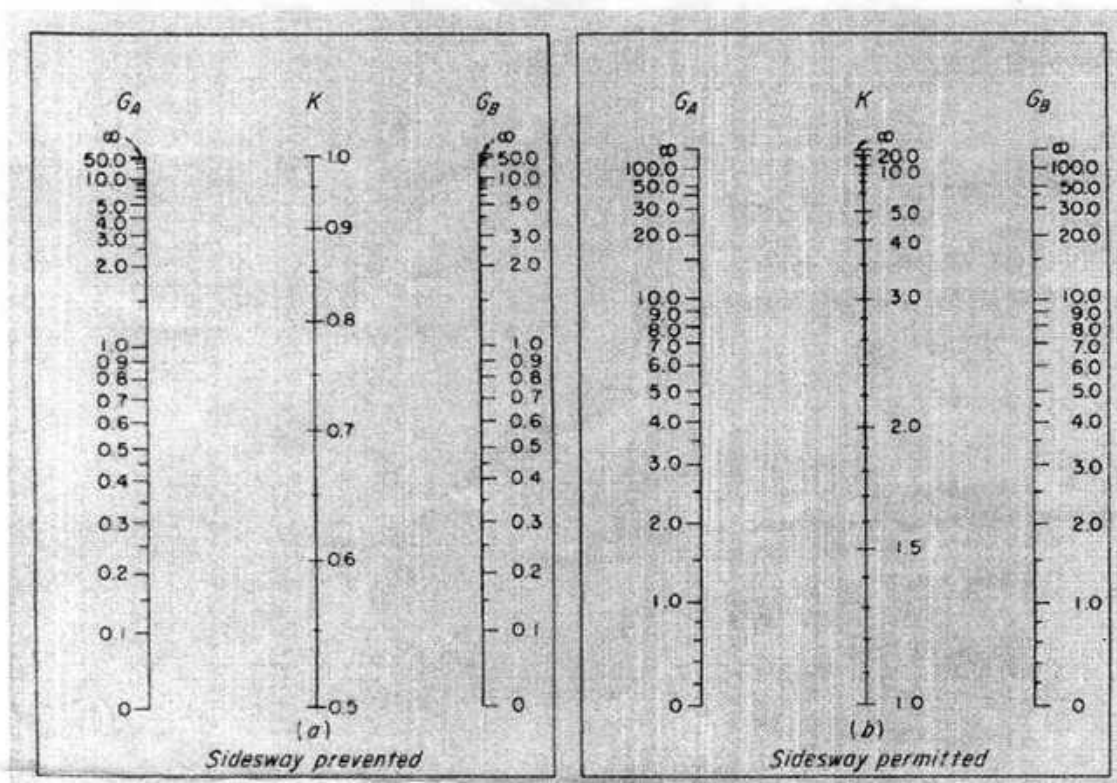
The AISC/LRFD design strength of columns is  $\phi_c P_n$ , where  $\phi_c = 0.85$  and  $P_n = A_g F_{cr}$ , with  $F_{cr}$  given by

$$F_{cr} = \begin{cases} 0.658^{\lambda_c^2} F_y & 0 \leq \lambda_c < 1.5 \quad (4-27) \\ \frac{0.877}{\lambda_c^2} F_y & \lambda_c > 1.5 \quad (4-28) \end{cases}$$

in which

$$\lambda_c = \frac{KL}{r\pi} \sqrt{\frac{F_y}{E}}$$

**ANNEXURE-5**



**Nomograph for effective length of columns.**

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Environmental Engineering III  
Time- 2 hour

Course Code: CE 431  
Full marks: 100

**Answer any four questions out of five.**  
**(Note: Assume any missing data)**

1. (a) Discuss the different stages of decomposition in a typical landfill. (9)
- (b) What is a sanitary landfill? Describe different types of landfills. (2+4)
- (c) Write explanatory notes on the following: (10)
- i) Leachate, ii) Liner, iii) Final Cover, and iv) Street Cleansing
2. (a) Define the following terms as per HCS and SCS: (3)
- i. pick-up time  
ii. haul time  
iii. at site time
- (b) Estimate the overall energy of a solid waste sample. Use the given table and formula. (15)

Component	Wet mass (kg)	Moisture Content, % (wet)
Food waste	35	70
Paper (mixed)	32.5	6
Cardboard	4	5
Plastics	3	2
Yard Waste	0.5	60
Wood	3	5

- (e) Explain transfer station including its advantages and disadvantages. (7)
3. (a) Write down the disadvantages of recycling process. (5)
- (b) Classify and describe recycling process based on the reuse of the recycled materials. (5)
- (c) Determination of screen recovery efficiency and effectiveness. (10)
- Given that 3000 kg/h of municipal solid waste with 15 percent glass is applied to a rotary screen for the removal of glass prior to shredding. Weight of underflow is 600 kg/h and weight of glass in screen underflow is 300 kg/h, determine the recovery efficiency and effectiveness of the screen.

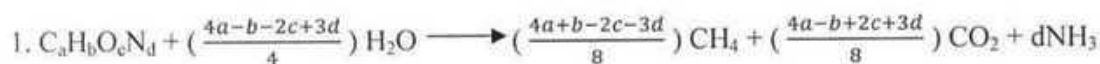
- (d) Discuss the present practices of recycling in developing countries. (5)
4. (a) Discuss the different types of maintenance of collection vehicles. (4)
- (b) What is break-even distance (with figure)? (2)
- (c) What are the objectives of thermal treatment process? Write down the benefits and drawbacks of incineration. (2+7)
- (d) A transfer station handling 400 tons/day, 5 days per week, costs \$6 million to build and \$160,000 per year to operate. An individual tractor-trailer costs \$150,000 and carries 20 tons per trip. Operation and maintenance costs (including fuel) of the truck are \$65,000 per year and the driver makes \$45,000 per year (including benefits). The capital costs of the building and transfer trucks are to be amortized over a 10 year period using a 12 percent discount factor. Suppose it takes 30 minutes to make a one way trip from the transfer station to the disposal site, and 7 round trips per day are made. Find the transfer station and hauling cost in dollars per ton. (10)
5. (a) Estimation of the amount of gas produced from the organic fraction of MSW under anaerobic conditions. Estimate the total theoretical amount of gas that could be produced under anaerobic conditions in a sanitary landfill per unit weight of solid wastes given that the chemical formula of the typical waste are as follows: (10)

Without water:  $C_{60.0}H_{94.3}O_{37.8}N$

Given that the total weight of the organic material in 100 lb of solid waste is equal to 75 lb including moisture. Assume 5% of the decomposable material will remain as an ash. Also given that the specific weight of methane and carbon dioxide are 0.0448 and 0.1235 lb/ft<sup>3</sup> respectively.

- (b) Discuss the mechanisms (different stages) of anaerobic digestion. (10)
- (c) Write down the advantages of anaerobic digestion. (5)

Formulae:



$$2. \text{Percentage Recovery} = \frac{W_1 f_1 (100)}{W_2 f_2}$$

$$3. \text{Effectiveness} = \frac{W_1 f_1}{W_2 f_2} \left\{ 1 - \frac{W_1 (1-f_1)}{W_2 (1-f_2)} \right\}$$

$$4. \text{Energy content (kJ/kg)} = 338.2C + 1430 (H-O/8) + 95.4S$$

$$5. CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

**Table 2.10: Ultimate analysis of solid waste (per cent by weight in dry basis)**

Component	Carbon (C)	Hydrogen (H)	Oxygen (O)	Nitrogen (N)	Sulphur (S)	Ash (A)
Food waste	49.1	6.6	37.6	1.7	0.2	4.8
Paper (mixed)	43.4	5.8	44.3	0.3	0.2	6.1
Newsprint	49.1	6.1	43.0	0.1	0.2	1.5
Cardboard	44.0	5.9	44.6	0.3	0.2	5.0
Rubber	77.8	10.4	-	-	2.0	9.8
Plastics	60.0	7.0	23.0	-	-	10.0
PVC	45.2	5.6	1.6	0.1	0.1	47.4
Leather shoes	42.0	5.3	22.8	6.0	1.0	22.9
Textiles	55.0	6.5	31.2	4.5	0.2	2.6
Yard waste	48.7	6.3	37.9	3.0	0.3	3.8
Wood	50.5	6.0	42.4	0.2	0.1	0.8

Source: adapted in part from Kaiser (1978)

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Environmental Engineering IV  
Time: 2 Hours

Course No. CE 433  
Full Marks: 135(=45x3)

*[Assume reasonable value for missing data (if any)]*

**Answer ANY THREE of the following Four Questions**

1. (a) What are the sources of thermal effluents (heat waste) in rivers? What is the effect of thermal effluents on the Dissolved Oxygen sag curve? Explain with diagrams. 10
  - (b) What are the factors that have contributed to the pollution of the Buriganga river in Bangladesh? 5
  - (c) How can the Streeter-Phelps DO sag equation help you in water quality management in rivers? 6
  - (d) A city of 200,000 people deposits  $37 \text{ ft}^3/\text{sec}$  of sewage having a BOD of  $28 \text{ mg/L}$  and  $1.8 \text{ mg/L}$  of DO into a river that has a flow rate of  $250 \text{ ft}^3/\text{sec}$  and flow speed of  $1.2 \text{ ft/sec}$ . Just upstream of the release point, the river has a BOD of  $3.6 \text{ mg/L}$  and a DO of  $7.6 \text{ mg/L}$ . The saturation value of DO is  $8.5 \text{ mg/L}$ . Deoxygenation coefficient,  $k_d$  is  $0.61/\text{day}$  and the reaeration coefficient  $k_r$  is  $0.76/\text{day}$ . Assuming complete and instantaneous mixing of the sewage and river, find 24
    - (i) The initial oxygen deficit and ultimate BOD just downstream of the outfall.
    - (ii) The time and distance to reach the minimum DO.
    - (iii) The minimum DO.
    - (iv) The DO that could be expected 10 miles downstream.
- 
2. (a) What do you understand by eutrophication? What is cultural eutrophication? Which nutrients are primarily responsible for eutrophication? Why is phosphorus typically the limiting nutrient in lakes? 12
  - (b) How does thermal stratification affect the water quality in lakes both in summer and winter? Explain with diagrams. 11
  - (c) Suppose there are  $0.10 \text{ mg}$  of N and  $0.04 \text{ mg}$  of P available for algal production per liter of water. Assuming adequate amounts of the other nutrients, which is the limiting nutrient? 6
  - (d) Consider a lake with  $100 \times 10^6 \text{ m}^2$  of surface area for which the only source of phosphorus is the effluent from a wastewater treatment plant. The effluent flow rate is  $0.4 \text{ m}^3/\text{s}$  and its phosphorus concentration is  $10 \text{ mg/L}$ . The lake is also fed by a stream having  $20 \text{ m}^3/\text{s}$  of flow with no phosphorus. If the phosphorus settling rate is estimated to be  $10 \text{ m/year}$ , 16
    - (i) Estimate the average phosphorus concentration in the lake.
    - (ii) What level of phosphorus removal at the treatment plant would be required to keep the average lake concentration below  $0.010 \text{ mg/L}$ ?

3. (a) What do you understand by BOD? For a particular wastewater, draw BOD rate equation (i.e., BOD<sub>t</sub> vs. time curve) for two different temperatures, T<sub>1</sub> and T<sub>2</sub>; where T<sub>1</sub> > T<sub>2</sub>. 7
- (b) List the common options for control of vehicular air pollution. Briefly explain the working principles of (i) Thermal Reactor, and (ii) Exhaust Gas Recirculation. 10
- (c) Discuss the effects of air/fuel ratio on emissions of CO, hydrocarbon, and NO<sub>x</sub> from four-stroke engines with diagrams. Also explain the effects of air/fuel ratio on the efficiency of a 3-way catalytic converter. 12
- (d) A road has 10 cars passing a given point per minute, and each car on an average emits 9.5 g/km of carbon monoxide (CO). Wind is blowing at 2.0 m/sec perpendicular to the road and the atmosphere is "neutral". A building of 20 m height is located 200 m down-wind of the road. Estimate CO concentration at the ground floor and the roof of the building. (Table is provided for calculation of dispersion coefficient). 16
4. (a) What are the different options of managing (improving) lake water quality? 10
- (b) How does suspended solid affect the water quality of lakes and rivers? 7
- (c) List the principal assumptions of the "point source Gaussian plume model". 6
- (d) Carbon monoxide (CO) is emitted from a stack at the rate of 5.0 g/s. The effective stack height is 30 m and The wind velocity at a height of 10 m is 4.0 m/sec. The atmosphere is adiabatic. Estimate concentration of CO 22
- (i) At 0.5 km downwind along the centerline of the plume.
- (ii) At 0.5 km downwind and 100 m off the centerline of the plume. (Given: p = 0.15; Table is provided for calculation of dispersion coefficient).

Table 7.2 Values of the constants a, c, d, and f for use in (7.44) and (7.45) expressions for  $\sigma_y$  and  $\sigma_z$

Stability	a	$x \leq 1$ km			$x \geq 1$ km		
		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	0.911	0	61.0	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

Note: The computed values of  $\sigma$  will be in meters when x is given in kilometers.  
Source: Martin (1976).

$$\sigma_y = a \cdot x^{0.894} \quad ; \quad \sigma_z = cx^d + f$$

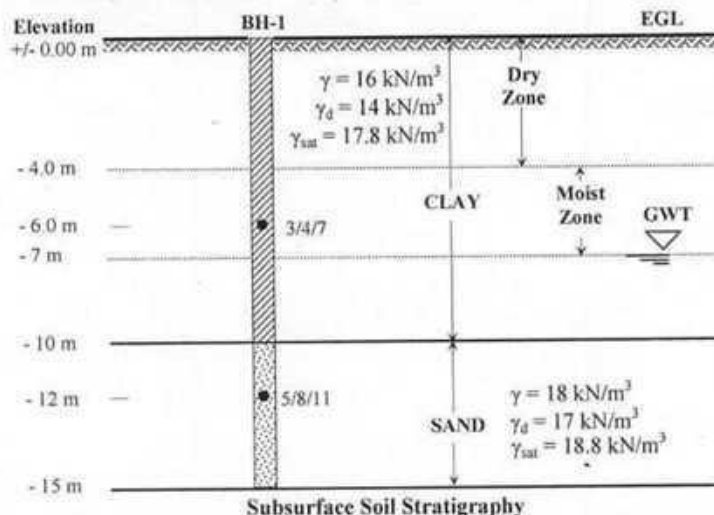
**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall – 2012**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Geotechnical Engineering II  
 Time: 3 hours

Course Code: CE 441  
 Full Marks: 120 (20 X 6 = 120)

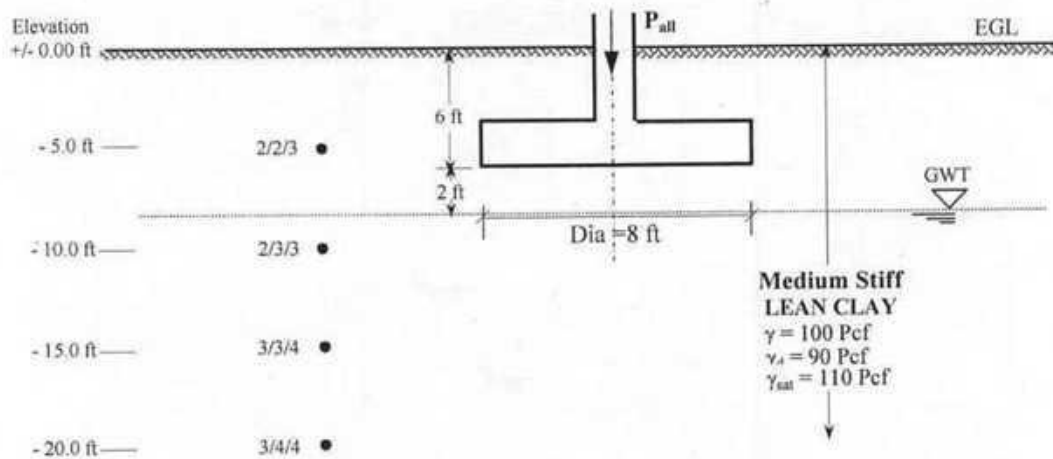
Answer any 6 (six) of the following 8 (eight) questions

1. (a) Mention four purposes of geotechnical subsurface exploration. 4
  - (b) Write down any two general guidelines (GG) used for the selection of depth and location of boreholes for civil engineering projects. 4
  - (c) Mention the name of the in-situ test most frequently used in Bangladesh. Write a short note on this test. 1 + 5 = 6
  - (d) Write short notes (any two) on: (i) Ground water table (ii) Logging and sampling (iii) Site reconnaissance. 3 x 2 = 6
  
  2. (a) The outside and inside diameters of a split-spoon sampler are 50.8 mm and 34.93 mm, respectively. The outside and inside diameters of a Shelby tube sampler are 76.2 mm and 73 mm, respectively. Estimate the degree of disturbances for two soil samples; one obtained using the split-spoon sampler and the other using the Shelby tube. Also determine whether the samples are disturbed or undisturbed. 4
  
  - (b) An eight-inch diameter borehole (BH-1) was advanced at a site under the scope of a preliminary geotechnical sub-surface exploration program. Determine the Field SPT-N values at elevations -6 m and -12 m. Apply necessary corrections, as required, and determine the corrected SPT values (Use Appendix as necessary). Also estimate the shear strength parameters as necessary at corresponding depths. 8
- Notes:**
- Wash Boring method was used.
  - Hammer efficiency = 70%.
  - Standard sampler was used during sampling.



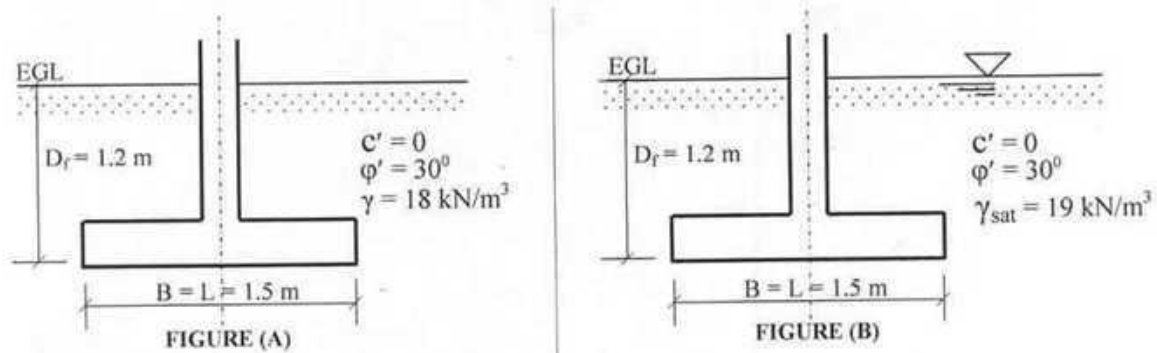
- (c) From a preliminary field investigation, the subsurface condition obtained is shown in the figure below. SPT-N values were obtained at each 5-foot depth intervals. Using Terzaghi's bearing capacity equation (as appropriate), determine the allowable column load ( $P_{all}$ ) for the individual column circular footing founded as shown below. Use F.S = 3. 8

**NOTE:** No laboratory tests were conducted to obtain the shear strength of the clay formation. So, use empirical correlation to estimate the average shear strength below the foundation level.

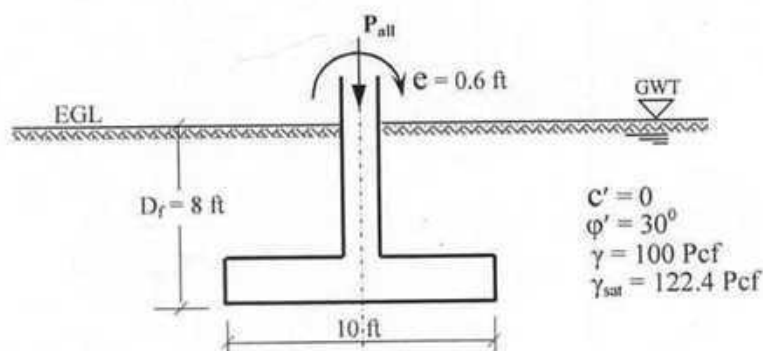


3. (a) Using Terzaghi's bearing capacity equation, an entry-level engineer designed a square foundation for a column load of  $170 \text{ kN}$  for the soil conditions (Medium dense) as shown in the following FIGURE (A). In his design he did not consider the effect of ground water condition. Other than that his calculations were correct and the footing size was found to be  $1.5 \text{ m} \times 1.5 \text{ m}$  with a  $\text{FS} = 3$ . Use  $\gamma_w$  as  $10 \text{ kN/m}^3$ . 10

His design was not properly reviewed and the structure was constructed. The site investigation revealed that the GW was at the EGL. You are now involved in reviewing his design. Considering the actual GW condition as shown in FIGURE (B), what would be the actual ultimate load ( $P_u$ ) that the column can take? Also calculate the actual FS the structure is having now.

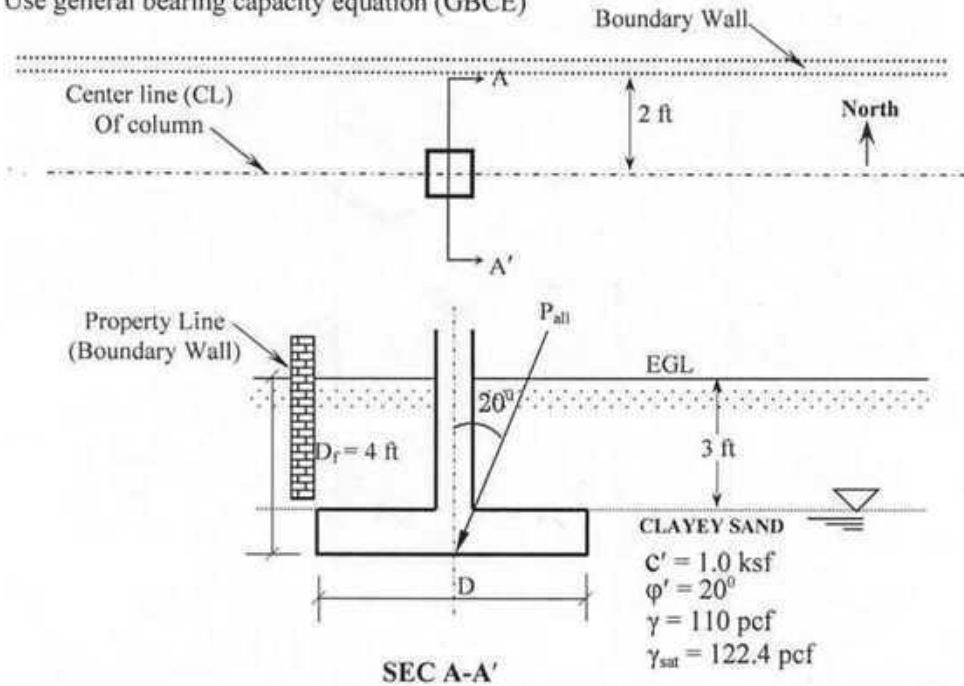


- (b) An eccentrically loaded continuous foundation is shown below. Determine the allowable load per unit length that the foundation can carry. Use Meyerhof's effective area method. Use  $\text{FS} = 2.5$ . 10

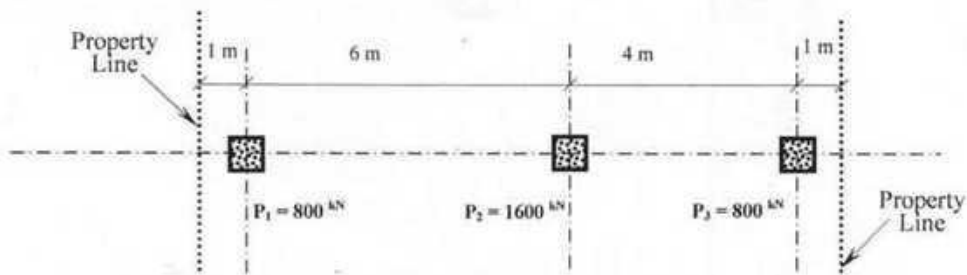


4. (a) For the following given conditions, determine the allowable column load ( $P_{all}$ ) for the following footing. Factor of safety = 2.5 12

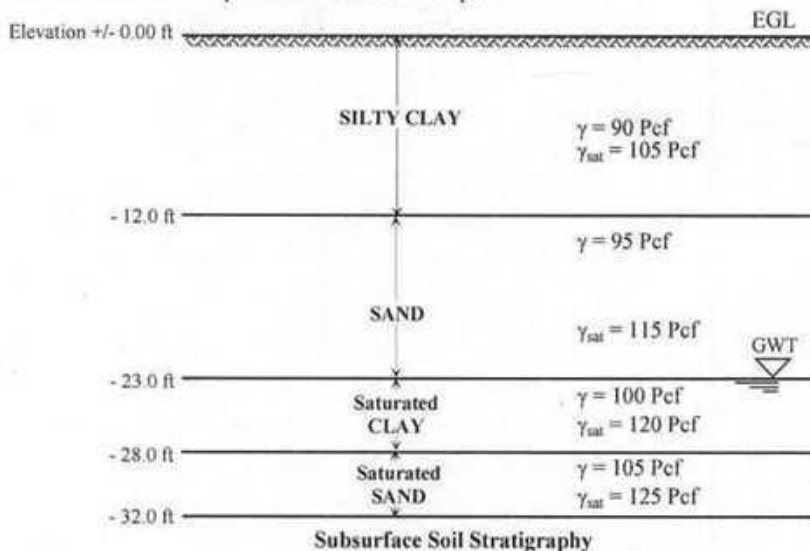
- Foundation spread cannot go beyond the interior of the boundary wall
- Circular footing
- Column location cannot be moved
- Use general bearing capacity equation (GBCE)



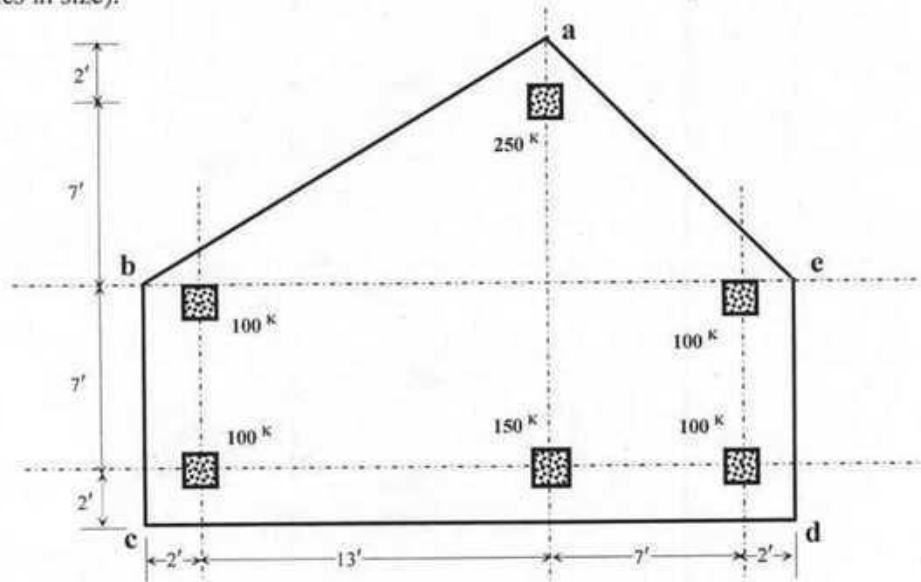
- (b) Design the size of a trapezoidal combined footing for the loading, geometric and boundary conditions as shown in the figure below. Use allowable bearing capacity as 125 kN/m<sup>2</sup>. 8



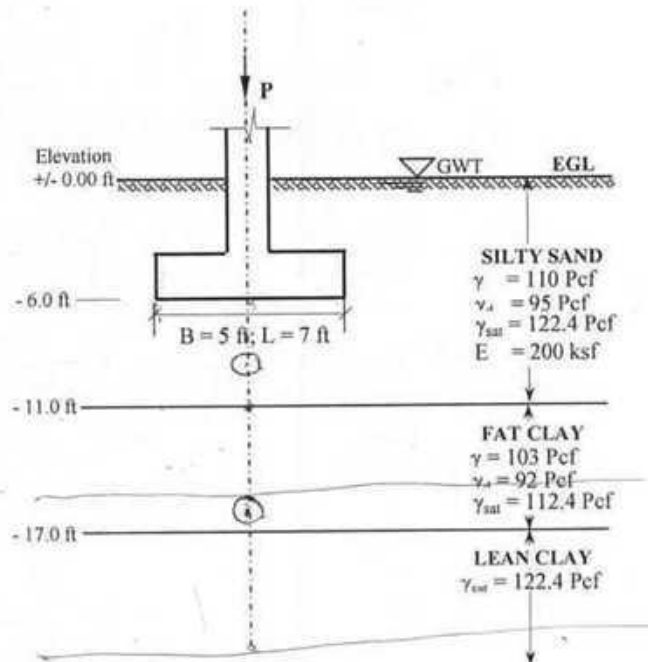
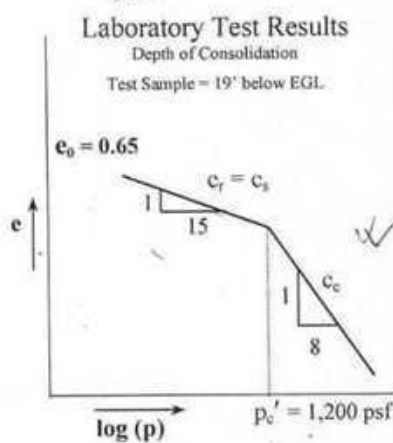
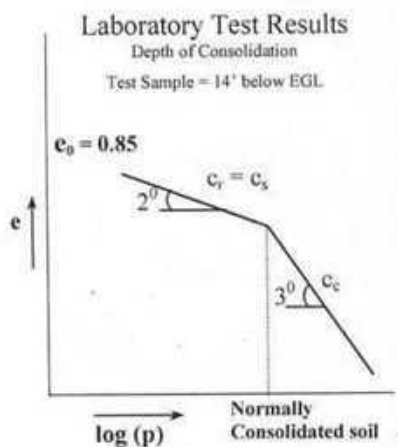
5. (a) For a fully compensated condition (floating foundation), if the depth of the mat foundation is selected to be 25 ft. below EGL, determine the number of stories that could be built. Consider uniform per floor load of 250 psf. 6



(b) The plan of a mat foundation is shown in the figure below. Calculate the soil pressures at points a, c and at the geometric centroid of the foundation (all the columns are of 15 by 15 inches in size).



6. (a) Show with sketches different types of shear failures in soils of different strength. 3
- (b) Categorize (mention names only) combined footings with sketches. 3
- (c) A rectangular footing designed as per allowable bearing capacity based on shear failure is shown in the following figure. Estimate settlements for both sand and clay layers. Use  $p = 3.0$  ksf. Consider increased induced stress (applied stress) up to a depth of  $3B$  below the foundation level. 14



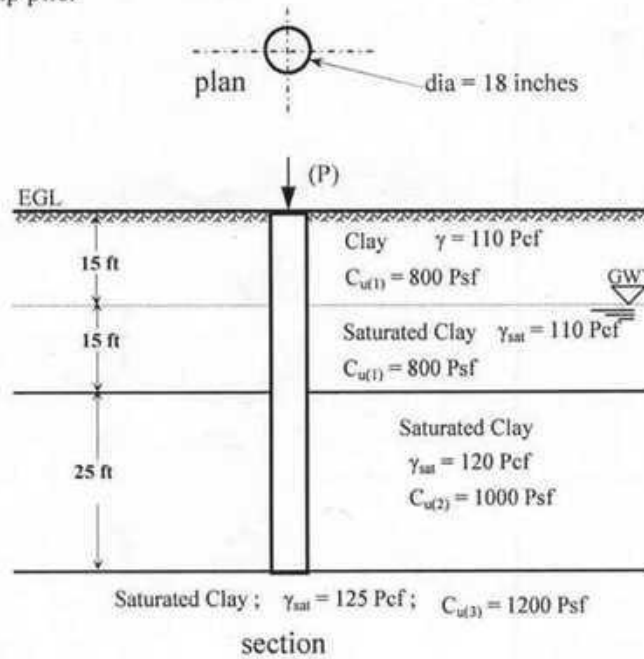
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15

7.

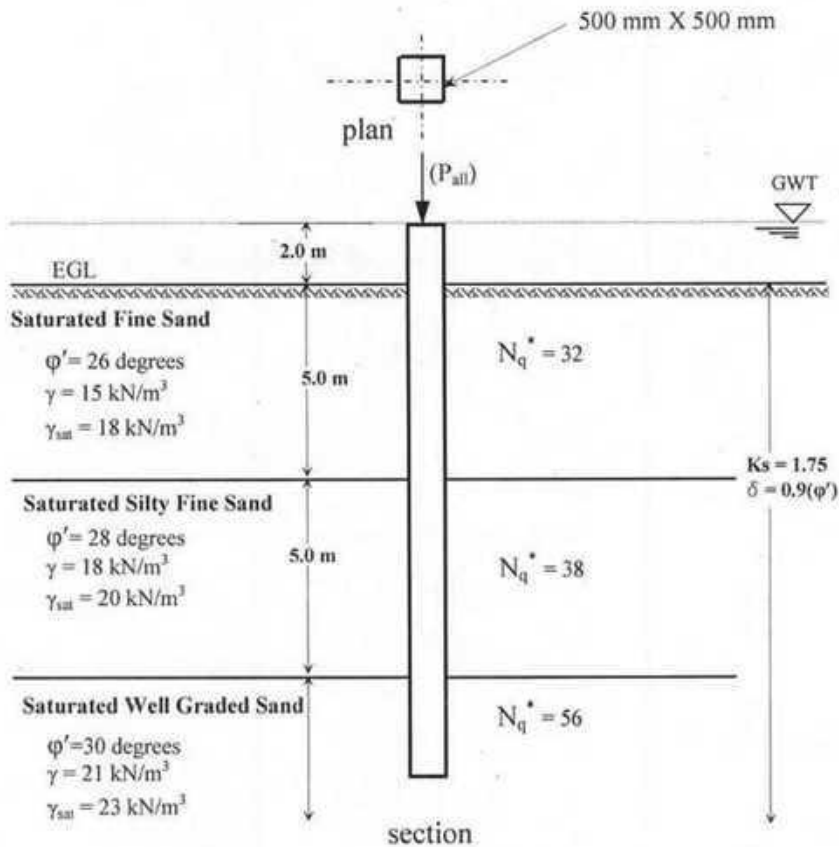
(a) For the soil stratigraphy as shown below, a group of 9 bored piles (each having diameter of 18-inches) were installed as per minimum center-to-center distance required. Calculate the capacity of the group pile.

10



(b) The plan and X-section of a 15-meter long single pre-cast concrete pile (square) driven in different sand deposits are shown below. Estimate the allowable capacity of the single pile.

10



8. (a) Classify pile foundations (mention names only) according to their materials (composition), method of installation and displacement criteria. 6
- (b) Determine the factor of safety (stability) against the failure arcs through the slope for the slope as shown below. 14

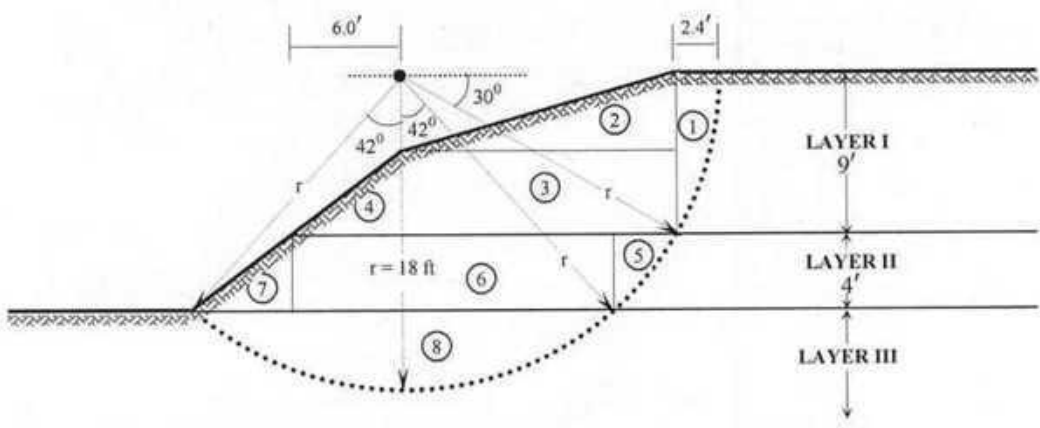
**LAYER I:**  
 Sandy Clay  
 Average SPT Blow Count,  $N = 6$   
 Unit Weight = 110 pcf

**LAYER II:**  
 Clay  
 Average SPT Blow Count,  $N = 12$   
 Unit Weight = 115 pcf

**LAYER III:**  
 Clay  
 Average SPT Blow Count,  $N = 16$   
 Unit Weight = 120 pcf

Segment No.	Area (ft <sup>2</sup> )	Arm (ft)
1	10.8	---
2	31.2	---
3	---	7.8
4	15	---
5	---	13.2
6	---	---
7	---	---
8	---	---

--- to be calculated



**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2012**  
**Program: B.Sc. Engineering (Civil)**

Course Title: Transportation Engineering II:  
Highway Design & Railways  
Time : 3 Hours

Course Code: CE 451

Full Marks: 100 (=5x20)

**There are SIX questions. Answer any FIVE**

1. (a) What is ballast? What are the different requirements of good ballast? (1+4)  
(b) What are the different techniques to improve railway embankment stability? (4)  
(c) Describe different types of materials used as ballast in a railway track. (7)  
(d) Write a short note on ballast cushion. (4)
  
2. (a) State the function of Railway Signal. (5)  
(b) Discuss the classification of Fixed Signals. (10)  
(c) What is interlocking? (5)
  
3. (a) Elaborately explain different type of distresses in rigid and flexible pavement. Also discuss the causes of these distresses and relevant remedial measures. (12)  
(b) Design a minimum thickness of flexible pavement (i.e. thickness of different layers) for the following traffic condition: (8)

Daily Count	Axle load (kips)
2000 (Single Axle)	12
2000 (Single Axle)	20
100(Single Axle)	34
100 (Tandem Axle)	50

Given:

Sub grade soil CBR value is 5

Design life is 20 years

Traffic growth rate is 6% per annum

Reliability is 90%

Overall standard deviation is 0.45

Design serviceability loss is 3.0

Available material:

- Hot mix asphalt surface concrete ( $a_1=0.44$ )
- Crushed stone base course ( $a_2=0.14$ ,  $m_2=0.4$  &  $Mr_2= 35$  ksi)
- Crushed stone sub base ( $a_3=0.11$ ,  $m_3=0.9$  &  $Mr_3= 15.5$  ksi)

Note: AASHTO Design Chart is in Fig 1.

4. (a) Describe different stresses that development in rigid pavement. What is pumping of joints? (3+4)
- (b) What are the fundamental properties of bituminous mixture? (2)
- (c) Given below the requirements of a specification related to the grading of the mineral aggregates in an asphaltic concrete mixture and the sieve analyses of the two aggregates (A and B) that are economically available for this use. Determine the range of blends of aggregates A and B will produce a combined aggregate that will meet the limits of the specification and given the gradings of the aggregate combinations selected. (8)

Sieve Designation	Percentage passing (by weight)		
	Aggregate A	Aggregate B	Mix
2"	100	-	-
1"	100	100	100
3/8"	68	45	50-85
# 4	42	28	35-65
#10	30	17	25-50
# 40	28	7	15-30
#200	11	3	5-15

- (d) What is air – entrained concrete mixture? (3)
5. (a) Compare the rigid and flexible pavement systems from various criteria. (5)
- (b) Write a short note on slump test. (2)
- (c) For a four –lane expressway between Dhaka and Chittagong, the outer lanes have been decided to be cement concrete rigid pavement to carry heavy vehicles. Combined K of the sub grade and a 4 inch thick untreated granular base is  $100 \text{ lb/in}^3$ . Design period is 20 years. Over this period, the expected loadings of heavy vehicle in each direction are tabulated below. Determine the minimum thickness of slab that can be used safely for the outer lanes if the modulus of rupture of concrete is 650 psi (28 days). Assumed doweled joints and no concrete shoulder. Show calculations in a tabular form (at least two trials). Assume reasonable value for missing data, if any. (13)

	Axle load, kips	Expected repetitions
Single axle	30	20,000
	26	75,000
	22	3500,000
	18	1000,00
	14	900,000
Tandem Axle	52	920,00
	48	1500,00
	32	2500,000
	40	4600,000
	36	9500,000
	32	Unlimited

**Note: PCA Method design tables and figures are attached.**

6. (a) Discuss the outcomes of AASHO Road Test. (5)  
 (b) Explain "Pavement Serviceability Concept." (3)  
 (c) An asphalt concrete surface course mixture is being designed by Marshall Method for heavy traffic. Test results for different asphalt contents are given in the following table: (12)

Asphalt content (%)	Unit wt. of specimens, (pcf)	Marshall stability (lbs)	Marshall flow value	V <sub>a</sub> (%)	VMA (%)
4.5	150.32	1732	8.0	5.40	16.30
5.0	151.63	1785	9.0	3.10	14.90
5.5	152.88	1808	11.0	2.45	15.45
6.0	152.56	1652	14.0	1.90	15.19
6.5	151.63	1426	18.0	0.82	16.30

The maximum size of the aggregate is 1.0 inch for which the minimum VMA% should be 12% as per Marshall design criteria. Compaction, no. of blows in each end of specimen is 75. Determine the optimum asphalt content. Is the mix satisfactory? Check from the design criteria table. If not, what adjustments may be suggested? To plot data, use graph paper.

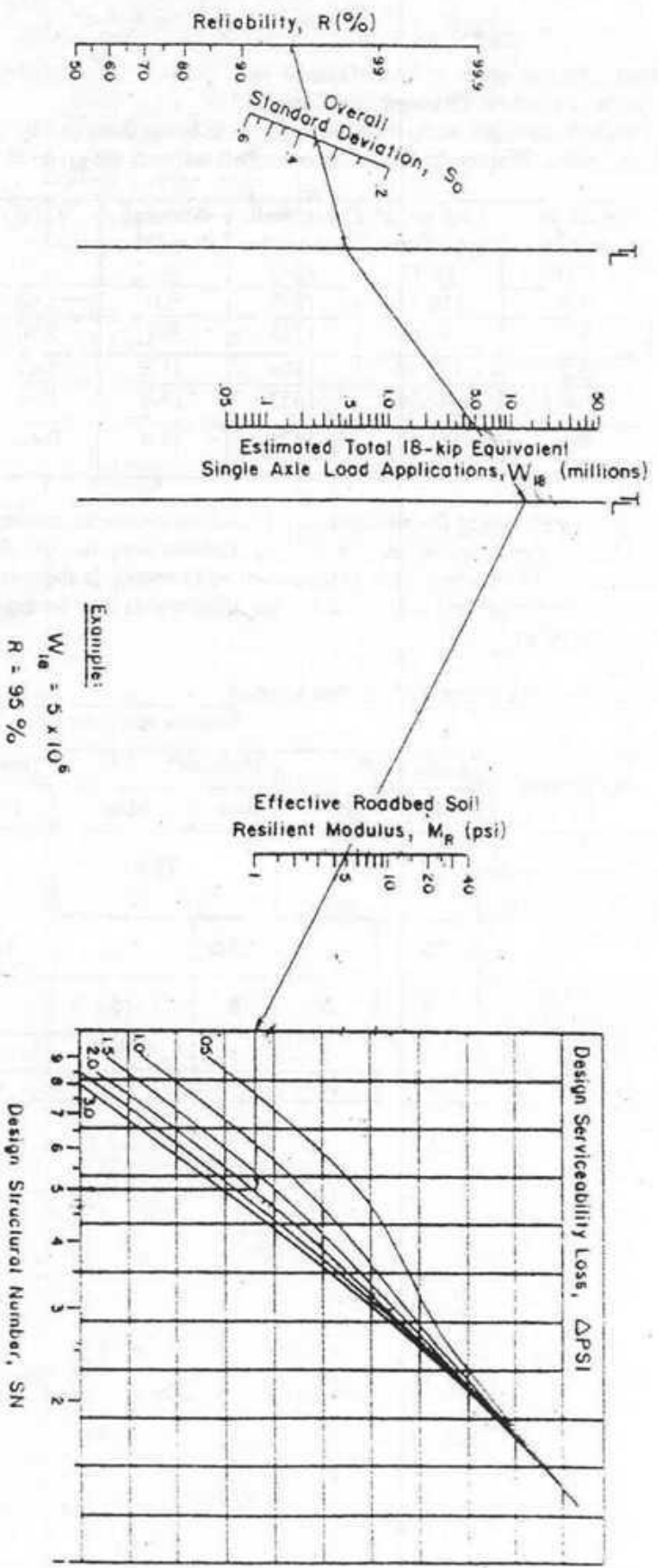
Table : Design Criteria for Marshall Method

Marshall method mix criteria	Surface and base					
	Light traffic		Medium traffic		Heavy traffic	
	Min.	Max.	Min.	Max.	Min.	Max.
Compaction, no. of blows each end of specimen	35		50		75	
Stability (lb)	750	-	1200	-	1800	-
Flow, 0.25 mm (0.01 in)	8	18	8	16	8	14
% Air voids	3	5	3	5	3	5
% VFA	70	80	65	78	65	75

MONOGRAM SOLVES:

$$\log_{10} W_{18} = Z_R \cdot S_0 + 9.36 + \log_{10} (SN+1) - 0.20 + \frac{\log_{10} \left[ \frac{\Delta \text{PSI}}{4.2 - 1.5} \right]}{1094} + 2.32 \cdot \log_{10} M_R - 8.07$$

$$0.40 = \frac{0.40}{(SN+1)} \cdot 5.19$$



Example:

- $W_{18} = 5 \times 10^6$
- $R = 95\%$
- $S_0 = 0.35$
- $M_R = 5000 \text{ psi}$
- $\Delta \text{PSI} = 1.9$
- Solution:  $SN = 5.0$

FIGURE 14 AASHTO design chart for flexible pavements based on using mean values for each input. (Courtesy American Association of Highway and Transportation Officials.)

Table 1

**Table 1. Equivalent Stress — No Concrete Shoulder  
(Single Axle/Tandem Axle)**

Slab thickness, in.	k of subgrade-subbase, pci						
	50	100	150	200	300	500	700
4	825/679	726/585	671/542	634/516	584/486	523/457	484/443
4.5	699/586	616/500	571/460	540/435	498/406	448/378	417/363
5	602/516	531/436	493/399	467/376	432/349	390/321	363/307
5.5	526/461	464/387	431/353	409/331	379/305	343/278	320/264
6	465/416	411/348	382/316	362/296	336/271	304/246	285/232
6.5	417/380	367/317	341/286	324/267	300/244	273/220	256/207
7	375/349	331/290	307/262	292/244	271/222	246/199	231/186
7.5	340/323	300/268	279/241	265/224	246/203	224/181	210/169
8	311/300	274/249	255/223	242/208	225/188	205/167	192/155
8.5	285/281	252/232	234/208	222/193	206/174	188/154	177/143
9	264/264	232/218	216/195	205/181	190/163	174/144	163/133
9.5	245/248	215/205	200/183	190/170	176/153	161/134	151/124
10	228/235	200/193	186/173	177/160	164/144	150/126	141/117
10.5	213/222	187/183	174/164	165/151	153/136	140/119	132/110
11	200/211	175/174	163/155	154/143	144/129	131/113	123/104
11.5	188/201	165/165	153/148	145/136	135/122	123/107	116/98
12	177/192	155/158	144/141	137/130	127/116	116/102	109/93
12.5	168/183	147/151	136/135	129/124	120/111	109/97	103/89
13	159/176	139/144	129/129	122/119	113/106	103/93	97/85
13.5	152/168	132/138	122/123	116/114	107/102	98/89	92/81
14	144/162	125/133	116/118	110/109	102/98	93/85	88/78

Table 2

**Table 2. Equivalent Stress — Concrete Shoulder  
(Single Axle/Tandem Axle)**

Slab thickness, in.	k of subgrade-subbase, pci						
	50	100	150	200	300	500	700
4	640/534	559/468	517/439	489/422	452/403	409/388	383/384
4.5	547/461	479/400	444/372	421/356	390/338	355/322	333/316
5	475/404	417/349	387/323	367/308	341/290	311/274	294/267
5.5	418/360	368/309	342/285	324/271	302/254	276/238	261/231
6	377/325	327/277	304/255	289/241	270/225	247/210	234/203
6.5	334/295	294/251	274/230	260/218	243/203	223/188	212/180
7	302/270	266/230	248/210	236/198	220/184	203/170	192/162
7.5	275/250	243/211	226/193	215/182	201/168	185/155	176/148
8	252/232	222/196	207/179	197/168	185/155	170/142	162/135
8.5	232/216	205/182	191/166	182/156	170/144	157/131	150/125
9	215/202	190/171	177/155	169/146	158/134	146/122	139/116
9.5	200/190	176/160	164/146	157/137	147/126	136/114	129/108
10	186/179	164/151	153/137	146/129	137/118	127/107	121/101
10.5	174/170	154/143	144/130	137/121	128/111	119/101	113/95
11	164/161	144/135	135/123	129/115	120/105	112/95	106/90
11.5	154/153	136/128	127/117	121/109	113/100	105/90	100/85
12	145/146	128/122	120/111	114/104	107/95	99/86	95/81
12.5	137/139	121/117	113/106	108/99	101/91	94/82	90/77
13	130/133	115/112	107/101	102/95	96/86	89/78	85/73
13.5	124/127	109/107	102/97	97/91	91/83	85/74	81/70
14	118/122	104/103	97/93	93/87	87/79	81/71	77/67

Table 3

Erosion Factors — Doweled Joints, No Concrete Shoulder  
(Single Axle/Tandem Axle)

Slab thickness, in.	k of subgrade-subbase, pci					
	50	100	200	300	500	700
4	3.74/3.83	3.73/3.79	3.72/3.75	3.71/3.73	3.70/3.70	3.68/3.67
4.5	3.59/3.70	3.57/3.65	3.56/3.61	3.55/3.58	3.54/3.55	3.52/3.53
5	3.45/3.58	3.43/3.52	3.42/3.48	3.41/3.45	3.40/3.42	3.38/3.40
5.5	3.33/3.47	3.31/3.41	3.29/3.36	3.28/3.33	3.27/3.30	3.26/3.28
6	3.22/3.38	3.19/3.31	3.18/3.26	3.17/3.23	3.15/3.20	3.14/3.17
6.5	3.11/3.29	3.09/3.22	3.07/3.16	3.06/3.13	3.05/3.10	3.03/3.07
7	3.02/3.21	2.99/3.14	2.97/3.08	2.96/3.05	2.95/3.01	2.94/2.98
7.5	2.93/3.14	2.91/3.06	2.88/3.00	2.87/2.97	2.86/2.93	2.84/2.90
8	2.85/3.07	2.82/2.99	2.80/2.93	2.79/2.89	2.77/2.85	2.76/2.82
8.5	2.77/3.01	2.74/2.93	2.72/2.86	2.71/2.82	2.69/2.78	2.68/2.75
9	2.70/2.96	2.67/2.87	2.65/2.80	2.63/2.76	2.62/2.71	2.61/2.68
9.5	2.63/2.90	2.60/2.81	2.58/2.74	2.56/2.70	2.55/2.65	2.54/2.62
10	2.56/2.85	2.54/2.76	2.51/2.68	2.50/2.64	2.48/2.59	2.47/2.56
10.5	2.50/2.81	2.47/2.71	2.45/2.63	2.44/2.59	2.42/2.54	2.41/2.51
11	2.44/2.76	2.42/2.67	2.39/2.58	2.38/2.54	2.36/2.49	2.35/2.45
11.5	2.38/2.72	2.36/2.62	2.33/2.54	2.32/2.48	2.30/2.44	2.29/2.40
12	2.33/2.68	2.30/2.58	2.28/2.49	2.26/2.44	2.25/2.39	2.23/2.36
12.5	2.28/2.64	2.25/2.54	2.23/2.45	2.21/2.40	2.19/2.35	2.18/2.31
13	2.23/2.61	2.20/2.50	2.18/2.41	2.16/2.36	2.14/2.30	2.13/2.27
13.5	2.18/2.57	2.15/2.47	2.13/2.37	2.11/2.32	2.09/2.26	2.08/2.23
14	2.13/2.54	2.11/2.43	2.08/2.34	2.07/2.29	2.05/2.23	2.03/2.19

Table 4

Erosion Factors — Aggregate-Interlock Joints,  
No Concrete Shoulder (Single Axle/Tandem Axle)

Slab thickness, in.	k of subgrade-subbase, pci					
	50	100	200	300	500	700
4	3.94/4.03	3.91/3.95	3.88/3.89	3.86/3.86	3.82/3.83	3.77/3.80
4.5	3.79/3.91	3.76/3.82	3.73/3.75	3.71/3.72	3.68/3.68	3.64/3.65
5	3.66/3.81	3.63/3.72	3.60/3.64	3.58/3.60	3.55/3.55	3.52/3.52
5.5	3.54/3.72	3.51/3.62	3.48/3.53	3.46/3.49	3.43/3.44	3.41/3.40
6	3.44/3.64	3.40/3.53	3.37/3.44	3.35/3.40	3.32/3.34	3.30/3.30
6.5	3.34/3.56	3.30/3.46	3.26/3.36	3.25/3.31	3.22/3.25	3.20/3.21
7	3.26/3.49	3.21/3.39	3.17/3.29	3.15/3.24	3.13/3.17	3.11/3.13
7.5	3.18/3.43	3.13/3.32	3.09/3.22	3.07/3.17	3.04/3.10	3.02/3.06
8	3.11/3.37	3.05/3.26	3.01/3.16	2.99/3.10	2.96/3.03	2.94/2.99
8.5	3.04/3.32	2.98/3.21	2.93/3.10	2.91/3.04	2.88/2.97	2.87/2.93
9	2.98/3.27	2.91/3.16	2.86/3.05	2.84/2.99	2.81/2.92	2.79/2.87
9.5	2.92/3.22	2.85/3.11	2.80/3.00	2.77/2.94	2.75/2.86	2.73/2.81
10	2.86/3.18	2.79/3.06	2.74/2.95	2.71/2.89	2.68/2.81	2.66/2.76
10.5	2.81/3.14	2.74/3.02	2.68/2.91	2.65/2.84	2.62/2.76	2.60/2.72
11	2.77/3.10	2.69/2.98	2.63/2.86	2.60/2.80	2.57/2.72	2.54/2.67
11.5	2.72/3.06	2.64/2.94	2.58/2.82	2.55/2.76	2.51/2.68	2.49/2.63
12	2.68/3.03	2.60/2.90	2.53/2.78	2.50/2.72	2.46/2.64	2.44/2.59
12.5	2.64/2.99	2.55/2.87	2.48/2.75	2.45/2.68	2.41/2.60	2.39/2.55
13	2.60/2.96	2.51/2.83	2.44/2.71	2.40/2.65	2.36/2.56	2.34/2.51
13.5	2.56/2.93	2.47/2.80	2.40/2.68	2.36/2.61	2.32/2.53	2.30/2.48
14	2.53/2.90	2.44/2.77	2.36/2.65	2.32/2.58	2.28/2.50	2.25/2.44

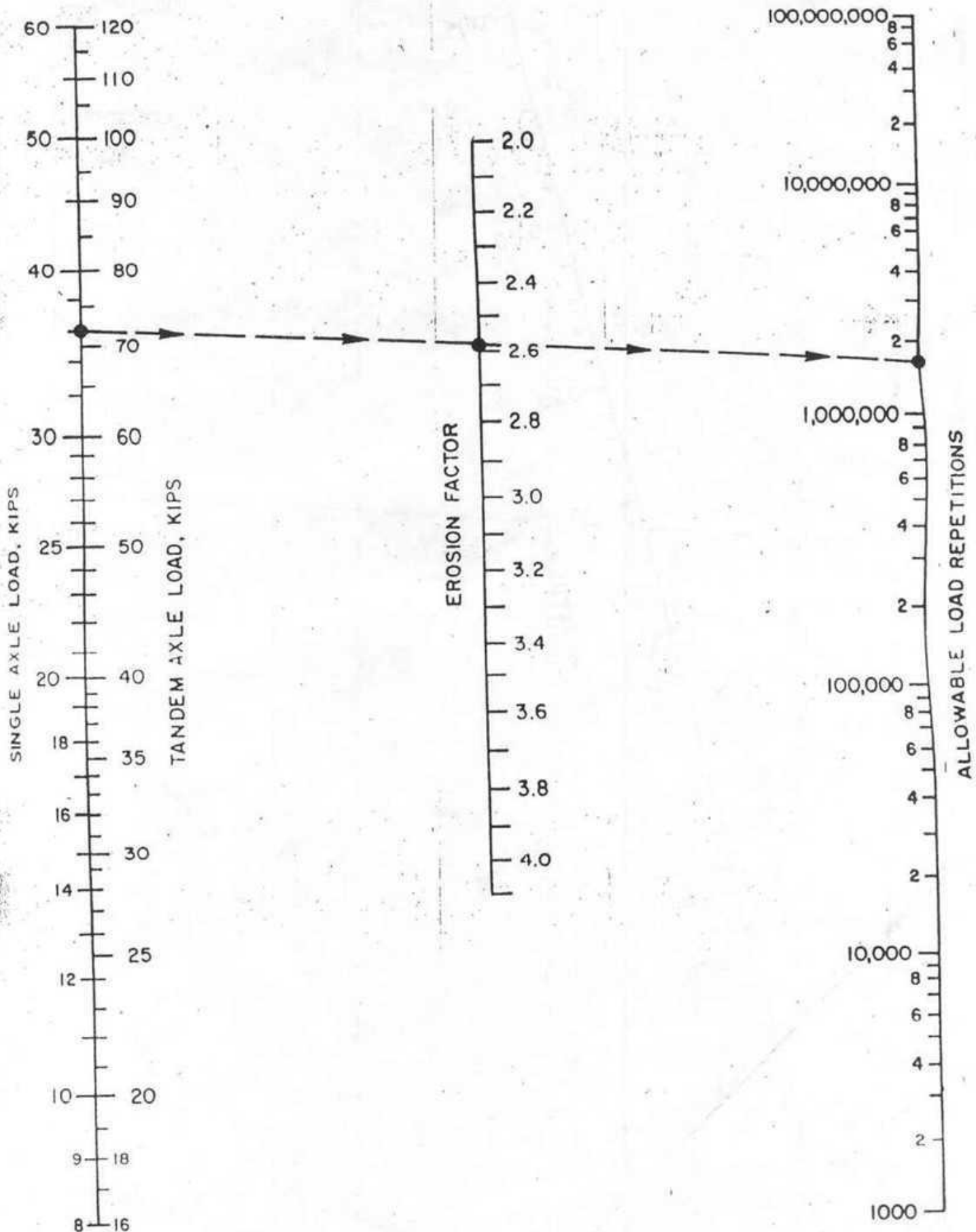


Fig. 3  
 Erosion analysis—allowable load repetitions based on erosion factor (without concrete shoulder).

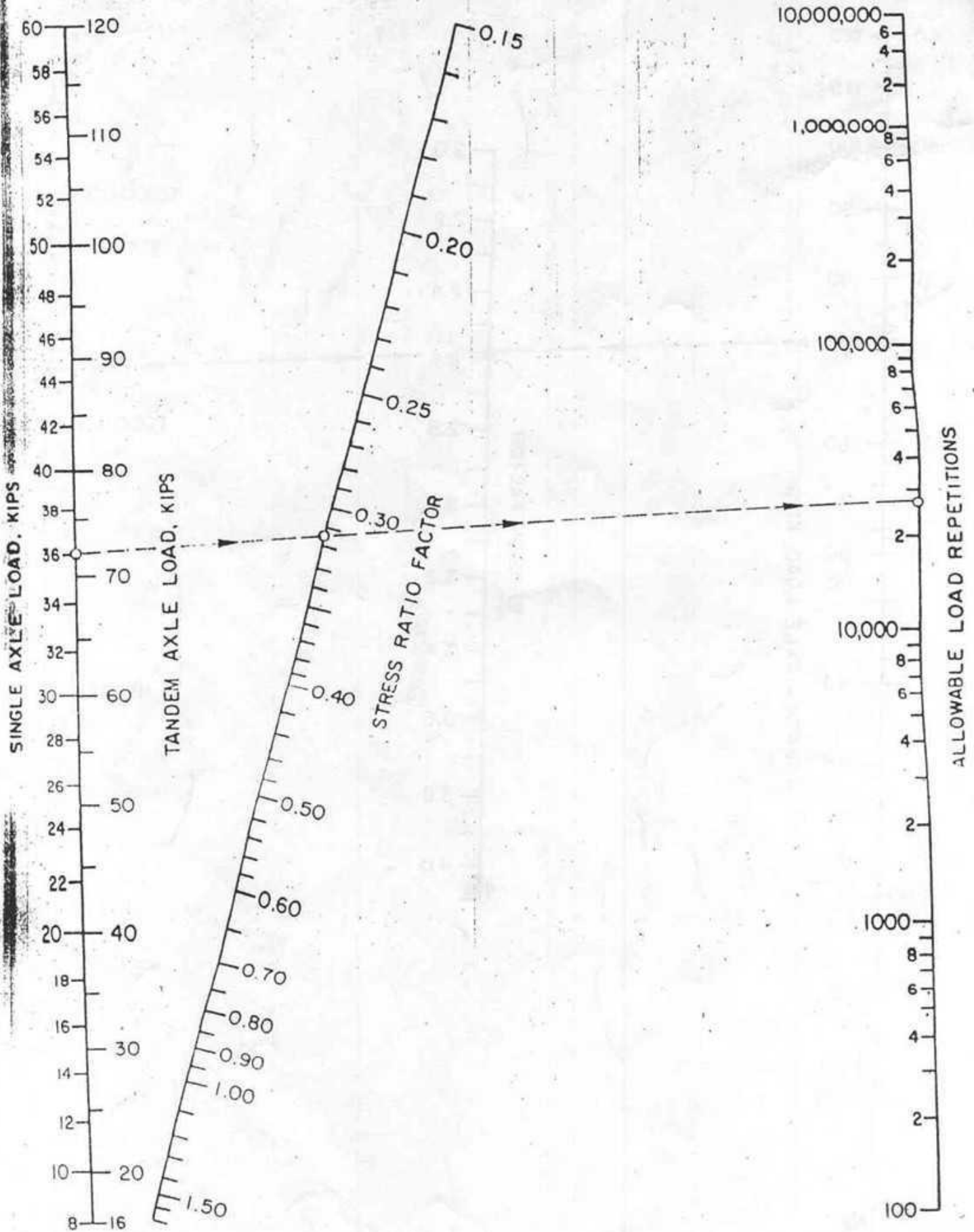
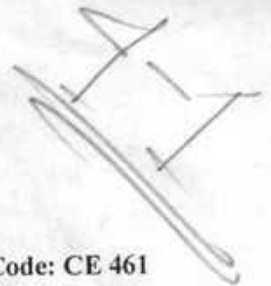


Fig. 4. Fatigue analysis—allowable load repetitions based on stress ratio factor (with and without concrete shoulder).

University of Asia Pacific  
 Department of Civil Engineering  
 Final Examination, Fall 2012  
 Program: B. Sc. Engineering (Civil)



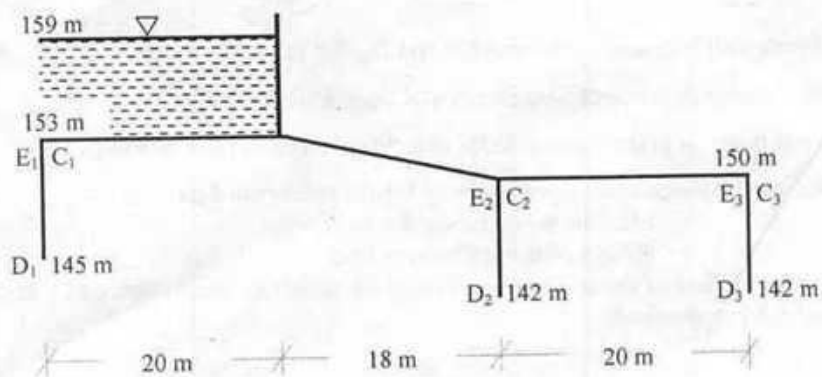
Course Title: Irrigation and Flood Control  
 Time: 3 hours

Course Code: CE 461  
 Full Marks: 150

SECTION A

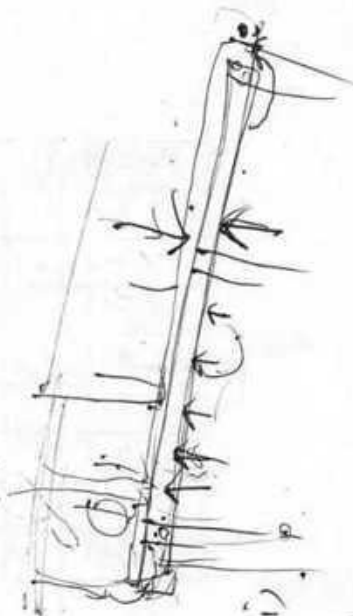
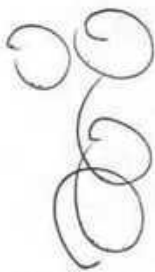
Answer question No. 1 and any THREE from the rest  
 (Assume any reasonable data if not given)

1. (a) Distinguish between the following (any four) (16)
- (i) Alluvial and Non-alluvial canals ✓
  - (ii) Attracting and repelling groyne ✓
  - (iii) Efficiency of water storage and water use ✓
  - (iv) Aqueduct and siphon aqueduct ✓
  - (v) Bligh's and Lane's theory
  - (vi) Free flooding and Border flooding
  - (vii) Contour canal and watershed canal
- (b) Use Khosla's curves to calculate the percentage uplift pressure at points  $C_1, E_2, C_2, D_3$  and  $E_3$  for a barrage foundation profile shown in figure below applying necessary corrections. Also determine the exit gradient. [Assume: floor thickness = 1 m] (18)



Slope (H : V)	Correction Factor
1 : 1	11.2
2 : 1	6.5
3 : 1	4.5
4 : 1	3.3
5 : 1	2.8
6 : 1	2.5
7 : 1	2.3
8 : 1	2.0

2. (a) Optimum utilization of irrigation water? Write short notes on Berms and Balancing depth. (4+6)
- (b) Why diversion of head works is needed? What are the components of diversion of head of works? Draw the layout of diversion of head works? (6)
- (c) The culturable command area for a distributary is 15,000 hectares. The intensity of irrigation is 40% for Rabi and 10% for rice. Duty for Rabi and rice may be assumed as  $1800 \text{ ha/m}^3/\text{sec}$  and  $275 \text{ ha/m}^3/\text{sec}$ . What is the design discharge at distributary head at 10% conveyance loss? (6)
3. (a) What is cross-drainage works? Explain its necessity. (2+4)
- (b) Explain four causes of failure of hydraulic structures. (7)
- (c) How will you justify economically the necessity of lining an existing canal? What added benefits you will expect if the canal to be lined? (6+3)
4. (a) Explain soil-water relationship. Explain its importance to make an economical irrigation canal. (5)
- (b) Write the purposes of marginal bunds. (3)
- (c) What are the important aspects need to be included in an irrigation project report? Define canal system along with his components. (4+3)
- (d) The discharge available from a tubewell is 136 cubic meters per hour. Assuming 3000 hours of working for this tubewell in a year, estimate the culturable area that this tubewell can command. The intensity of irrigation is 50% and the average water depth required for the rabi and kharif crops is 51 cm. (7)
5. (a) Distinguish between Montague fall and English fall with sketch. (5)
- (b) Distinguish between drop spillway and ogee spillway. (5)
- (c) What types of place is suitable for selecting diversion head works? (4)
- (d) Design the shape of an ogee spillway for the following data (8)
- Maximum head over the crest = 5m  
Height of the spillway = 15m
- Upstream face of the spillway is vertical for which constants value of k and n are 2.0 and 1.85 respectively.



(i)

(ii)

(iii)

(iv)

---

Section B

Answer Question no. 6 and any THREE from the rest

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6. What are the types of measures of flood management? Distinguish between them. (3+4+5)  
Name the methods of flood management under each type.
7. Explain the following (any three) (3×4)
- (a) Polder
  - (b) Distinguish between Flood proofing and Flood protection
  - (c) Flood Forecasting
  - (d) Retired Embankment
8. Write down the FAP guiding principles of flood management. (12)
9. (a) Write down the major issues that have been identified in the NWMP (8)  
(b) What are the objectives of flood management? (4)
10. What is water logging? What are the causes of water logging? How can you control water logging? (3+4+5)
11. (a) What is Leaching Requirement? Deduce equation for Leaching Requirement. (2+5)  
(b) Write down the process of salinization (5)

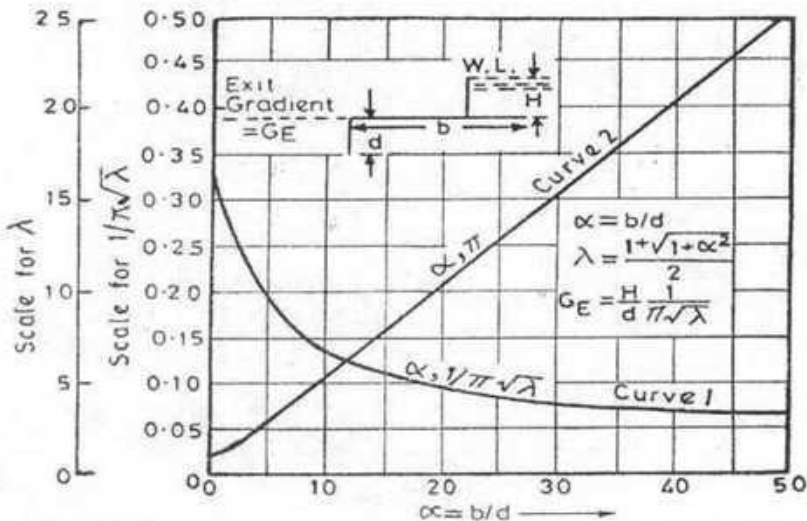
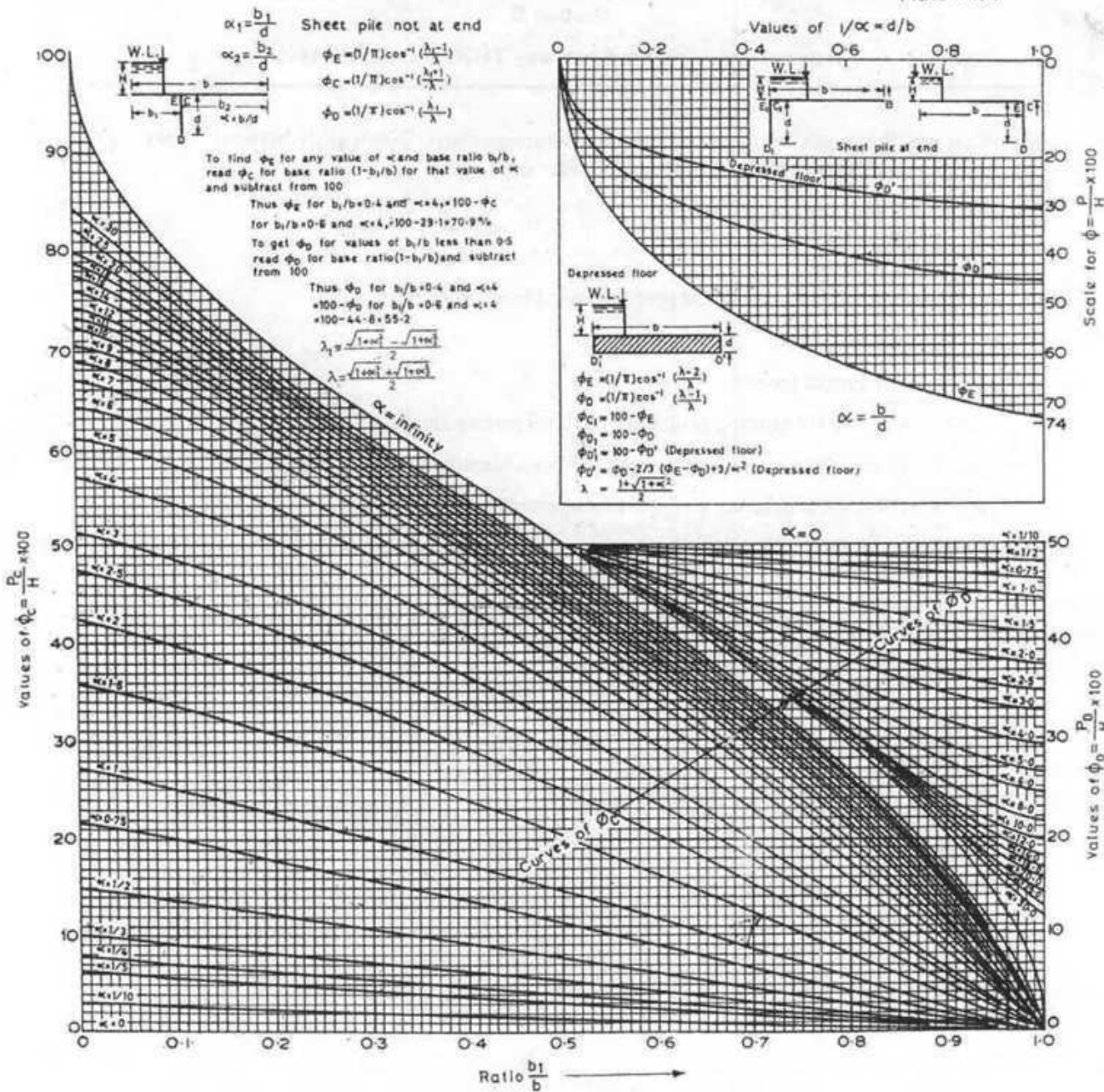


Plate 11.2

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall 2011**  
**Program: B. Sc. Engineering (Civil)**

Course Title: Chemistry  
Time: 3 Hours

Course Code: CHEM 111  
Full Marks: 150

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[THIS QUESTION IS DIVIDED INTO TWO SECTIONS, SECTION A AND SECTION B. ANSWER 3 QUESTIONS FROM EACH SECTION]

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**Section-A**

There are FOUR questions in this section. Answer any THREE.

1. (a) What is internal energy ( $E$ )? 5  
Show graphically how internal energy changes endothermically and exothermically in the chemical reactions.
  - (b) Explain the term enthalpy ( $H$ ). 10  
Derive thermodynamically the Kirchhoff's equation.
  - (c) What is heat of combustion? 10  
Draw and describe a bomb calorimeter used for the determination of heat change in the combustion of octane fuel.
  
  2. (a) What is associated liquid? 5  
Draw and explain the associated structure of water.
  - (b) What is water of crystallization? 10  
Explain that  $\text{NH}_3$  dissolves in water very easily whereas  $\text{CH}_4$  do not. Discuss the chemical action of water with metal carbides.
  - (c) Differentiate between hard water and heavy water. 10  
Discuss the preparation and exchange reactions of heavy water.
  
  3. (a) A solution is not always be said a homogeneous system – explain. 5  
How does a solution conflict with the concept of a compound?
  - (b) What is super saturated solution (SSS)? 10  
Describe the preparation and important characteristics of SSS.
  - (c) What is solubility curve? Draw and explain different types of solubility curves. 10  
Show that solubility of a solid in liquid is constant at a constant temperature.
  
  4. (a) What is reaction rate? Distinguish between instantaneous and average rates. 5
  - (b) Define order and molecularity. How molecularity differs from order? 10  
Classify molecularity based on chemical reactions.
  - (c) State rate law and half-life ( $t_{1/2}$ ) of a reaction. Derive expressions for integrated rate law and  $t_{1/2}$  of a first order reaction. 10  
For a certain first order reaction,  $t_{1/2}$  is 100s. How long will it take for the reaction to be completed 75% ?
-

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Semester Final Examination Fall-2012**

**Program: B. Sc Engineering (2<sup>nd</sup> Year / 1<sup>st</sup> Semester)**

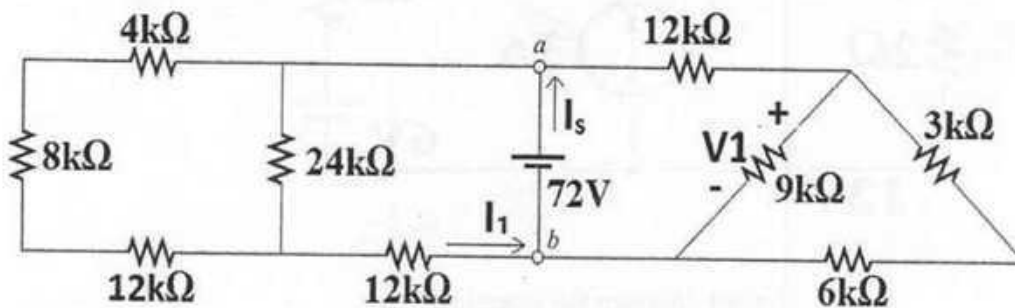
Course Title: Basic Electrical Engineering    Course No. ECE 201    Credits: 3.00

Time: 3.00 Hours.

Full Marks: 150

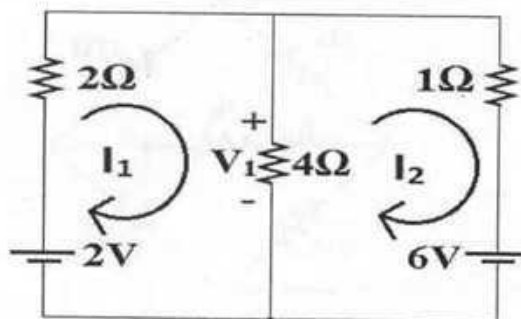
There are **Eight** Questions. Answer any **Six**. All questions are of equal value/Figures in the right margin indicate marks.

01. (a) Calculate the indicated currents ( $I_1$  and  $I_s$ ) and voltage ( $V_1$ ) for the figure shown (4+4+4) below.



Circuit diagram for question 1(a)

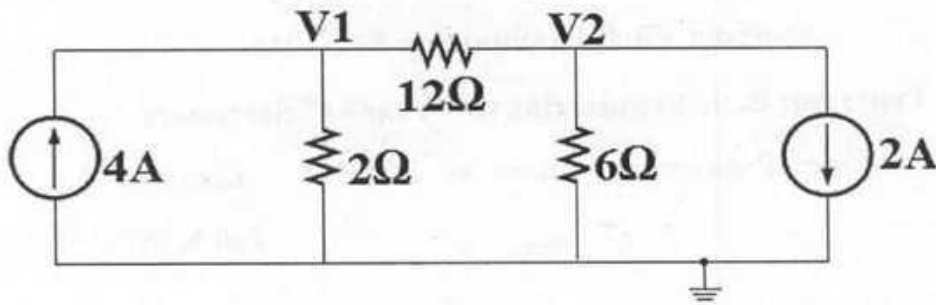
- (b) For the circuit given below, using mesh current method to find the mesh currents  $I_1$  and  $I_2$ . Also find the voltage  $V_1$  across the  $4\Omega$  resistor. (4+4+5)



Circuit diagram for question 1(b)

02. (a) Determine the nodal voltages  $V_1$  and  $V_2$  for the network given below.

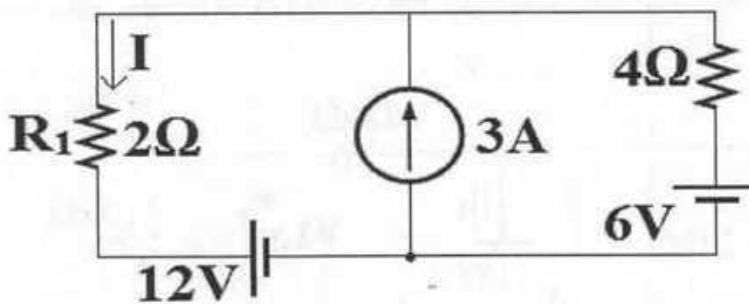
(5+5)



Circuit diagram for question 2(a)

(b) By using superposition method find the current through  $2\Omega$  resistor of the network given below.

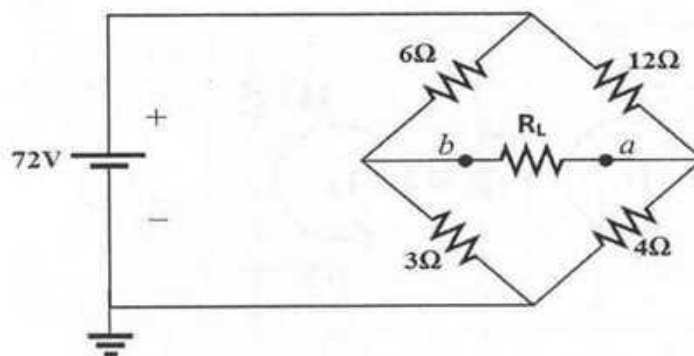
(5+5+5)



Circuit diagram for question 2(b)

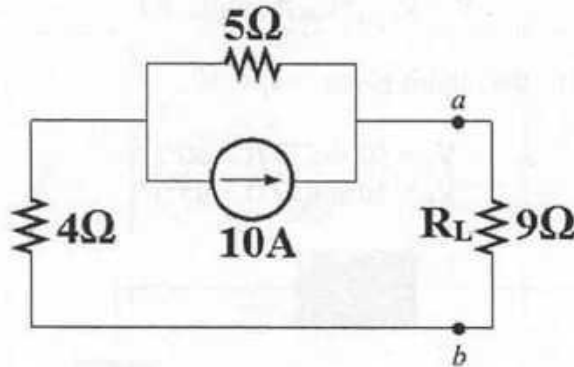
03. (a) For the circuit shown below, find the Thevenin circuit seen by the  $R_L$  between points 'a' and 'b'. Then determine the value of  $R_L$ , so that maximum power can be transferred through  $R_L$ . Also determine the value of maximum power.

(5+5+5)



Circuit diagram for question 3(a)

- (b) Find the Norton equivalent circuit between points 'a' and 'b' (external to  $9\Omega$  resistor) for the network given below. (5+5)



Circuit diagram for question 3(b)

04. (a) Describe the hysteresis loop of a ferromagnetic material. Explain it with a B-H curve. (13)
- (b) For the magnetic circuit given below: (6+6)
- (I) Find the value of  $I$  required to develop a magnetic flux of  $4 \times 10^{-4}$  Wb.  
 (II) Determine  $\mu$  and  $\mu_r$  for the material under these conditions.

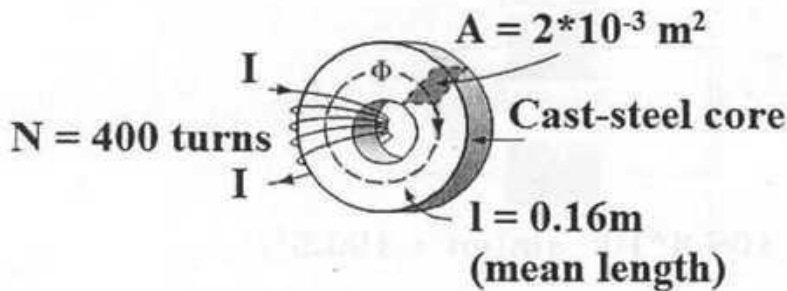


Figure for question 4(b)

05. (a) For an AC current  $I = I_m \sin(\omega t)$ , prove that, its r.m.s value is  $I_{r.m.s} = I_m / (\sqrt{2}) = 0.707 \cdot I_m$ . (12)
- (b) Calculate the reading which will be given by a hot-wire voltmeter if it is connected across the terminals of a generator whose voltage is represented by: (7)

$$V = 200 \sin(\omega t) + 100 \sin(3\omega t) + 50 \sin(5\omega t)$$

[Hint: voltmeter always gives the r.m.s value]

- (c) Add the following ac currents. (use any methods) (6)

$$I_1 = 7 \sin(\omega t) \text{ and } I_2 = 10 \sin(\omega t + 60^\circ)$$

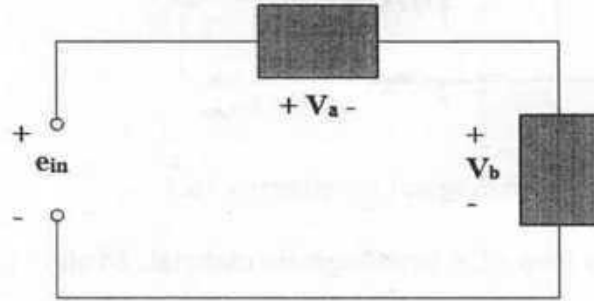
06. (a) Consider that an AC voltage  $V = V_m \sin(\omega t + \theta_v)$  and the corresponding current fo  $I = I_m \sin(\omega t + \theta_i)$ . Prove that the real power is: (11)

$$P = V_{r.m.s} * I_{r.m.s} * \cos(\theta_v - \theta_i)$$

- (b) Find the input voltage of the circuit given below. If: (7)

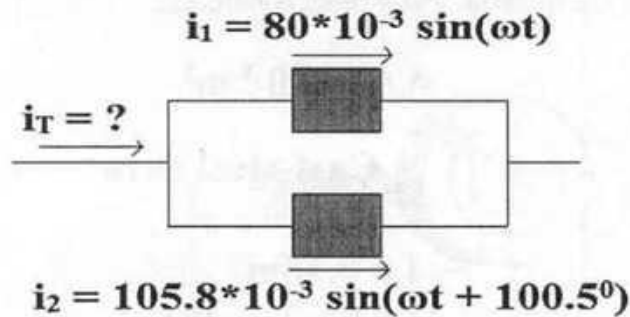
$$V_a = 50 \sin(377t + 30^\circ)$$

$$V_b = 30 \sin(377t + 45^\circ)$$



Circuit diagram for question 6(b)

- (c) Find the total current  $i_T$  for the circuit given below. (7)



Circuit diagram for question 6(c)

07. (a) Determine the phase relationship between the sinusoidal waveforms of each of the following sets. Also determine the real power  $P$  for each case. (5+5)

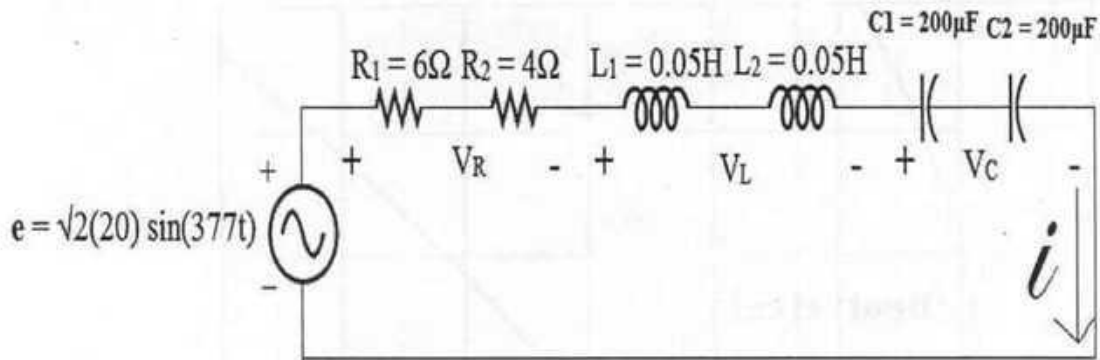
(I)  $V = 10 \sin(\omega t + 30^\circ)$   
 $I = 5 \sin(\omega t + 70^\circ)$

(II)  $V = 3 \sin(\omega t - 10^\circ)$   
 $I = 2 \cos(\omega t + 10^\circ)$

(b) For the circuit given below:

(5+5+5)

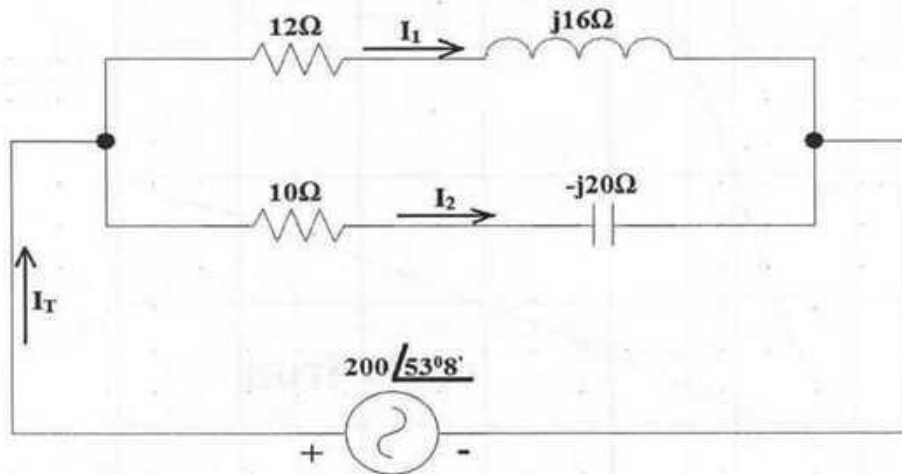
- (I) Calculate  $I$ ,  $V_R$ ,  $V_L$  and  $V_C$  in phasor form.
- (II) Calculate the total power factor of the source.
- (III) Calculate the total average power delivered by the source.



Circuit diagram for the question 7(b)

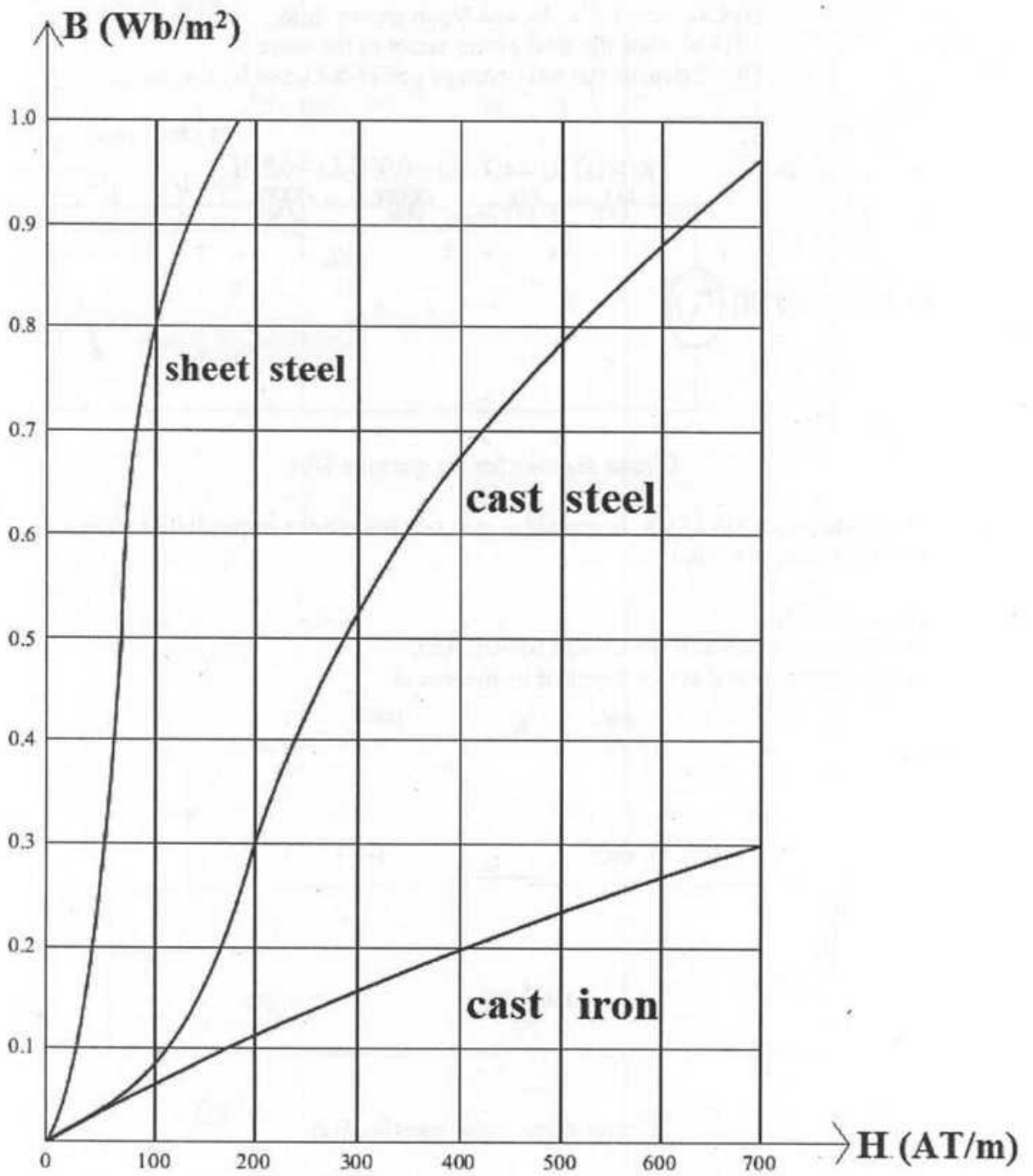
08. (a) A voltage of  $200 \angle 53^\circ 8'$  is applied across two impedance in parallel as shown in figure given below. Find (5+4+4)

- (I)  $I_1$ ,  $I_2$  and  $I_T$ .
- (II) The power factor of the voltage source. And,
- (III) The average real power supplied by the source.



Circuit diagram for question 8(a)

(b) Define the terms: Power Factor, Form factor, Crest Factor, Frequency, Amplitude and Time Period. (give necessary examples) (6\*2)



**University of Asia Pacific**  
**Department of Basic Sciences and Humanities**  
**Semester Final Examination, Fall 2012**  
**Programme: B.Sc. Engineering (Civil Engineering)**  
**(2<sup>nd</sup> Year 2<sup>nd</sup> Semester)**

**Course Title: Principles of Economics**  
**Credit: 2.00**

**Course Code: ECN 201**

**Total Time: 2 Hours**

**Full Marks: 100**

*There are two sections in the question paper namely "SECTION A" and "SECTION B". You have to answer from both sections according to the instruction mentioned in each section.*

**SECTION A**

There are **FIVE** questions in this section. Answer **ANY FOUR** (4 x 20)

1. a) Given some information

Year	CPI	Nominal GDP	Real GDP
2001	18.43	1950 Crore Taka	1020 Crore Taka
2002	25.98	2495 Crore Taka	1280 Crore Taka

Find out the GDP deflator of 2001, 2002 and inflation rate. (6)

- b) Describe two sectors circular flow of economic activities with necessary diagrams. (14)

2. a) Given the following data in the table

Components	\$ (Million)
GDP	6000
Consumption	4000
Investment	800
Government Expenditure	1100
GNP	2300
Depreciation cost	1800
Indirect business taxes	300
Personal income	2500
Personal tax and non tax payment	1250

On basis of these data calculate **net export, NNP, National Income & disposable personal income.** (8)

- b) Describe the social costs of inflation. (12)
3. Why people hold money? Describe the various functions of money. (6+14)
4. Distinguish between tariff and quota. Describe the role of protection in under developed countries. (8+12)
5. What is the problem of double counting in measuring GDP? Explain a method for measuring GDP that avoids this problem. (5+15)

### SECTION B

There are **THREE** topics in this section. Write short notes on **ANY TWO** (2 x 10)

6. National Income
7. Public Revenue
8. Direct and Indirect Taxes

University of Asia Pacific  
Semester Final Examination (Fall-2012)  
Programmes: B. Sc Engineering/B. Arch / B. Pharm / BBA  
Year: 1<sup>st</sup> Semester: 1<sup>st</sup>

Course Code: HSS 101  
Time: 3 Hours

Course Title: English Language I  
Full Marks: 50

\*Marks are indicated in the right margin

**Section-A**

**1. Read the passage carefully and then answer the corresponding questions.**

From far out in space, earth looks like a blue ball. Since water covers three-fourths of the earth's surface, blue is the colour we see most. The continents look brown, like small islands floating in the huge, blue sea. White clouds wrap around the earth like a light blanket. The earth is shaped like a sphere, or a ball. It is 25,000 miles around! It would take more than a year to walk around the whole planet. A spaceship can fly around the widest part of the sphere in only 90 minutes. Even though spaceships have traveled to the moon, people cannot visit the moon without special suits. The moon has no air or water. Plants and animals can't live there either. Astronauts first landed on the moon in 1969. After that, there were six more trips to the moon. They brought back moon rocks, which scientists are still studying. There are holes, or craters, all over the moon's surface. Scientists believe that meteorites smashed into the moon millions of years ago and **formed** the craters.

The sun is the closest star to earth. A star is a hot ball of burning gas. The sun looks very big because it is so close. But the sun is just a medium-sized star. Billions of far-away stars are much bigger than our sun. The burning gases from the sun are so hot that they warm the earth from 93 million miles away! Even though the sun is always glowing, the night here on earth is dark. That's because the earth rotates, or turns around, every 24 hours. During the day, the earth faces the sun. Then we see light. During the night, the earth turns away from the sun. Then it faces the darkness of space. Each day we learn more about the earth, the moon, and the sun.

**1.1 Answer the questions using not more than three sentences:**

**5×1=5**

- a) Write one fact and one opinion from the article that tells what the earth looks like from outer space?
- b) Describe some of the things we know about the moon?
- c) How were the craters on the moon created?
- d) Why did the astronauts bring rocks back from the moon?
- e) What is the main idea of the article?

**1.2 Choose the best answer:**

**5×0.5=2.5**

- i) Why do we see the blue colour when we look at the earth from outer space?
  - a) because most of the earth is covered in land.
  - b) because the sun's rays make the earth look blue.
  - c) because most of the earth is covered in water.
  - d) because clouds wrap around the earth.

- ii) What does **formed** mean in the passage?
- hit
  - made
  - broke
  - stopped
- iii) What causes daylight on earth?
- The full moon causes daylight.
  - Daylight is caused by the earth facing away from the sun.
  - The heat of the sun's rays causes daylight.
  - Daylight is caused by the earth facing toward the sun.
- iv) Which of the following sentences BEST describes the sun?
- The sun looks small because it is so far from earth.
  - The sun is a ball of burning gases that gives the earth heat and light.
  - The sun is a small star.
  - The sun is not as hot as it looks.
- v) Why do we have darkness at night?
- The sun turns away.
  - The earth turns away.
  - The moon turns away.
  - The stars turn away.

### Section B

2. Fill in **any three** of the blanks with appropriate parts of speech. 3×2=6
- Students need to \_\_\_\_\_ (clearance) why they tried to \_\_\_\_\_ (deception) the authority.
  - Sometimes \_\_\_\_\_ (beautiful) may \_\_\_\_\_ (foolish) you.
  - \_\_\_\_\_ (naturalize) products are more \_\_\_\_\_ (reliance) than the chemical ones.
  - The \_\_\_\_\_ (glorious) of Bangladesh will increase, if we have \_\_\_\_\_ (united).
  - The \_\_\_\_\_ (discover) of the new island was quite \_\_\_\_\_ (benefit) for the country.

3. Here are some prefixes and suffixes: **fore-, ex-, de-, with-, inter-, -ward, -ent, -ion, -en, -ous.**

Add any of them with **any five** of the following words and make a sentence with each of the new words.

5×1=5

teacher, nerve, soft, code, preside, see, for, held, act, mix

4. Fill in **any four** of the blanks with appropriate homophones conforming to their respective IPA transcriptions.

4×1=4

- This is the last \_\_\_\_\_ /aʊə(r)/ of \_\_\_\_\_ /aʊə(r)/ exam.
- \_\_\_\_\_ /pɔː(r)/ lots of water to clean your \_\_\_\_\_ /pɔː(r)/ in summer.
- It is hovering on the \_\_\_\_\_ /eə(r)/ that you are not the next \_\_\_\_\_ /eə(r)/ of this wealth.
- My life is at \_\_\_\_\_ /steɪk / after tasting the \_\_\_\_\_ /steɪk / from local Inn

- e) I am \_\_\_\_\_ /səʊ/ happy that you know how to \_\_\_\_\_ /səʊ/ clothes.
- f) Nawab Siraj ud-doulah was \_\_\_\_\_ /θrəʊn/ away from the \_\_\_\_\_ /θrəʊn / of Bengal by the British.

5. Write two sentences with any four of the following words and their homographs. 4×1=4

book, shed, log, execute, yard, chest

6. The following excerpt has some misspelled words. Trace them out and write them correctly.

10×0.25=2.5

Education is the proces by which our mind develops through formal learning. It is mental and intilectoual training, which provides oportunites of growth and helps to overcome impedements and obstacles. Again, the perpuse of education is to enlighten individowal capacity to the limite.

### Section C

(Answer any three of the following questions. Each question carries 7 marks) 3×7=21

7. Compare and contrast between two of your family members. (250 words)
8. Write a paragraph describing the picnic spot you have been to recently. (250 words)
9. Write a letter to your friend apologizing for your bad behaviour at a party. (250 words)
10. Translate the following passage into English:

একবার রাজ্য সুদর্শন ও তেজী মোড়া গ্রন্থের ইচ্ছা পোষন করলেন । তারপর একদিন রাজ্য লমণে যা ওয়ার সময়, পথে একটি মোড়া দেখে স্তীমণ পছন্দ হয়ে গেলো । তিনি অতঃপর মোড়ার মালিককে খুঁজে বের করে মোড়াটি গ্রন্থের প্রস্তুতাব দেন । বিদ্রোহতা ধুশি মনে তার মোড়া রাজ্যকে সোপর্দ করে । তারপর একদিন রাজ্য তার মন্ত্রীকে ডেকে রাজ্যের নির্বোধ লোকের একটি তালিকা তৈরী করতে বলেন । তালিকা তৈরী হয়ে গেলে দেখা গেলো যে, কোন গুণ ও পরীক্ষা ব্যতীত মোড়া গ্রন্থের জন্য, নির্বোধ লোকের তালিকায় রাজ্যের নাম প্রথমে রয়েছে ।

**The University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination Fall-2012**  
**Program: B. Sc Engineering**

Course Title: English Language II  
Time: 3.00 Hours

Course Code: HSS 103

Credit: 3 .00  
Full Mark: 50

1. Read the following passage and answer the questions that follow:

**The Pacific Ocean**

The Pacific is the largest and deepest ocean in the world. Around it there are the east coasts of Asia and Australasia and the west coast of the American continent. There are oceans to the north and south of the Pacific. To the north there is the Arctic Ocean. To the south there is the Antarctic Ocean, also known as the Southern Ocean.

The greatest breadth of the Pacific Ocean is about 10,000 miles, and its greatest length is 7,000 miles. It has an area of about 63,600,000 square miles, and its greatest known depth is 6.75 miles.

a) Answer six (06) of the following questions:

06

- 1) What is the Pacific?
- 2) What coasts are there to the west of the Pacific?
- 3) What coasts are there to the east of it?
- 4) Is the Arctic Ocean to the north or to the south of the Pacific?
- 5) What is the Antarctic Ocean sometimes known as?
- 6) What is the greatest depth of the Pacific Ocean?
- 7) How many continents are there around it?
- 8) What is the area of the Pacific?

b) Answer *yes* or *no* to each question:

04

- 1) Is the Mediterranean an ocean?
- 2) Is the Pacific Ocean larger than the Arctic Ocean?
- 3) Is the greatest breadth of the Pacific about 20,000 miles?
- 4) Is the length of the Pacific greater than its breadth?
- 5) Are there the coasts of three continents around the Pacific?
- 6) Are there oceans to the north and south of the Pacific?
- 7) Is the Arctic also known as the Southern Ocean?
- 8) Are there coasts of three continents around the Pacific?

2. Rewrite any **ten (10)** of the following sentences using appropriate modal verbs:

05

- a) There is a possibility of his attending the programme.
- b) We cannot but accept the truth.
- c) I was in the habit of going to school on foot.
- d) He is able to understand the lesson.
- e) You are permitted to do the task.
- f) It is suggested that you wash your car.
- g) I wish that you prosper in life.
- h) I am obliged to do my duties.
- i) You have the necessity to go there.
- j) Do you allow me to do the work, sir?
- k) I was able to do the work on my own.
- l) I advise you to study more on this subject.

3. Join any **ten (10)** of the following pairs of sentences with appropriate conjunctions or relative pronouns. Do not use the same joining word more than once: **05**

- a) I met the man. He is the Manager.
- b) I must run. I will miss the train.
- c) I appreciate him. He is honest.
- d) I will finish my job. I will go home.
- e) The man filed a case. He was cheated.
- f) He is a good student. He is a good player.
- g) We had some problems. We had to borrow some money.
- h) I couldn't understand what he said. His voice was too low.
- i) I use this pen. This is very smooth.
- j) Mehedi wants to be a teacher. He doesn't read much.
- k) The boy is intelligent. He didn't stand first.
- l) He'll return the book. I don't need it.

4. Write single sentence definitions any five (5) of the following words: **05**

- a) Dictionary (function)      b) University (negation)      c) Brutal (synonym)      g) Bank (function)
- d) Laptop (class)              e) Mobile Phone (description)      f) Democracy (class)

5. Write a letter to the Registrar of your university seeking help to organize a study tour.  
Or, Write a letter to your best friend inviting him/her to your elder sister's wedding. **05**

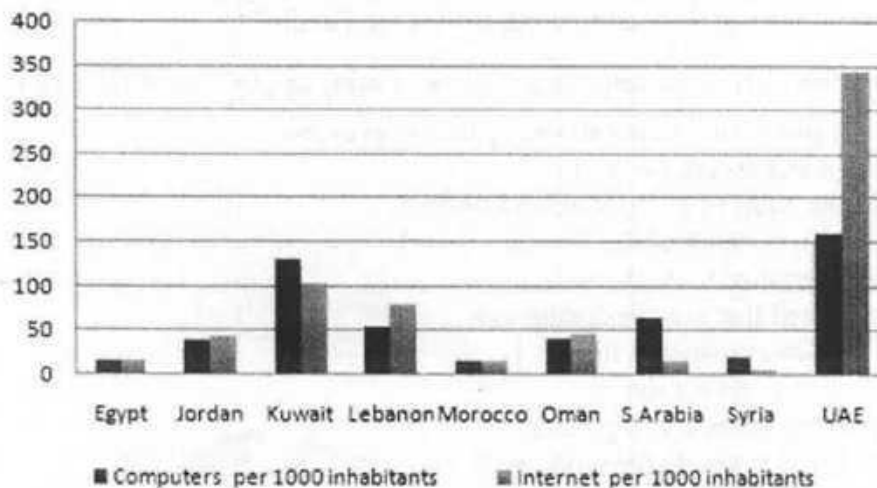
6. UAP will organize 'Inter-Departmental Sports 2013' soon. As the convener of UAP Sports Club, write a memorandum to this effect. **05**

7. UAP has recently laid the foundation stone of its permanent campus. As a reporter of a national daily, write a news-report on the event for publication in your newspaper. **05**

8. Write a paragraph on any one (1) of the followings (word limit 130 words) **05**  
a) My Favourite Sport;      b) My Mother;      c) Pahela Boishakh

9. The bar chart below shows information about use of computer and internet in the Arab World. Describe and analyze the information available in the chart in your own words. **05**

**Computers and Internet in the Arab World**



**University of Asia Pacific**  
**Department Basic Sciences and Humanities**  
**Semester Final Examination Fall-2012**  
**Program: B. Sc Engineering (Civil)**

**Course Title: Bangladesh Studies: Society and Culture**

**Course Code: HSS 211(a)**

**Credit: 2.00**

**Time: 2 Hours**

**Full Marks: 100**

*There are two sections in the question paper namely "SECTION A" and "SECTION B". You have to answer from both sections according to the instruction mentioned in each section.*

**SECTION A**

There are **FIVE** questions in this section. Answer **ANY FOUR** (4x20)

1. What is social stratification? Mention its characteristics. Discuss in brief on the general four types of social stratification pattern.
2. How rural Bangladesh is stratified? Discuss following the determinants of stratification of rural Bangladesh.
3. Define economic institution. Discuss the economic arrangements of human society in pre-industrial stage.
4. What are the general functions of a government? Discuss the types of government with example.
5. What is social process? Discuss the factors those contribute to the formation of social process.

**SECTION B**

There are **THREE** questions in this section. Answer **ANY TWO** (2x10)

6. Define class and caste. Distinguish between the two.
7. Discuss the functional pre-requisites of social structure according to Ginsberg.
8. Write on the stratification pattern of urban Bangladesh.

**University of Asia Pacific**  
**Department of Basic Sciences and Humanities**  
**Semester Final Examination, Fall 2012**  
**Programme: B.Sc. Engineering (Civil)**

**Course Title: Bangladesh Studies: History**  
**Credit: 2.00**

**Course Code: HSS 211(b)**

**Total Time: 2 Hours**

**Full Marks: 100**

*There are two sections in the question paper namely "SECTION A" and "SECTION B". You have to answer from both sections according to the instruction mentioned in each section.*

**SECTION A**

There are **FIVE** questions in this section. Answer **ANY FOUR** (4 x 20)

1. What were the causes behind the battle of Palashi?
2. How did Ishwarchandra contribute to the society?
3. Explain the causes behind the partition of Bengal in 1905. What were the reactions of the Bengalese to it?
4. Who was Shayesta Khan? Explain his achievements.
5. What was the demand of the people of Eastern Bengal about the state language? Give a brief description of the language movement of 1948.

**SECTION B**

There are **THREE** topics in this section. Write short notes on **ANY TWO** (2 x 10)

6. Permanent settlement
7. Six points of Awami League
8. Bara Bhuiya

3-2

**University of Asia Pacific**  
**Department of Civil Engineering**  
**Final Examination, Fall-2012**  
**Program: B.Sc Engineering (Civil)**

Course Title: Principles of Management  
Time: 2 hour

Course Code: IMG 301  
Full Marks: 100

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**Answer any 6 (Six) of the following questions. All questions are of equal value.**

01. Define and explain management. Discuss the various types of skills essential for managers. How do the required managerial skills differ in the organizational hierarchy?
02. Define objectives. Discuss the relationship between objectives and the organizational hierarchy. Describe MBO process.
03. What is organization? What do you mean by formal and informal organization? Discuss the advantages and limitations of decentralization.
04. Define staffing. Discuss Human Resource Management (HRM) functions. State the principles of HRM.
05. What is Motivation? Discuss the model of motivation. State briefly Maslow's theory of motivation.
06. What are the management functions? What is meant by controlling? Discuss the system and process of controlling.
07. What is ethics and business ethics? Discuss the factors influence ethical behavior. How would you encourage ethical behavior in business?
08. Write short note on any four of the following:  
(a) Decision making, (b) Strategy, (c) Leadership, (d) Time Management, (e) Budgeting

**University of Asia Pacific**  
**Department of Basic Sciences & Humanities**  
**Semester Final Examination, Fall-2012**  
**Program: B.Sc. Engineering (Civil, 1<sup>st</sup> year/1<sup>st</sup> semester)**

Course Title: Mathematics I  
Time: 3 hrs

Course Code: MTH 101  
Full Marks: 150

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N.B: There are two sections in the question paper namely "**SECTION A**" and "**SECTION B**". You have to answer from both sections according to the instruction mentioned in each section.

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**SECTION A**

There are **FOUR** questions in this section. Answer any **THREE**.

- Q1. (a) State and prove Rolle's theorem. 12.5  
(b) Verify this theorem for the function  $f(x) = e^x \sin x$  on  $(0, \pi)$ . 12.5
- Q2. (a) State and prove Cauchy's Mean value theorem (MVT). 12.5  
(b) Verify this theorem for  $f(x) = x^3 + x - 4$  and  $g(x) = x^2 + x + 2$  on the interval  $[-1, 2]$ . 12.5
- Q3. (a) State and prove Lagrange's Mean value theorem (MVT). 12.5  
(b) Verify this theorem for  $f(x) = x^3 - 2x - 3$  on the interval  $[-1, 1]$ . 12.5
- Q4. (a) Let  $f(x) = x^3 - 3x^2 + 1$ . Find the intervals on which the function  $f(x)$  is increasing, decreasing, concave up and concave down. 12.5  
(b) Define relative extrema. Find the relative extrema  $f(x) = (1 + \sin x) \cos x$ . 12.5

**SECTION B**

There are **FOUR** questions in this section. Answer any **THREE**

- Q5. (c) State Taylor's theorem with remainder. Use Taylor's theorem to expand  $f(x) = \cos x$  in powers of  $x$  with the remainder term. 12.5  
(b) State and prove L'Hospital's rule. Apply this rule to evaluate

$$\lim_{x \rightarrow 0} \frac{e^x + \ln\left(\frac{1-x}{e}\right)}{\tan x - x}$$

12.5

Q6. Integrate the following

25

(i)  $\int \frac{\sqrt{x}}{\sqrt{a^3 - x^3}} dx$  (ii)  $\int \frac{dx}{(e^x + e^{-x})^2}$  (iii)  $\int \frac{dx}{\sqrt{(x-1)(2-x)}}$  (iv)  $\int \frac{dx}{x^2 + 2x + 2}$   
(v)  $\int \cos^7 x dx$

Q7. a) State the fundamental theorem of calculus.

5

(b) Evaluate (i)  $\int_0^{\frac{\pi}{2}} \frac{dx}{4 + 5 \cos x}$  (ii)  $\int_0^1 \frac{dx}{1 + x^2}$

20

Q8. (a) Find the area of the region enclosed by the curves  $y^2 = 4x$  and  $x^2 = 4y$  9  
(b) Find the arc length of the parabola  $y^2 = 4ax$  cut off by the line  $3y = 8x$ . 8  
(c) Find the area of the region bounded by  $x^2 = y$ ,  $x = y - 2$ . 8

**University of Asia Pacific**  
**Department of Basic Sciences & Humanities**  
**Semester Final Examination, Fall - 2012**

**Program: B.Sc. Engineering (Civil, 1<sup>st</sup> year/2<sup>nd</sup> semester)**

Course Title: Mathematics II

Course Code: MTH 103

Time: 3 hours

Full Marks: 150

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There are two sections in the question paper namely "**SECTION A**" and "**SECTION B**". You have to answer from both sections according to the instruction mentioned in each section.

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**SECTION A**

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What do you know about gradient, divergence and curl? Find the directional derivatives of  $\phi = x^2yz + 4xz^2$  at  $(1, -2, -1)$  in the direction  $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$ . 10
- (b) If  $U = 3x^2y$ ,  $V = xz^2 - 2y$ , evaluate  $\text{grad}[(\text{grad } U) \cdot (\text{grad } V)]$ . 10
- (c) Show that  $\mathbf{F} = (2xy + z^3)\mathbf{i} + x^2\mathbf{j} + 3xz^2\mathbf{k}$  is a conservative force field. 5
2. (a) Prove that the curl of the gradient of scalar function  $\phi$  is zero and also the divergence of the vector  $\mathbf{A}$  is zero. 5
- (b) Find the angle between the surfaces  $x^2 + y^2 + z^2 = 9$  and  $z = x^2 + y^2 - 3$  at the point  $(2, -1, 2)$ . 10
- (c) Given the force  $\mathbf{F} = xy\mathbf{i} - y^2\mathbf{j}$ , find the work done by the path given by  $x = 2t^3$ ,  $y = t^2$  from  $(0, 0)$  to  $(2, 1)$ . 10
3. (a) Define surface integral. Show that  $\iint_S \mathbf{F} \cdot \mathbf{n} dS = \frac{3}{2}$  where  $\mathbf{F} = 4xz\mathbf{i} - y^2\mathbf{j} + yz\mathbf{k}$  and  $S$  is the surface of the cube bounded by the planes,  $x=0, x=1, y=0, y=1, z=0, z=1$ . 13
- (b) Evaluate  $\oint_C (y^2 dx + x^2 dy)$  where  $C$  is the triangle with vertices  $(0, 0), (1, 0), (1, 1)$ . 12
4. (a) If the vector field is given by  $\mathbf{F} = (2x - y + z)\mathbf{i} + (x + y - z^2)\mathbf{j} + (3x - 2y + 4z)\mathbf{k}$ , evaluate the line integral over a circular path given by  $x^2 + y^2 = a^2, z = 0$ . 13
- (b) Let  $\phi = y^2z$  and  $V$  denote the region bounded by the plane  $x + 4y + 2z = 4, x = 0, z = 0$ . Evaluate  $\iiint_V \phi dV$ . 12

## SECTION B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) State Gauss's Divergence Theorem. Verify it for  $\underline{F} = x^2 \hat{i} + y^2 \hat{j} + z^2 \hat{k}$  taken over the cube  $0 \leq x, y, z \leq 1$ . 13
- (b) State Green's theorem for a plane. Using Green's theorem evaluate  $\oint_C (2xy - x^2) dx + (x + y^2) dy$ , where  $C$  is the closed curve of the region bounded by the  $y = x^2$  and  $y^2 = x$ . 12
6. (a) State Stoke's theorem. Using Stoke's theorem or otherwise evaluate  $\oint_C \underline{F} \cdot d\underline{r}$  where  $\underline{F} = (x^2 + y^2) \hat{i} - 2xy \hat{j}$  taken round the rectangle bounded by the lines  $x = \pm a, y = 0, y = b$ . 13
- (b) State Gauss divergence theorem. Use Divergence theorem to evaluate  $\iint_S \underline{F} \cdot \underline{n} \, dS$  where  $\underline{F} = 4x \hat{i} - 2y^2 \hat{j} + z^2 \hat{k}$  and  $S$  is the surface bounded by the region  $x^2 + y^2 = 4, z = 0$ , and  $z = 3$ . 12
7. (a) Find the angle between the planes  $2x - y + z = 6$  and  $x + y + 2z = 7$ . If a line makes angles  $\alpha, \beta, \gamma$  with the axes, show that  $\text{Cos}^2 \alpha + \text{Cos}^2 \beta + \text{Cos}^2 \gamma = 1$ . 10
- (b) Show that the four points  $(-3, 2, 5), (0, 1, 3), (5, 4, 2)$  and  $(7, 0, -1)$  lie on a plane. 5
- (c) Find the equation of the plane through the points  $(2, 2, 1)$  and  $(9, 3, 6)$  and perpendicular to the plane  $x + 6y + 6z = 9$ . 10
8. (a) Find the equation of the plane through the intersection of the planes  $x - 2y + 3z + 4 = 0$  and  $2x - 3y + 4z - 7 = 0$  and the point  $(1, -1, 1)$ . 5
- (b) Find the equation of the line perpendicular to both the line  $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z+2}{3}$ ,  $\frac{x+2}{2} = \frac{y-5}{-1} = \frac{z+3}{2}$  and passing through their intersection. 10
- (c) Find the shortest distance between the lines  $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$  and  $\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$ . 10

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**University of Asia Pacific**  
**Department of Basic Sciences & Humanities**  
**Semester Final Examination, Fall-2012**  
**Program: B.Sc. Engineering (Civil, 2<sup>nd</sup> year/1<sup>st</sup> semester)**

Course Title: Mathematics III  
Time: 3 hrs

Course Code: MTH 201  
Full Marks: 150

N.B: There are two sections in the question paper namely "**SECTION A**" and "**SECTION B**". You have to answer from both sections according to the instruction mentioned in each section.

**SECTION A**

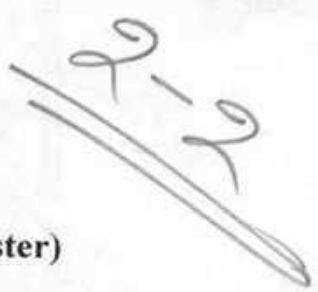
There are **FOUR** questions in this section. Answer any **THREE**

1. (a) Define linear transformation with example. 3  
  
(b) Test whether the transformation  $T : \mathbb{R}^2 \rightarrow \mathbb{R}$  defined by  
(i)  $T(x, y) = xy$  and 12  
(ii)  $T(x, y) = 2x - 3y$   
is linear or not.  
(c) Let  $T : U \rightarrow V$  be a linear transformation, then prove that 10  
(i)  $T(0) = 0$   
(ii)  $T(-x) = -T(x)$   
(iii)  $T(x-y) = T(x) - T(y)$ .
  
2. (a) Define kernel and image of a linear transformation  $T : U \rightarrow V$ . 15  
Prove that (i) Kernel of T is a subspace of U and  
(ii) Image of T is a subspace of V.  
  
(b) Find the kernel and image from the following linear transformation 10  
 $T(x, y, z) = (3x - y, y - z, 3x - 2y + z)$ .
  
3. (a) Define row rank and column rank of a matrix. 5  
  
(b) Find the row rank and column rank of the matrix 20  
$$\begin{pmatrix} -1 & 2 & 0 & 4 & 5 & -3 \\ 3 & -7 & 2 & 0 & 1 & 4 \\ 2 & -5 & 2 & 4 & 6 & 1 \\ 4 & -9 & 2 & -4 & -4 & 7 \end{pmatrix}$$
  
4. (a) Define eigenvalues and eigenvectors of a matrix. 5  
  
(b) Find the eigenvalues and eigenvectors of a matrix  $\begin{pmatrix} 3 & 1 & 1 \\ 2 & 4 & 2 \\ 1 & 1 & 3 \end{pmatrix}$ . 15  
  
(c) Is the matrix mention in (b) is diagonalizable? 5

## SECTION B

There are **FOUR** questions in this section. Answer any **THREE**

5. (a) State Cayley Hamilton theorem. 5
- (b) Verify the Cayley Hamilton theorem for the matrix 15
- $$A = \begin{pmatrix} 1 & 1 & -2 \\ 1 & 0 & 3 \\ -2 & 3 & 2 \end{pmatrix}.$$
- (c) Find the inverse of A using the Cayley Hamilton theorem. 5
6. (a) Define Statistics with examples. 5
- (b) Explain the types of Statistics with examples. 10
- (c) Give some examples which is not Statistics. 5
- (d) Explain the frequency distribution with example. 5
7. (a) Define arithmetic mean, geometric mean and harmonic mean with examples. 5
- (b) Calculate the arithmetic mean and harmonic mean from the following data 10
- |            |      |       |       |       |       |
|------------|------|-------|-------|-------|-------|
| Class:     | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 |
| Frequency: | 8    | 15    | 20    | 4     | 3     |
- (c) Define variance and standard deviation. Find the variance and standard deviation from the following data 10
- 5 17 12 10 9 13 8 14 20
8. (a) Define random experiment, sample space, event and probability with examples. 5
- (b) If  $P$  is probability, then prove that 10
- (i)  $P(A^c) = 1 - P(A)$  (ii) If  $A \subset B$  then  $P(A) \leq P(B)$
- (iii)  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ .
- (c) A class containing 6 girls and 10 boys. If 3 students are chosen at 10 random from the class to form a picnic committee, find the probability that (i) all are boys (ii) exactly 2 are boys and (iii) at least one is a boy. 10



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**Program: B.Sc. Engineering (Civil, 2<sup>nd</sup> year/2<sup>nd</sup> semester)**

Course Title: Mathematics IV  
Time: 3 hrs

Course Code: MTH 203  
Full Marks: 150

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N.B: There are two sections in the question paper namely "**SECTION A**" and "**SECTION B**".  
You have to answer from both sections according to the instruction mentioned in each section.

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**SECTION A**

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Define Fourier series in the interval  $[-l, l]$ . Determining the coefficient of  $a_0, a_n$  and  $b_n$  in Fourier series. [5+10]  
(b) Derive the complex form of the Fourier series. [10]
2. (a) The function  $x^2$  is periodic with period  $2l$  on the interval  $[-l, l]$ . Find its Fourier series. [15]  
(b) Prove that  $\int_0^{\infty} \frac{x \sin mx}{x^2 + 1} dx = \frac{\pi}{2} e^{-m}; m > 0$ . [10]
3. (a) Define Fourier transform, Fourier sine transform and Fourier cosine transform of  $F(x)$  for the infinite interval. [9]  
(b) Find the Fourier sine transform of  $F(x) = \begin{cases} x & \text{for } 0 < x < 1 \\ 2 - x & \text{for } 1 < x < 2 \\ 0 & \text{for } x > 2 \end{cases}$ . [16]
4. Find the finite Fourier sine and cosine transform of  $f(x) = x^2, 0 < x < 4$ . [12.5+12.5]

### SECTION B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Find the general solution of the following differential equations:

(a)  $\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} - 3y = 2e^{4x}$ . [13]

(b)  $\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} - 3y = 2e^x - 10 \sin x$ . [12]

6. (a) State and prove the change of scale and second translation property of Laplace transform. [6+9]

(b) If  $L\{F(t)\} = f(s)$ , prove that  $L\{F''(t)\} = s^2 f(s) - sF(0) - F'(0)$ . [10]

7. Evaluate:

(a)  $\int_0^{\infty} t e^{-2t} \cos at \, dt$ . [8]

(b)  $\int_0^t \frac{\sin t}{t} \, dt$ . [8.5]

(c)  $L\left\{\frac{\cos at - \cos bt}{t}\right\}$ . [8.5]

8. (a) Solve the following initial value problem [13]  
 $Y''(t) + 4Y(t) = 12t$ ,  $Y(0) = 0$ ,  $Y'(0) = 7$ .

(b) Solve:  $\frac{d^4 Y}{dx^4} = \frac{W_0}{EI}$ ,  $0 < x < l$ , [12]

$$Y(0) = 0, Y''(0) = 0, Y(l) = 0, Y''(l) = 0.$$

**University of Asia Pacific**  
**Department of Basic Sciences and Humanities**  
**Final Examination, Fall -2012**  
**Program: B.Sc Engineering (Civil)**

Course Title: Physics I  
Time: 3.00 Hours

Course Code: PHY-101

Credit: 3.00  
Full Marks: 150

*[N.B- The figures in the right margin indicate full marks. There are two sections in the question paper namely "SECTION A" and "SECTION B". Answer from both sections according to the instruction mentioned in each section.]*

**SECTION A**

There are FOUR questions, Answer any THREE

Marks

1. (a) Show that the total energy of the simple harmonic oscillator is  $E = \frac{1}{2}kA^2$ , where the symbols have their usual meanings. 15  
  
(b) A particle executes simple harmonic motion given by the equation  $y = 12 \sin\left(\frac{2\pi t}{10} + \frac{\pi}{4}\right)$ . Calculate (i) amplitude, (ii) frequency, (iii) epoch, (iv) acceleration at  $t = 5$  s. 10
2. (a) Show that the differential equation of a progressive wave is  $\frac{d^2 y}{dt^2} = v^2 \frac{d^2 y}{dx^2}$ , where the symbols have their usual meanings. 15  
  
(b) Show that for a particle executing simple harmonic motion, the acceleration at any instant is  $a = -\omega^2 y$ , where the symbols have their usual meanings. 10
3. (a) Prove that the equation of Newton's formula for velocity of sound in gas is  $v = \sqrt{\frac{P}{\rho}}$ , where the symbols have their usual meanings. 15  
  
(b) Discuss the effect of temperature on the velocity of sound in gas. 10
4. (a) Derive the equation of Doppler effect when observer at rest and source in motion. 15  
  
(b) Two trains traveling in the opposite direction at  $100$  km/hr each, cross each other while one of them is whistling. If the frequency of the note is  $800$  Hz, find the apparent pitch as heard by an observer in the other train:  
(i) before the trains cross each other  
(ii) after the trains have crossed each other  
Consider the velocity of sound at NTP. 10

*[Turn over*

**SECTION B**

**There are FOUR questions. Answer any THREE**

Marks

5. (a) Derive the necessary conditions under which elliptically and circularly polarized light are formed by deriving the general equation of ellipse,  $\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{2xy}{ab} \cos \delta = \sin^2 \delta$ . 15
- (b) Show that at Brewster's angle the reflected and refracted rays are at right angles to each other. 10
6. (a) Prove the law of Malus,  $I \propto \cos^2 \theta$ , where the symbols have their usual meanings. 15
- (b) Write short notes on half and quarter waveplate. 10
7. (a) Show that the moment of inertia of a ring is  $I = MR^2$ , where the symbols have their usual meanings. 15
- (b) Prove that the kinetic energy of a rotating body is  $= \frac{1}{2} I \omega^2$ , where the symbols have their usual meanings. 10
8. (a) Show that the moment of inertia of a uniform rod is  $\frac{1}{12} ML^2$ , where the symbols have their usual meanings. 15
- (b) Derive the following relations: angular momentum  $L = I\omega$  and torque  $\tau = I\alpha$ , where the symbols have their usual meanings. 10