3-1

University of Asia Pacific
Department of Civil Engineering
Final Examination (Fall 2013)
Program: B.Sc. Engg ((3rd year 1st semester)

Course Title: Principles of Accounting **Credit Hours: 2.0** **Course : ACN 301**
Full marks : 50 **Time : 2 hrs**

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

Part-A

Q.1. The comparative statements of Tony Brown Consultants Ltd. are presented below:

TONY BROWN CONSULTANTS LTD.
Balance Sheet
December 31, 2013

Assets	2013	2012
Current assets		
Cash and cash equivalents	$60,100	$ 64,200
Short-term Investment	69,000	50,000
Accounts receivable (net)	122,800	102,800
Inventories	113,000	115,500
Total current assets	**364,900**	**332,500**
Property, plant, and equipment (net)	605,300	520,300
Total assets	**$970,200**	**$852,800**
Liabilities and Stockholders' equity		
Current liabilities		
Accounts Payable	$160,000	$ 145,400
Income Tax Payable	$43,500	42,000
Total Current liabilities	203,500	187,400
Long-term liabilities	210,000	200,000
Total liabilities	413,500	387,400
Stockholders' equity		
Common stock	280,000	300,000
Retained Earnings	276,700	165,400
Total Stockholders' equity	**556,700**	**465,400**
Total liabilities and stockholders' equity	**$970,200**	**$852,800**

TONY BROWN CONSULTANTS LTD.
Income Statement
For the Years Ended December 31, 2013

	2013	2012
Sales	$1,828,500	$1,750,500
Less: Cost of goods sold	1,010,500	996,000
Gross profit	818,000	754,500
Less: Operating expenses	619,000	570,000
Net income	$ 199,000	$ 184,500

Compute the following ratios for 2013 and 2012 and make comments.

i. Current Ratio
ii. Quick or Acid Test Ratio
iii. Asset turnover ratio (Total asset for 2011 was 850,500.)
iv. Profit margin ratio.
v. Debt to total assets ratio.

(10+2.5)

Q.2.a. Carver Construction Company is under contract to build a condominium at a contract price of $4,000,000. The building will take 18 months to complete at an estimated cost of $2,800,000. Construction began in November 2011, and was finished in April 2012. Actual construction costs incurred in each year were: 2011, $280,000; 2012, $1820,000; and 2013, $700,000.

Instruction:
Compute the gross profit to be recognized in each year keeping in mind revenue recognition and matching principles. **(9)**

Q.2.b. Define owner's equity. What items affect Owner's equity? **(3.5)**

Q.3. At the end of its first six months of operations, Global Designs has the following adjusted trial balance on June 30, 2013. (in '000BDT)

	Debit	Credit
Cash	9,500	
Accounts Receivable	16,000	
Prepaid Insurance	1,200	
Supplies	1,300	
Equipment	45,000	
Notes Payable		17,000
Accounts Payable		9,000
Global, Capital		25,000
Design Revenue		54,100
Consulting Revenue		4,900
Interest Payable		850
Salaries Expense	30,000	
Depreciation Expense	1,000	
Accumulated depreciation-Equipment		1,000
Supplies Expense	2,400	
Advertising Expense	1,900	
Rent Expense	1,500	
Interest Expense	850	
Unearned Consulting Revenue		1,100
Utilities Expense	1,700	
Insurance Expense	600	
Total	**112,950**	**112,950**

Instruction:

(a) Prepare an income statement for six months ended, June 30, 2013.
(b) Prepare an Owner's equity statement for six months ended, June 30, 2013.
(c) Prepare a Balance Sheet at June 30, 2013. **(5+2.5+5)**

Part-B

Q.4.a. Superior Development CompanyLtd. has the following cost and expense data for the year ended December 31, 2013.

Raw Material, 1/1/13	$30,000	Factory Insurance	$14,000
Raw Material, 31/12/13	20,000	Factory –Property tax	6,000
Finished Goods, 1/1/13	110,000	Raw material purchases	205,000
Finished Goods, 31/12/13	120,000	Administrative Expense	300,000
Work in process, 1/1/13	80,000	Sales (Net)	1,500,000
Work in process, 31/12/13	50,000	Utilities, Factory	65,000
Direct labor	350,000	Delivery Expense	100,000
Indirect labor	90,000	Sales commission	150,000
Indirect material	15,000	Machine rent, Factory	40,000
Factory Manager's Salary	35,000	Depreciation, Factory Building	24,000

Instruction:
Prepare a cost of goods manufactured schedule for Superior Development Company Ltd. for the year ended, December 31, 2013. **(8.0)**

Q.4.b. State the nine steps of a complete accounting cycle. **(4.5)**

Q.5.a.B.T. Hernandez Company, maker of high-quality flashlights, has experienced steady growth over the last 6 years. However, increased competition has led Mr. Hernandez, the president, to believe that an aggressive campaign is needed next year to maintain the company's present growth. The company's accountant has presented Mr. Hernandez with the following data for the current year, 2013, for use in preparing next year's advertising campaign.

Cost Schedules

Variable costs

Direct labor per flashlight	$9.00
Direct materials	4.00
Variable overhead	3.00
Variable cost per flashlight	$16.00

Fixed costs

Manufacturing cost	$25,000
Selling cost	40,000
Administrative cost	70,000
Total fixed costs	$1,35,000

Selling price per flashlight	: $25.00
Expected sales, 2013 (20,000 flashlights)	: $5,00,000

Mr. Hernandez has set the sales target for the year 2014 at a level of $550,000 (22,000 flashlights).

Instruction:

(a) What is the contribution margin per unit for 2013?

(b) What is the break-even point in using for 2013?

(c) Mr. Hernandez believes that to attain the sales target in the year 2014, the company must incur an additional selling expense of $10,000 for advertising in 2014, with all other costs remaining constant. What will be the break-even point in dollar sales for 2014 if the company spends the additional $10,000?

(d) If the company spends the additional $10,000 for advertising in 2014, what is the sales level in dollars required to equal 2013 operating income of 45,000? **(2+2+3+2)**

Q.5.b. Expro Ltd. uses standard costing technique for evaluating the performance of its construction projects. The followings were the results from last month's variance analysis:
Material Price Variance: 5800 U
Material Quantity Variance: 1800 F
Labor Price Variance: 2450 F
Labor Quantity Variance: 1200 F

Instruction:
Pin point the problem area and write down the probable reasons behind the occurrence of the unfavorable variance from standard. **(3.5)**

Q.6. Hyung Corporation is considering investing in two different projects. It could invest in both, neither, or just one of the projects. The forecasts for the projects are as follows:

	Project A	Project B
Capital investment	$400,000	$600,000
Net annual cash flows	$100,000	$130,000
Length of project	5 years	7 years

The required rate of return acceptable to Hyung is 10%.

Instructions:

(a) Compute the net present value of the two projects. (Present Value table is attached herewith)

(b) What capital budgeting decision should Hyung make?

(c) Project A could be modified. By spending $40,000 more initially, the net annual cash flow could be increased by $20,000 per year. Would this change Hyung's decision? **(6+2+4.5)**

TABLE 2 Present Value of $1

$$PV = \frac{\$1}{(1 + i)^n}$$

n/i	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%	7.0%	8.0%	9.0%	10.0%	11.0%	12.0%	20.0%
1	0.99010	0.98522	0.98039	0.97561	0.97087	0.96618	0.96154	0.95694	0.95238	0.94787	0.94340	0.93458	0.92593	0.91743	0.90909	0.90090	0.89286	0.83333
2	0.98030	0.97066	0.96117	0.95181	0.94260	0.93351	0.92456	0.91573	0.90703	0.89845	0.89000	0.87344	0.85734	0.84168	0.82645	0.81162	0.79719	0.69444
3	0.97059	0.95632	0.94232	0.92860	0.91514	0.90194	0.88900	0.87630	0.86384	0.85161	0.83962	0.81630	0.79383	0.77218	0.75131	0.73119	0.71178	0.57870
4	0.96098	0.94218	0.92385	0.90595	0.88849	0.87144	0.85480	0.83856	0.82270	0.80722	0.79209	0.76290	0.73503	0.70843	0.68301	0.65873	0.63552	0.48225
5	0.95147	0.92826	0.90573	0.88385	0.86261	0.84197	0.82193	0.80245	0.78353	0.76513	0.74726	0.71299	0.68058	0.64993	0.62092	0.59345	0.56743	0.40188
6	0.94205	0.91454	0.88797	0.86230	0.83748	0.81350	0.79031	0.76790	0.74622	0.72525	0.70496	0.66634	0.63017	0.59627	0.56447	0.53464	0.50663	0.33490
7	0.93272	0.90103	0.87056	0.84127	0.81309	0.78599	0.75992	0.73483	0.71068	0.68744	0.66506	0.62275	0.58349	0.54703	0.51316	0.48166	0.45235	0.27908
8	0.92348	0.88771	0.85349	0.82075	0.78941	0.75941	0.73069	0.70319	0.67684	0.65160	0.62741	0.58201	0.54027	0.50187	0.46651	0.43393	0.40388	0.23257
9	0.91434	0.87459	0.83676	0.80073	0.76642	0.73373	0.70259	0.67290	0.64461	0.61763	0.59190	0.54393	0.50025	0.46043	0.42410	0.39092	0.36061	0.19381
10	0.90529	0.86167	0.82035	0.78120	0.74409	0.70892	0.67556	0.64393	0.61391	0.58543	0.55839	0.50835	0.46319	0.42241	0.38554	0.35218	0.32197	0.16151
11	0.89632	0.84893	0.80426	0.76214	0.72242	0.68495	0.64958	0.61620	0.58468	0.55491	0.52679	0.47509	0.42888	0.38753	0.35049	0.31728	0.28748	0.13459
12	0.88745	0.83639	0.78849	0.74356	0.70138	0.66178	0.62460	0.58966	0.55684	0.52598	0.49697	0.44401	0.39711	0.35553	0.31863	0.28584	0.25668	0.11216
13	0.87866	0.82403	0.77303	0.72542	0.68095	0.63940	0.60057	0.56427	0.53032	0.49856	0.46884	0.41496	0.36770	0.32618	0.28966	0.25751	0.22917	0.09346
14	0.86996	0.81185	0.75788	0.70773	0.66112	0.61778	0.57748	0.53997	0.50507	0.47257	0.44230	0.38782	0.34046	0.29925	0.26333	0.23199	0.20462	0.07789
15	0.86135	0.79985	0.74301	0.69047	0.64186	0.59689	0.55526	0.51672	0.48102	0.44793	0.41727	0.36245	0.31524	0.27454	0.23939	0.20900	0.18270	0.06491
16	0.85282	0.78803	0.72845	0.67362	0.62317	0.57671	0.53391	0.49447	0.45811	0.42458	0.39365	0.33873	0.29189	0.25187	0.21763	0.18829	0.16312	0.05409
17	0.84438	0.77639	0.71416	0.65720	0.60502	0.55720	0.51337	0.47318	0.43630	0.40245	0.37136	0.31657	0.27027	0.23107	0.19784	0.16963	0.14564	0.04507
18	0.83602	0.76491	0.70016	0.64117	0.58739	0.53836	0.49363	0.45280	0.41552	0.38147	0.35034	0.29586	0.25025	0.21199	0.17986	0.15282	0.13004	0.03756
19	0.82774	0.75361	0.68643	0.62553	0.57029	0.52016	0.47464	0.43330	0.39573	0.36158	0.33051	0.27651	0.23171	0.19449	0.16351	0.13768	0.11611	0.03130
20	0.81954	0.74247	0.67297	0.61027	0.55368	0.50257	0.45639	0.41464	0.37689	0.34273	0.31180	0.25842	0.21455	0.17843	0.14864	0.12403	0.10367	0.02608
21	0.81143	0.73150	0.65978	0.59539	0.53755	0.48557	0.43883	0.39679	0.35894	0.32486	0.29416	0.24151	0.19866	0.16370	0.13513	0.11174	0.09256	0.02174
24	0.78757	0.69954	0.62172	0.55288	0.49193	0.43796	0.39012	0.34770	0.31007	0.27666	0.24698	0.19715	0.15770	0.12640	0.10153	0.08170	0.06588	0.01258
25	0.77977	0.68921	0.60953	0.53939	0.47761	0.42315	0.37512	0.33273	0.29530	0.26223	0.23300	0.18425	0.14602	0.11597	0.09230	0.07361	0.05882	0.01048
28	0.75684	0.65910	0.57437	0.50088	0.43708	0.38165	0.33348	0.29157	0.25509	0.22332	0.19563	0.15040	0.11591	0.08955	0.06934	0.05382	0.04187	0.00607
29	0.74934	0.64936	0.56311	0.48866	0.42435	0.36875	0.32065	0.27902	0.24295	0.21168	0.18456	0.14056	0.10733	0.08215	0.06304	0.04849	0.03738	0.00506
30	0.74192	0.63976	0.55207	0.47674	0.41199	0.35628	0.30832	0.26700	0.23138	0.20064	0.17411	0.13137	0.09938	0.07537	0.05731	0.04368	0.03338	0.00421
31	0.73458	0.63031	0.54125	0.46511	0.39999	0.34423	0.29646	0.25550	0.22036	0.19018	0.16425	0.12277	0.09202	0.06915	0.05210	0.03935	0.02980	0.00351
40	0.67165	0.55126	0.45289	0.37243	0.30656	0.25257	0.20829	0.17193	0.14205	0.11746	0.09722	0.06678	0.04603	0.03184	0.02209	0.01538	0.01075	0.00068

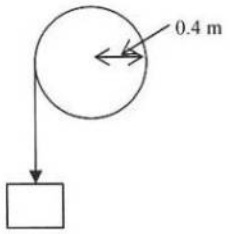
University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course No: CE 103 (A) Course Title: Engineering Mechanics II

Full Marks: 120 Time: 3.0 hours

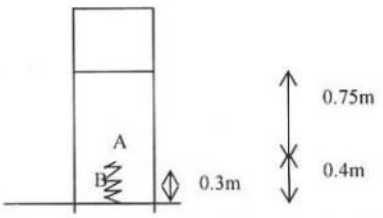
There are **EIGHT** questions. Answer any **SIX**. The figures in the right margin indicate the marks of the questions.

1.(a) The drum shown has a mass of 60 kg and a radius of gyration of 0.25 m. A cord of negligible mass is wrapped around the periphery of the drum and attached to a block of 20 kg mass. If the block is released, determine the drum's angular velocity. (10)



(b) A block of 2000 lb weight is sliding down on a 3% grade for 3 minutes. If the frictional force between the block and the incline is 25 lb, calculate the value of impulse. (10)

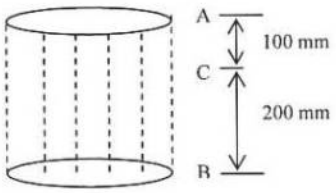
2(a) The ram shown in figure has a mass of 100 kg and is released from rest at 0.75 m from the top of a spring A that has a stiffness of 12 KN/m. If a second spring B having stiffness of 15 KN/m is nested in it, determine the maximum deflection of A needed to stop the downward motion of the ram. (10)



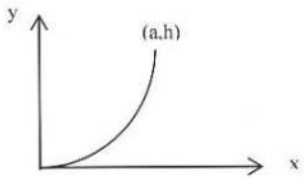
(b) Derive the expressions for the moment of inertia of a right circular homogeneous cone (i) about an axis through its apex and parallel to the plane of the base and (ii) about a parallel gravity (centroidal) axis. (10)

3(a) A race car C travels around a horizontal circular track with radius 300 ft, if the car increases its speed at a constant rate of 7 ft/sec^2 starting from rest, determine the time needed it to reach an acceleration of 8 ft/sec^2. What is its speed at this instant? (10)

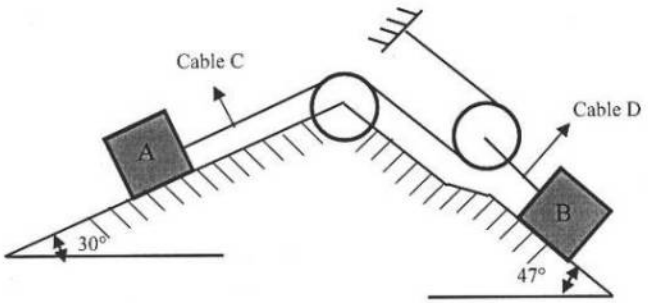
(b) A metallic particle is subjected to the influence of magnetic field such that it travels vertically through a fluid that extends from plate A to B. The particle released from rest to C, s = 100 mm and the acceleration is measured as 4s m/s^2 where s in meters. Determine velocity when particle in B, s = 200 mm and time to travel from C to B. (10)



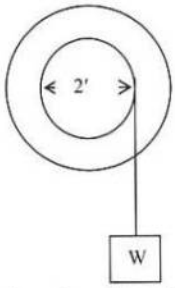
4 (a) Calculate mass moment of inertia of the parabolic rod about the y-axis. Assume the rod is made of a uniform material and has a mass of m. (10)



(b) In the following figure, $W_A = 300$ lb, $W_B = 175$ lb, $f_A = 1/4$, $f_B = 1/3$. How far and in what direction does 'A' travel from rest during 25 sec? Determine also the forces in the cable C and in the cable D. The cables are weightless and the pulleys are weightless and frictionless. (10)

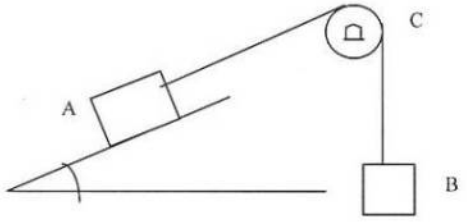


5(a) The rotating assembly shown in figure weighs 200 lb, diameter = 2 ft, and the weight, W = 32.2 lb. Neglect friction and the mass of the cable. If W is released from rest and descends 20 ft in 4 seconds, Determine the tension in the cable and the radius of gyration of the rotating assembly. (10)

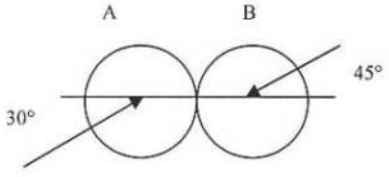


(b) A 16″ diameter solid cylinder A weighs 1300 lb. It rolls without slipping down a 30° incline. Its c.g. has an initial speed of 14 fps. How long will it move, before its c.g. has a speed of 40 fps? What is the force of friction between the cylinder and the plane? (10)

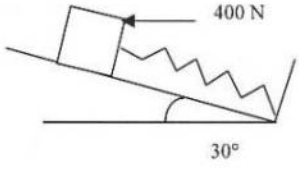
6(a) A body A weighing $W_A = 50$ lb is on a plane inclined at an angle of 30°. The coefficient of friction on this plane (f_A) = 0.3. A cable attached to this body passes over a stationary member C, for which the coefficient of friction is $f_c = 0.2$. From the other end of the cable is suspended a body B weighing $W_B = 100$ lb. What are the tensions in the cable and what are the speeds of the bodies after they move 20 ft from rest? The weight of the cable is negligible. (10)



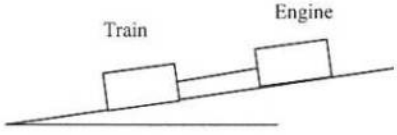
(b) Two smooth spheres A and B of equal diameter and on a horizontal plane collide with oblique central impact. Each sphere weighs 5 lb, e = 0.75, $v_{A1} = 20$ fps, $v_{B1} = 30$ fps. What are the absolute velocities (including directions) of each sphere after impact? (10)



7(a) The 10 kg block shown below rests on the rough incline for which the kinetic coefficient of friction is 0.3. If the spring is originally unstretched, determine the total work done by all the forces acting on the block when a horizontal force of 400 N pushes the block up the plane 2 m. Given, k = 30 N/m. (10)



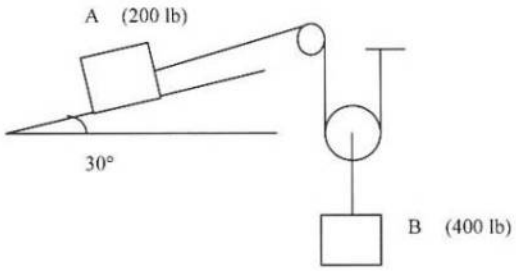
(b) An engine of weight 500 KN pulls a train weighing 1500 KN up on incline of 1 in 100. The train starts from rest and moves with a constant acceleration against a resistance of 5 N/KN. It attains a speed of 18 kmph in 60 seconds. Determine the tension in the drawbar connecting the train and the engine. What will be its speed 90 second after start? (10)



(10)

8(a) An automobile starts from rest and moves around a circular path whose radius is 600 ft. Its tangential acceleration is $a_t = (s+6)^{1/2}$. Determine the tangential and normal acceleration after the car has travelled 100 ft.

(b) The two blocks shown start from rest. Given the frictional coefficient between the block and incline is 0.25. The pulleys are weightless and frictionless. Determine the acceleration of each block and tension of each cord. (10)



University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013 (Section B)
Program: B. Sc. Engineering (Civil)

Course Title: Engineering Mechanics II
Time: 3 hours

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

[Answer **any 10 (TEN)** of the following 14 (FOURTEEN) questions. All questions carry equal marks. Assume Reasonable values for missing data only, if any.]

1) Determine the mass moment of inertia of the rectangular cube about Z-Z axis shown in Figure 1.

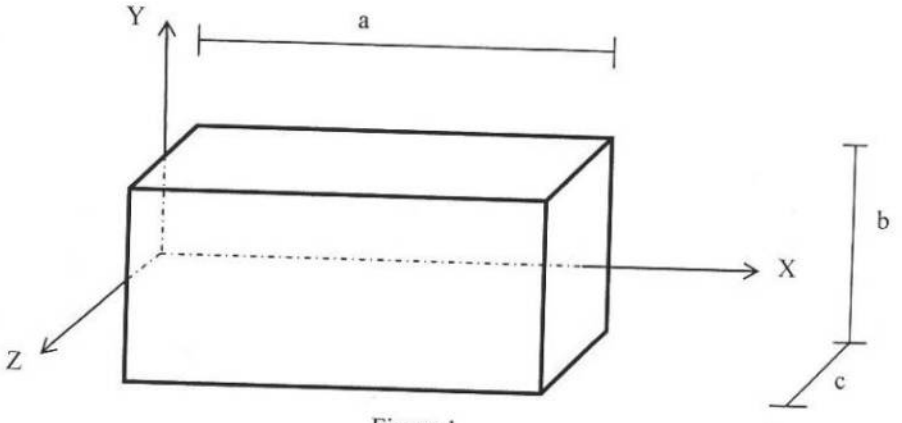


Figure 1

2) Determine the mass moment of inertia of the right circular cone about X-X axis shown in Figure 2.

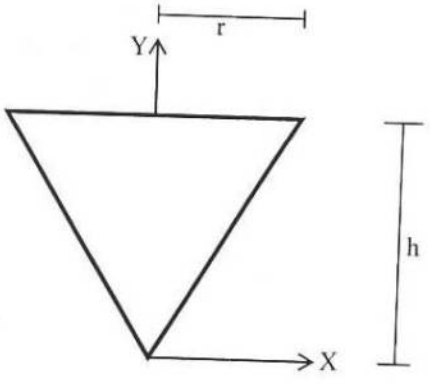


Figure 2

3) Based on observations, the speed of a jogger can be approximated by the relation $v = 7.5(1- 0.04x)^{0.3}$, where v and x are expressed in mile/h and miles, respectively. Knowing that $x = 0$ at $t = 0$, determine (*a*) the distance the jogger has run when $t = 1$ h, (*b*) the jogger's acceleration in ft/s2 at $t = 0$, (*c*) the time required for the jogger to run 6 mile.

4) A sprinter in a 100-m race accelerates uniformly for the first 35 m and then runs with constant velocity. If the sprinter's time for the first 35 m is 5.4 s, determine (*a*) his acceleration, (*b*) his final velocity, (*c*) his time for the race.

5) An outdoor track is 420 ft in diameter. A runner increases her speed at a constant rate from 14 to 24 ft/s over a distance of 95 ft. Determine the magnitude of the total acceleration of the runner 2 s after she begins to increase her speed.

6) An automobile having a mass of 2 Mg travels up a 7° slope at a constant speed of 100 km/h. If mechanical friction and wind resistance is neglected, determine the power developed by the engine if the automobile has an efficiency $\varepsilon = 0.65$.

7) Two bumper cars, shown in Figure 3, each having a mass of 150 kg are coasting towards each other before they freely collide head on. If no energy is lost during the collision, determine their velocities after the collision.

Figure 3

8) The 50-lb crate shown in Figure 4 is acted upon by a force having a variable magnitude P = (20t) lb, where t is in seconds. Determine the crate's velocity 2 s after P has been applied. The initial velocity is $v_1 = 3$ ft/s down the plane, and the coefficient of kinetic friction between the crate and the plane is $f_k = 0.3$.

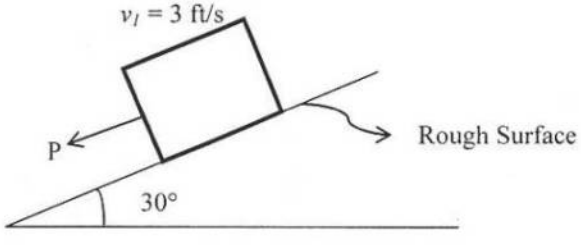


Figure 4

9) If an automobile's braking distance from 90 km/h is 45 m on level pavement, determine its braking distance from 90 km/h when it is (a) going up a 5° incline, (b) going down a 3 percent incline. Assume the braking force is independent of grade.

10) A body is rotating about a fixed axis so that its angular acceleration is $\alpha = 4t^2 - t + 4$ rad per sec^2. If the initial angular velocity is 10 rad per sec, calculate the angular velocity and angular displacement after 2 sec?

11) A 4-oz cricket ball is bowled with a velocity of 80 ft/s toward a batsman. After the ball is hit by the bat B, it has a velocity of 120 ft/s in the direction shown in Figure 5. If the ball and the bats is in contact for 0.015 s. determine the average impulsive force exerted on the ball during the impact.

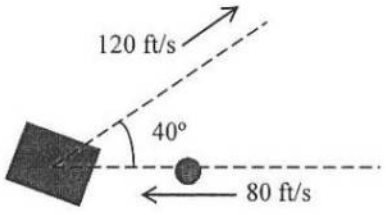


Figure 5

12) Determine the value of 'W' and 'h' so that the 100-lb block shown in Figure 6 is on the verge of both sliding up the plane and tipping. The coefficient of friction between the rope and the fixed drum, as well as between the block and the plane, is 0.2. The rope between the weight and drum is parallel to the plane.

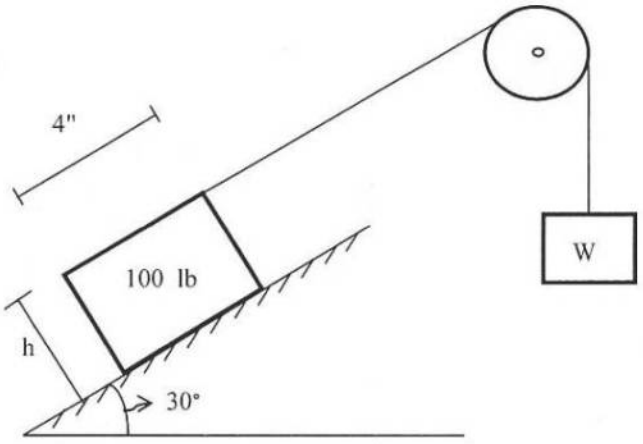


Figure 6

13) Crates A and B, shown in Figure 7, weighs 100 lb and 50 lb, respectively. If they start from rest, determine their speed when t = 5s. Also, find the force exerted by crate A on crate B during the motion. The coefficient of kinetic friction between the crates and ground is $f_k = 0.25$.

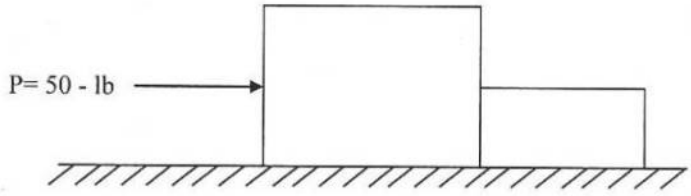


Figure 7

14) Figure 8 shows that the magnitude and direction of velocities of two frictionless balls A and B, having mass of 1 kg and 2 kg respectively, before they strike each other. Assuming e = 0.75, determine the x and y components of the final velocity of each ball just after collision.

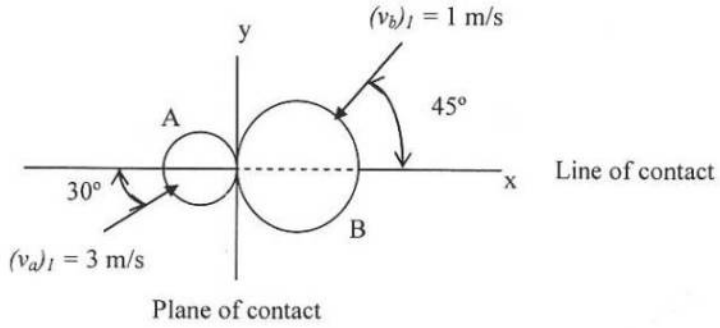


Figure 8

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

Course Title: Surveying Credit Hours: 4.0 Course Code: CE 105
Time: 3 hours Full Marks: 100

SECTION A

There are **Four** questions in this section.Answer any **Three** of them.

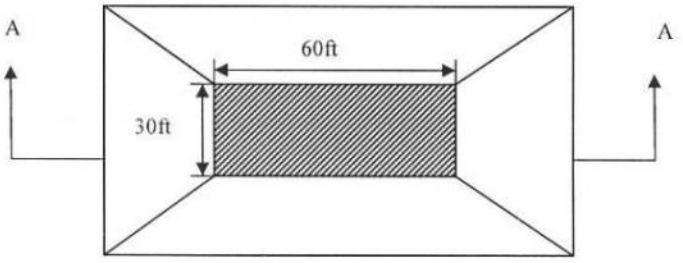
1. (a) Determine Local apparent time (L.A.T.) when Local Mean Time (L.M.T.) is 10h 30m 30s at Longitude 30°18' E. Given that, Equation of time at G.M.N. is 6m 4.35s increasing at a rate of 0.30 s/h. $(6\frac{2}{3})$

(b) Calculate the earthwork for an embankment using the following data applying Prismoidal correction: (10)

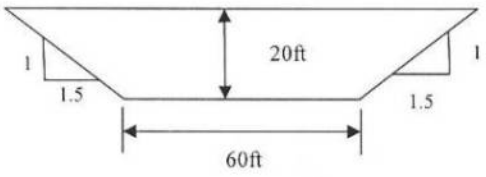
Chainage (ft)	0	100	200	300
Ground Level (ft)	8.4	14	20.4	20
Formation Level (ft)	17	17	17	17

Formation level width = 100 ft. Side slope = 2 horizontal to 1 vertical.

2. (a) Apply both Prismoidal Rule and Trapezoidal Rule to compute the volume of a 20 ft. deep reservoir 40- ft long and 20ft wide at bottom with a side slope of 1.5 horizontal to 1 vertical on all sides. The ground surface is horizontal in both directions (See **Figure 1**). $(4\frac{2}{3})$



Plan View



Section A-A

Figure 1

(b) Compare between *Horizon System* and *Dependent Equatorial System* with neat sketch. (02)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course title: Introduction to Civil and Environmental Engineering — Course code: CE 107
Time: 120 minutes — Full marks: 50

There are TWO sections in the question paper namely "SECTION A" and "SECTION B". You have to answer from the both sets according to the instruction mentioned on each section.

SECTION A
MARKS: 25

There are FIVE (5) questions. Answer question no. 01 (COMPULSORY) and any THREE (3) from the rest.

1. a) Define the following: 4

   - Ecosystem
   - Autotrophs
   - Heterotrophs
   - Biomass
   - Secondary production
   - Non-renewable energy
   - Water Pollution
   - Phytoplankton

   b) Write the names of twelve international rivers flowing through Bangladesh. 3

2. a) Draw the schematic diagram of institutional framework for water resources management in Bangladesh. 3

   b) Draw the schematic water balance diagram of Bangladesh for average year. 3

3. a) Define biodiversity and explain different components of biodiversity. 3

   b) Define acid rain and graphically show the process of acid rain formation. 3

4. a) What is climate change? What is the difference between weather and climate? 2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

Course Title: Engineering Materials — Course Code: CE 201 (Sec. A)
Time: 3 Hours — Full Marks: 150

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 a bridge project on the following data: (40)

Volume ratio of sand to total aggregate = 0.35
Air Content = 2.0% (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 = ¾ inch, Aggregate type = Stone chips
Dosage of superplasticizer = 5 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 kg/m^3, 1450 kg/m^3 and 1400 kg/m^3, respectively,
(vi) Calculate cost of concrete per cubic meter based on the current unit rates of materials,
(vii) Assume 5% surplus water in sand over SSD condition and the amount of bulking of sand is 20%. Make proper adjustments in mixture proportions.
(viii) 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?, and
(ix) 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?

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

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

Section A

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

1. (a) Draw a schematic diagram of the rock cycle. Distinguish between sediments and sedimentary rocks. Give at least two examples of each type of rock and discuss about igneous rock. 12
   (b) Describe (no sketch is required), in brief, the principal zones of the earth from geologic point of view. With the aid of a sketch show the thicknesses of different parts of geosphere. 8

2. (a) What is geomorphic process? Distinguish between physical and chemical weathering processes. Mention the names of major chemical weathering processes 6
   (b) Define mineral. Mention major physical properties of mineral. Classify (no description is required) major minerals. Discuss, in brief, major silicate minerals. 9
   (c) Define fold, fault and joint. Classify fold based on geometry. 5

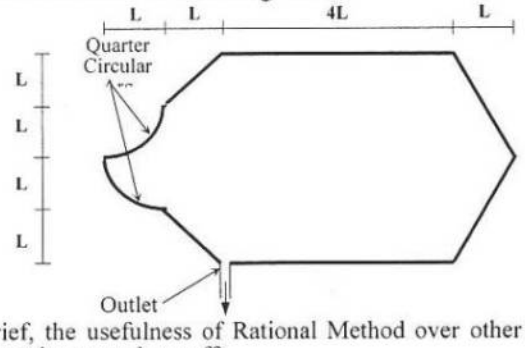
3. (a) Classify and discuss briefly (with neat sketches) various types of faults according to the direction of movement and net slip. 9
   (b) Discuss liquefaction phenomenon (with basic mechanism) due to earthquake. 7
   (c) Tabulate Modified Mercalli intensity scales of earthquake (IX to XII). 4

4. Briefly discuss, mention or draw sketches, as asked for, on **any four** of the following topics:- 5 X 4 = 20
   (i) Major earthquake parameters (geometric)
   (ii) Neat sketches of Horst and Graben
   (iii) Surface waves of earthquake (no sketch required)
   (iv) Typical geometry of a fold (with neat sketch)
   (v) Geomorphic processes on the basis of origin

Section B

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

5. (a) Sketch different routes of runoff. Write down the factors affecting runoff. 5
   (b) Calculate the FF and CC of the following basin. 6



   c) Discuss, in brief, the usefulness of Rational Method over other method, such as flood hydrograph, to estimate peak runoff. 3

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: Numerical Analysis & Computer Programming — Course Code: CE 205
Time: 3 Hours — Full Marks: 90

Section- A :Answer any 6(Six) out of 8(Eight)

1. Using Regula-Falsi method determine the root of the following equation which lies between 1 and 1.5 — 10

$$x\cos(\frac{x}{x-2}) = 0 \text{ ; take } \varepsilon = 0.0001$$

2. Determine the root of the equation $x^3 - x - 1 = 0$ by Newton-Raphson method. correct upto 5 decimal places. — 10

3. Use Gauss-Seidal method to approximate the solution of the following system of linear equations. — 10

$$5x - 2y + 3z = -1$$
$$-3x + 9y + z = 2$$
$$2x - y - 7z = 3$$

4. Use Crout's method to approximate the solution of the following system of linear equations. — 10

$$2x - 5y + z = 12$$
$$-x + 3y - z = -8$$
$$3x - 4y + 2z = 16$$

5. Using Rombergs method, compute — 10

$$I = \int_0^{1.2} [1/(1+x)]dx$$

6. Find y(1.0) using RK method of order four by solving the equation $dy/dx = -2xy^2$, $y(0) = 1$ with step length 0.2. — 10

7. Using Lagrangian polynomials, Find **f(0.25)** for — 10

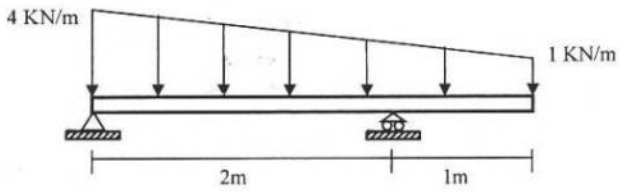
x	0.1	0.2	0.3	0.4	0.5
f(x)	9.9833	4.9667	3.2836	2.4339	1.9177

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

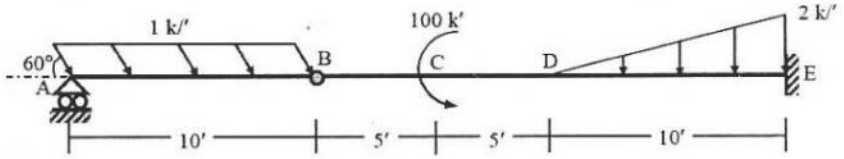
Course Title: Mechanics of Solids I | Course Code: CE 211
Time: 3:00 hours | Full Marks: 10 x 10 = 100

Answer any 10 (Ten) of the following 14 Questions

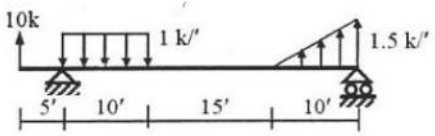
1. Draw SFD and BMD for following beam loading



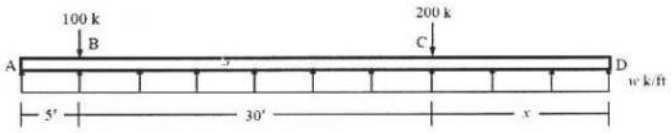
2. Draw AFD, SFD and BMD for the beam with loading shown below. B is a internal hinge.



3. Use singularity functions to write equations of SF and BM of the beam loaded as shown below.



4. For the load distribution over the length of footing ABCD shown in the figure below, calculate
(i) the length x and uniformly distributed load w k/ft required to maintain equilibrium,
(ii) the shear force at the left and right of B and bending moment at C using Singularity Functions.



University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013 (Set 1)
Program: B. Sc. Engineering (Civil)

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

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

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

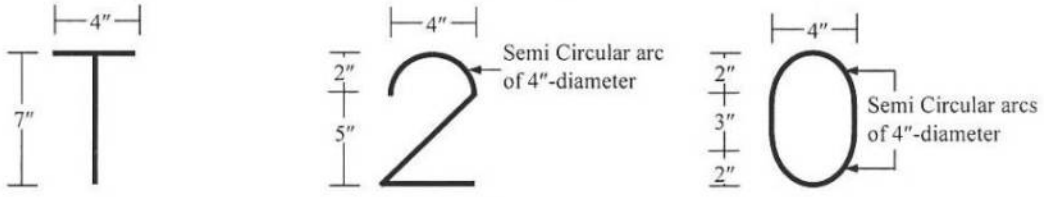


Fig. 1

2. Fig. 2 shows beams *ac*, *cd* and *db* carrying uniformly distributed loads of 1 k/ft, and supported by square-shaped beam *ab* and column *be*.
   (i) Draw the torque diagram of beam *ab*,
   (ii) Calculate the required width and depth (*H*) of beam *ab*, if allowable torsional shear stress is 100 psi and allowable torsional rotation is 1° [Given: Shear modulus $G = 1 \times 10^6$ psi].

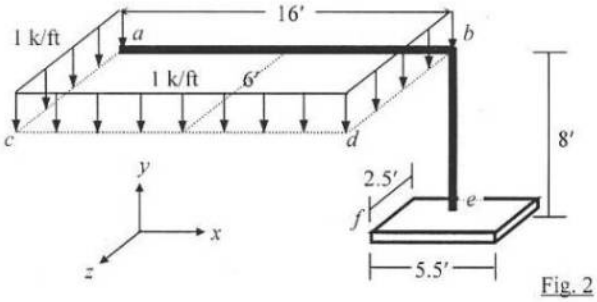
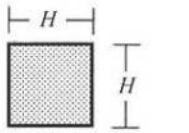


Fig. 2



Cross-section of beam *ab* and column *be*

3. For the frame structure shown in Fig. 2, calculate the
   (i) Required width and depth (*H*) of column *be*, if the allowable normal stress is 400 psi,
   (ii) Normal stress at each corner of the footing (*f*) and comment if the footing will overturn.

4. Fig. 3 shows plan of a building floor supported by six columns and subjected to shear force $V = 100$ k, applied as shown.

   Determine the required width and depth (*H*) of columns *a* and *b* if the allowable shear stress (due to combined direct and torsional shear) is 150 psi.

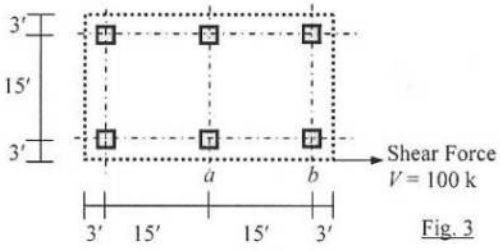
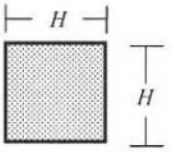


Fig. 3



Column cross-section

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Fluid Mechanics | Course No: CE 221
Time: 3.0 hour | Full Marks: 150

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

Section-A

There are **4 (Four)** questions in this section. Answer any **3 (three)** questions.

1. (a) With a neat sketch show the relation among Absolute, Atmospheric and Gauge Pressure. (2)

(b) Define Center of Pressure. Derive an expression for center of pressure to show that the center of pressure is always below the center of gravity of any area. (10)

(c) A prismatic object 8 in thick by 8 in wide by 16 in long is weighted in water at a depth of 20 in and found to weigh 11.0 lb .Determine its weight in air and its specific gravity. (5)

(d) In Figure 1, the pipe AB is of uniform diameter. The pressure at A is 200 kN/m^2 and at B is 350 kN/m^2. If a crude oil (S = 0.85) is flowing through the pipe, determine the direction of flow and head loss. (8)

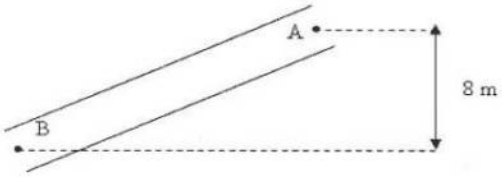


Figure-1

2. (a) Give a statement of the Bernoulli's energy equation. State the limitations of this equation. (2+2=4)

(b) For the water shooting out of the pipe and nozzle under conditions shown in Figure 2 determine the height above nozzle to which water will "shoot" (i.e. distance *h* in Figure 2). Assume no head loss. (12)

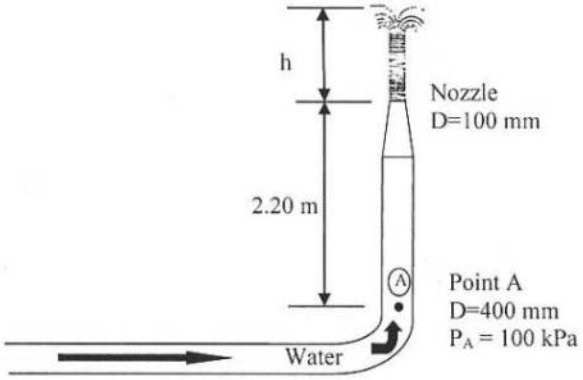


Figure- 2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Professional Practice and Communication | Course Code: CE 403
Time: 120 minutes | Full Marks: (12½×8)=100

Answer any 8 (eight) questions

1.
   a. What is leadership? [1½]
   b. In a diagram, show ten basic general characteristics of leadership. [5]
   c. Briefly mention six important characteristics of each of the following type of leaderships: Authoritarian and transformational. [3+3]

2.
   a. What are the stages that are usually followed in public procurement? [3½]
   b. Write short notes on open tendering method and limited tendering method? [3+3]
   c. Under what circumstances two stage tendering method (TSTM) is preferable? [3]

3.
   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 shingle is Tk. 130 and price of that at the time of execution (as per BBS) is Tk. 170 and the price 28 days before receiving tenders was Tk. 140. What will be adjusted unit price of that item? Use usual value of coefficient. [4½]

4.
   a. What is DPP? [1½]
   b. DPP has two major parts. What are they? [2]
   c. What are the three stages of DPP? [3]
   d. Show flow diagram for preparation and approval procedures of DPP? [6]

5.
   a. What is MDG? [1½]
   b. What are the eight goals of MDG? [4]
   c. Write short note on PRSP. [3]
   d. What are the functions of ECNEC? [4]

6.
   a. According to PMBOK explain the five process groups. Show schematic timeline of the process groups. [5+1½]
   b. What are phases of a project? Explain with example how each phase and process groups are related? Show schematic diagram of a three-phase project. [1+3+2]

7.
   a. What is unemployment? [1½]
   b. Explain through equation that "steady state rate of unemployment 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 [5]
   c. What are the objectives of Industrial Relation? [6]

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course No: CE 415 Course Title: Prestressed concrete

Full Marks: 100 Time: 2.0 hours

There are **five** questions. Answer **four** questions. **Question 1 is Compulsory**. The figures in the right margin indicate the marks of the questions.

1.(a) Make a preliminary design for section of a prestressed-concrete beam to resist a total moment of 435 KN-m. Girder moment is 285 KN-m. The overall depth of the section is 920 mm. The effective prestress for steel is 860 MPa, and allowable stress for concrete under working load is -11 MPa. (25)

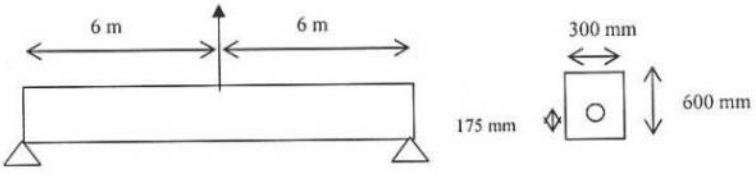
(b) Make final design for the preliminary section obtained in 1(a) based on elastic theory and allowing no tension in the concrete both at transfer and under working load. Given values are f_b = -12.5 MPa, f_0 = 1035 MPa.

(c) Revise the design for the section in 1(b) allowing and considering tension in concrete.

Given formulae: $f_b = \frac{F_0}{A_c} + \frac{(F_0 e - M_G)C_b}{I}$, $A_c = \frac{F_0}{f_b}\left(1 + \frac{e - (\frac{M_G}{F_0})}{k_t}\right)$

2.(a) Describe bonded and unbonded post tensioned concrete. What are the advantages/ disadvantages of these types of prestressed concrete? (10)

(b) A post tensioned bonded beam with a transfer prestress of 1560 KN is being wrongly picked up at its midspan point. (i) Compute the critical fiber stresses. Check for cracking, given f'_c = 34 MPa. (ii) If the top fiber cracks and the concrete is assumed not to take any tension, compute the bottom fiber stress. (15)



3.(a) A post tensioned simple beam on a span of 12 m carries a super-imposed load of 11 KN/m. Self weight of the beam is 4.5 KN/m and cross sectional area is 300×600 mm^2. The prestressing steel is located at 175 mm from bottom fiber in the midspan. The initial prestress in the steel is 950 MPa, reducing to 820 MPa after deducting all losses and assuming no bending of the beam. The parabolic cable has an area of 1600 mm^2, n = 6. Compute the stress in the steel at midspan, assuming (18)

(i) The steel is bonded by grouting

(ii) The steel is unbonded and entirely free to slip.

(b) Describe the cracking moment in a prestressed concrete beam using relevant figures. (7)

4.(a) In case of prestressed concrete, how can you measure prestress in the steel? Derive the (12)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
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. Using AISC/ASD method, determine the block shear allowable load for the joint shown in Fig. 1. Fasteners are ⅞" A-325 bolts in standard holes. All plates are A36 steel. See Annexure-1. 8 ⅓

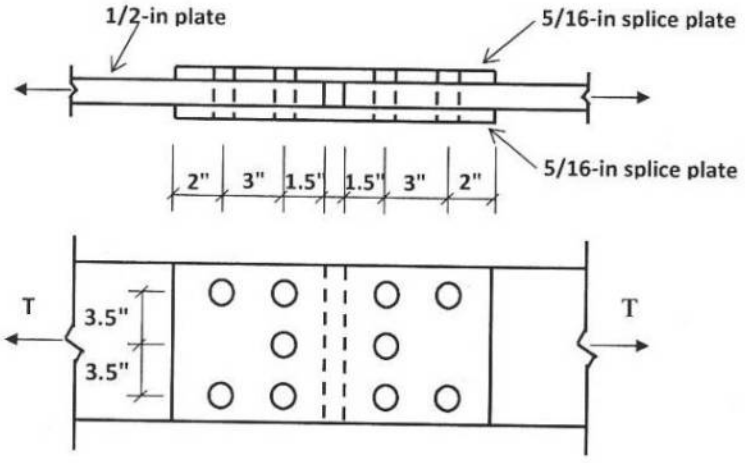


Fig. 1

2. To carry a uniformly distributed live load of 1.5 kip/ft and a dead load of 0.5 kip/ft. on a 30-ft simply supported span, check the design adequacy of the wide flange beam section W21x62 with section modulus S_x = 127 in^3. In design checking assume that compact section requirements will be satisfied and hence, design the spacing of lateral bracings to satisfy the compact section requirements. Also check whether the deflection criterion is satisfied or not. Given: F_y = 36 ksi; For beam section W21x62, b_f = 8.24 inch and d/A_f = 4.14. See Annexure-2. 8 ⅓

3. The equation for the stress-strain curve for the cross section with the residual stresses shown in Fig. 2 was determined as $\sigma = -15{,}625{,}000\varepsilon^2 + 48{,}750\varepsilon - 5.625$ for a range of compressive strain $-0.0006 \le \varepsilon \le -0.0012$. Determine the values of stress and tangent modulus, if a column with the given section is subjected to an imposed uniform compressive strain of 0.0010 in./in. What is the corresponding slenderness ratio L/r according to tangent modulus E_t, if the column buckles at this compressive strain.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering IX (Earthquake Resistant Design and Retrofitting) | Course Code: CE 423

Time: 2 Hour | Full Marks: 50

*There are **6 (Six)** questions. Answer any **5 (Five)**.*

N.B. Students are allowed to bring ***Chapter 21 of ACI code***. Handwritten documents/handwriting on the code is not permitted. If you use ***Column Interaction Diagram***, do not forget to attach it.

1. A heavy table in **Figure 1** is supported by flat steel legs. **(10)**

Its natural period in lateral vibration is 0.5 sec. When a 50 lb plate is clamped to its surface, the natural period in lateral vibration is lengthened to 0.75 sec.

Determine the weight and lateral stiffness of the table.

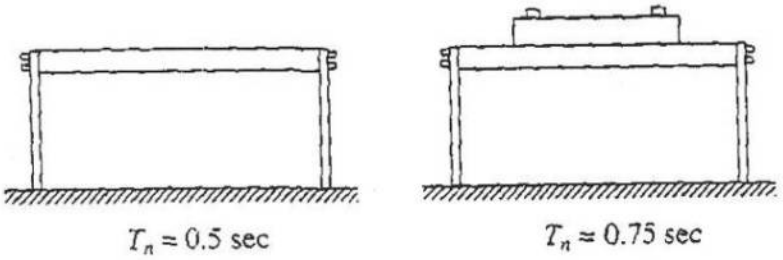


Figure 1

2. A single degree of freedom system is excited by a sinusoidal force. **(10)**

At resonance the amplitude of displacement was measured to be 2 inch and at an exciting frequency of one-tenth of the natural frequency of the system, the displacement amplitude was measured to be 0.2 inch.

Determine the damping ratio of the system.

3. a) Write the equation of motion for the following cases: **(4)**

(i) Undamped free vibration
(ii) Viscously damped free vibration
(iii) Undamped system subjected to sinusoidal force
(iv) Damped system subjected to sinusoidal force

b) Define underdamped, critically damped and overdamped systems. **(3)**

c) Draw schematic plot of Deformation Response Factor (R_d) vs Frequency Ratio (β) and briefly explain it. **(3)**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering III — Course Code: CE 431
Time: 2 hour — Full marks: 100 (=4×25)

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

1. (a) Discuss the different generation phases of landfill gases with necessary figures. (7)

   (b) Write explanatory notes on the following: (3x3) (9)
   i) Pyrolysis ii) Significance of source reduction iii) Resource-recovery

   (c) Municipal solid waste from packer trucks is placed and well compacted in a sanitary landfill site in four lifts, each 3m deep, separated by a 250 mm clay layer and topped with a 1 meter thick clay cap, having a 4% slope . If annual precipitation in the area is 900 mm (36 in) of which 67% is lost through evapotranspiration estimate – (9)
   (a) The quantity of leachate that will be generated and
   (b) The time until the refuse is saturated and the leachate flows from the landfill.
   Assume that the separating clay layers are saturated when placed and do not affect the leachate percolation rate through the refuse.
   Given –
   i. Density of waste as delivered = 300 kg/m^3
   ii. Average moisture content as delivered = 25% (by weight)
   iii. Density of well compacted landfill = 600 kg/m^3
   iv. Maximum moisture content of compacted refuse = 30% (by volume)
   v. Surface runoff for the given slope = 17%

2. (a) Define the following terms as per Hauled Container System and Stationary Container System: (3)
   i. Pick-up time
   ii. Haul time
   iii. At site time

   (b) How source reduction and on-site processing can be implemented effectively? (9)

   (c) Define break-even distance with figure? (3)

   Determine the break-even time for a stationary container system and a separate transfer & transport system for transporting wastes collected from a metropolitan area to a landfill disposal site. Assume the following cost and system data are applicable. (10)

4-2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering IV — Course Code: CE 433
Time: 2 hour — Full marks: 100 (=4×25)

Answer any FOUR questions out of FIVE.
(Note: Assume reasonable value for any missing data)

1. (a) Classify the major sources of outdoor pollution. (5)

   (b) Write explanatory notes on the followings: (3×3) (9)
   i) Air toxins ii) Fumigating Plume iii) Coning plume

   (c) A power plant has a 100 m stack with inside radius of 1m. The exhaust gases leave the stack with an exhaust velocity of 10m/s at a temperature of 220°C. Ambient temperature is 6°C. Wind speed at effective stack height is estimated to be 5m/s, surface wind speed is 3m/s and it is a cloudy summer day. Estimate the effective stack height. (7)
   If the stack height remains above the inversion layer where super-adiabatic lapse rate exists, draw the plume dispersion pattern. Also explain the pollution potential near to ground surface from this dispersion pattern. (4)

2. (a) How CO is formed from anthropogenic sources? (2)
   Briefly explain the health effects of CO. (3)

   (b) Mention the name of control devices for particulate contaminants. (3)
   Calculate the minimum size of the particle that will be removed with 100% efficiency from a settling chamber under the following conditions. (5)
   Air: horizontal velocity is 0.3 m/s and temperature is 77°C
   Particle: specific gravity is 2.0
   Chamber dimension: length is 7.5 m and height is 1.5 m
   Also calculate the fractional efficiency of 20μm particles in the settling tank mentioned in the previous problem.

   (c) Describe the approaches for engineering control of air pollutant. (5)
   Explain the effects of Air-Fuel Ratio on Pollution with relevant figure. (7)

3. (a) 20 mL wastewater is mixed with dilution water to fill 300 mL BOD bottle. The drop of DO after 5 days is 4.8 mg/L. For a BOD bottle filled with only dilution water, DO drop is 1.2 mg/L after 5 days. (7)
   Again, the total concentration of organic and ammonia nitrogen in wastewater is 4.0 mg/L. If $k = 0.21\ d^{-1}$ at 20°C, estimate the ultimate strength of the sample.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course title: Environmental Engineering VII | Course code: CE 439
Time: 120 minutes | Full marks: 50

There are SIX (6) questions. Answer question no. 01 (COMPULSORY) and any THREE (3) from the rest.

1. A) Define the following: 8
   - Environmental Impact Assessment (EIA)
   - Screening
   - Scoping
   - Impact analysis
   - Impact mitigation
   - Environmental management plan
   - EIA review
   - Environmental Auditing

   B) Draw the flow diagram of EIA process and parallel studies. 6

2. A) According to the Bangladesh Environmental Conservation Rules (1997), write seven factors that should be considered while declaring any area as *ecologically critical area*? 3

   B) According to Article 7 of the Bangladesh Environmental Conservation Rules (1997), write the procedures to obtain environmental clearance certificate for a red category factory? 6

   C) Explain four main types of social impacts? 3

3. Write the name of your own group work's project.

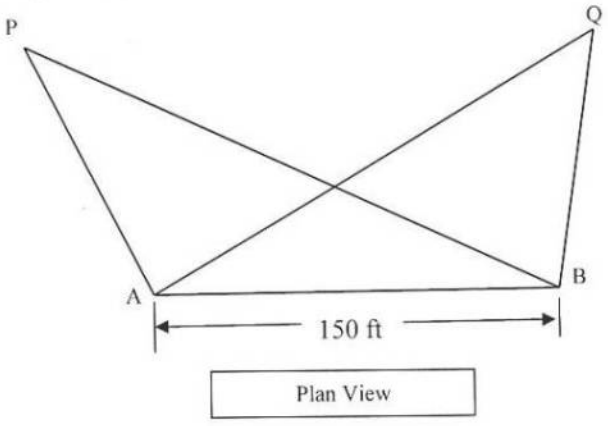
   One of the following projects: a) Rampal Thermal Power Plant b) Padma Multipurpose Bridge Project c) Mass Rapid Transit in Dhaka City d) Rooppur Nuclear Power Plant.

   A) Identify the three most important impacts of your project. Write only the names. 2

   B) Graphically show the time versus impact significance of these three impacts at different phases of your specific project. Draw three different figures for three selected impacts. 10

   (Examples of different phases of the project are: *before the project started, at*

(c) Two tower structures are located at points P & Q .Readings are taken with two theodolite from two points A and B 150ft apart .Plan view is given in **Figure 2**.The R.L. of instrument centre at A ft & B are 25.2 ft and 20.4 ft respectively. The vertical angle readings from A to top towers at P & Q are 40° and 30° respectively. Determine the aerial distance between top of towers at P & Q. (10)



$\angle PAB = 130^0$
$\angle PBA = 45^0$
$\angle QBA = 112^0$
$\angle QAB = 55^0$

Figure 2

3. (a) Derive an expression for tacheometric surveying when staff is held normal to line of sight. ($6\frac{2}{3}$)

(b) A tacheometer was set up at A. The following observations were made on a vertically held staff: (10)

Instrument Station	Staff Point	Whole Circle Bearing	R.L. (ft)	Vertical Angle, Θ	Stadia Reading		
A	X	45°30′	36	0	3	3.625	4.25
A	P	32°30′	26.4	-2 °30′	2.25	3.75	5.25
A	Q	212°30′	56.4	+ 3°30′	?	3.25	?

AX = 100 ft.(horizontal distance)

Determine followings:
i. Tacheometric constants
ii. Missing stadia readings

4. (a) Define following terms: (04)
Diurnal Circle, Transit of Star, Circumpolar Star and Exposure Station.

(b) Describe orbit of Earth around Sun with a neat sketch. ($5\frac{2}{3}$)

(c) Explain *Drift* and *Crab* with respect to aerial photogrammetry with neat sketches. (02)

(d) Distinguish between Vertical ,Oblique and Tilted photograph. (02)

(e) A line AB, 4000 m long lying at an elevation of 500 m measures 15 cm on a vertical photograph for which focal length is 20 cm. Determine the scale of the photograph in an area the average elevation of which is 900 m. (03)

SECTION B

There are **Four** questions in this section.Answer any **Three** of them

1. (a) Define field book. Write down the name of different instruments used for chaining. (3⅓)

   (b) How can you measure a chain line if you face obstacles in both chaining and ranging? (04)

   (c) In passing an obstacle in the form of a pond, station P and S, on the main line, were taken on the opposite sides of the pond. On the left of PS, a line PQ, 120m long was laid down and a second line PR, 150m long, was ranged on the right of PS, The points Q, R, S being in the same straight line. QS and SR were then chained and found to be 75m and 90m respectively. Find the length of PS. (09)

2. (a) Define True meridian and Magnetic meridian. (02)

   (b) Distinguish between the whole circle bearing system and the quadrantal Bearing system. (2⅔)

   (c) In an old map, a line MN was drawn to a magnetic bearing of 6° 25′ the magnetic declination at the time being 1° East. To what magnetic bearing should the line be set now if the present magnetic declination is 8°50′ East. (04)

   (d) The flowing interior angles were measured with a sextant in a closed traverse. The bearing of the line AB was measured as 50°00′ with prismatic compass. Calculate the bearings of all other line if $\angle A$=130°15′; $\angle B$=92°11′;$\angle C$=59°28′;$\angle D$=78°6′. (08)

3. (a) Draw the figure of a Circular curve and show its various components. (03)

   (b) Two tangents intersect at chainage 85+75, the deflection angle being 68°25′. Calculate the necessary data for setting out a curve of 40 chains radius to connect the two tangents if it is intended to set out the curve by offsets from chords. Take peg interval equal to 100 links, the length of the chain being equal to 20 meters (100links). (13⅓)

4. (a) Define Contour. Write down the characteristics of Contours (03)

   (b) The following figures were extracted from a level field book, some of the entries being illegible owing to exposure to rain. Insert the missing figures and check your results. Rebook all the figures by the rise and fall method. (13⅓)

Station	B.S.	I.S.	F.S.	Rise	Fall	RL	Remarks
1	2.285					232.46	B.M. 1
2	1.650		?	0.020			
3		2.105			?		
4	?		1.960	?			
5	2.050		1.925		0.300		
6		?		?		232.255	B.M. 2
7	1.690		?	0.340			
8	2.865		2.10		?		
9			?	?		233.425	B.M. 3

Given formula:

$$T = R\tan\frac{\Delta}{2}, \quad l = \frac{\pi R\Delta}{180^\circ}, \quad \delta = 1718.9\frac{c}{R}$$

$$O_1 = \frac{c^2}{2R}, \quad O_2 = \frac{C}{2R}(c + C), \quad O_3 = \ldots\ldots = O_{n-1} = \frac{C^2}{R}, \quad O_n = \frac{c'}{2R}(C + c')$$

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	1100
3/8 inch	0	900
#4	0	2000
#8	0	950
#12	50	0
#16	70	0
#30	70	0
#40	70	0
#50	70	0
#100	0	0
#200	75	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 3.0. 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) 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) Toughness.

(d) Write a short note on worldwide cement consumption of cement with its influence to the global environment. (3)

(e) "Bricks get strength during burning"- How? (3)

(f) What is a pug mill? How do you check the consistency of brick earth before moulding? (3)

(g) Write the functions of frog mark on brick. (2)

(h) Discuss three harmful ingredients of 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 CEM I, CEM II A-M, CEM II B-M, CEM II A-L, and CEM II B-S cements as per BDS EN 197-1:2003. (5)

(e) Compare flash setting and false setting of cement. (3)

5 (a) Discuss seawater attack (due to carbonation, chloride, and sulfate) of concrete with chemical reactions. (8)

(b) What is the significance of cover concrete 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) Shape of the aggregate,
- ii) Cement content,
- iii) W/C, and
- iv) 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) Waster to cement ratio,
- (ii) Cement content,
- (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) Ferrocement,
- (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) Cold joint,
(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 hot 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 plastic in Civil Engineering works,
iii) Crystal structure and amorphous structure, and
iv) Objectives of seasoning of timber.

(e) "Fly ash shows pozzonanic 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) Discuss three defects of 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 rubber in Civil Engineering works,
(ii) Atomic packing factor for the face centered cubic unit cell,
(iii) Ingredients of varnish,
(iv) Electroplating,
(v) Hot dipping,
(vi) Cathodic protection of corrosion of steel by discrete anode.

(e) Define bulking of sand? Compare bulking of fine sand, medium sand, and coarse sand. (2)

(f) Draw typical stress strain curves of rubber and copper. (3)

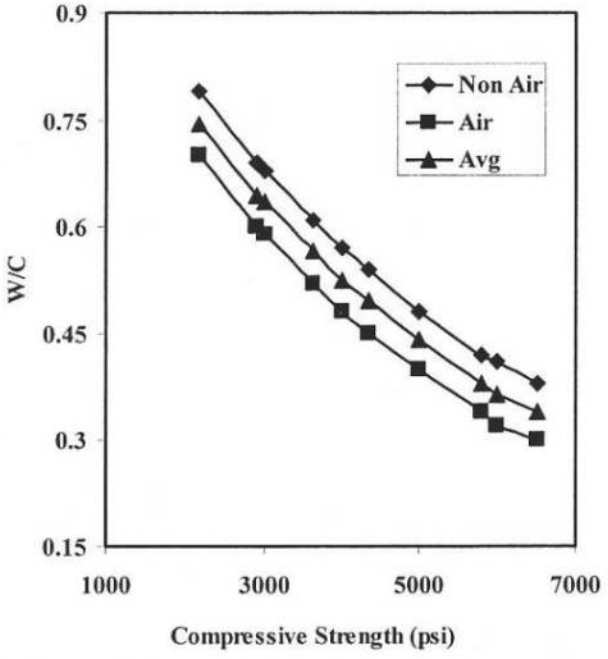


Fig. W/C versus Compressive Strength (aggregate type = stone chips)

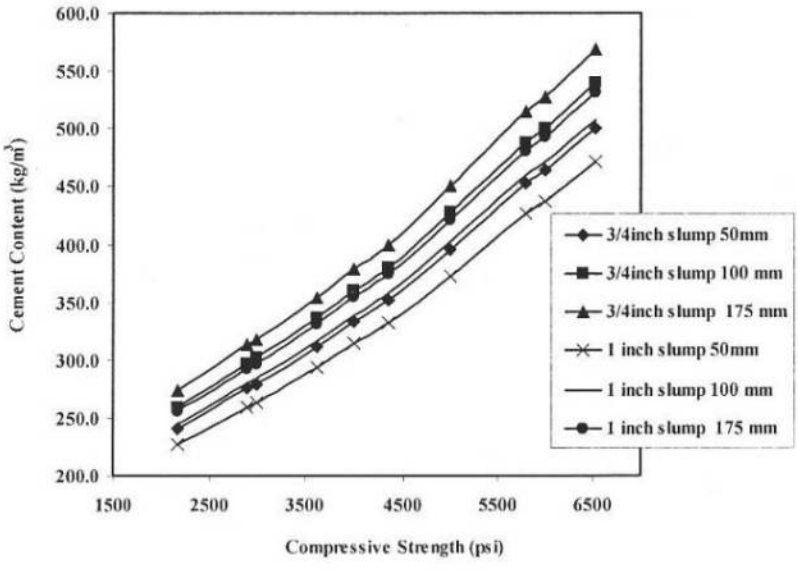


Fig. Cement Content versus Compressive Strength (aggregate type = stone chips)

Table Traditional American and British Sieve Sizes

Aperture mm or μm	*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	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.
75 mm	3	3 in.	3 in.
63 mm	2.5	$2\frac{1}{2}$ in.	$2\frac{1}{2}$ in.
53 mm	2.12	2 in.	2.12
45 mm	1.75	$1\frac{3}{4}$ in.	$1\frac{3}{4}$ in.
37.5 mm	1.50	$1\frac{1}{2}$ in.	$1\frac{1}{2}$ in.
31.5 mm	1.25	$1\frac{1}{4}$ in.	$1\frac{1}{4}$ in.
26.5 mm	1.06	1 in.	1.06
22.4 mm	0.875	$\frac{7}{8}$ in.	$\frac{7}{8}$ in.
19.0 mm	0.750	$\frac{3}{4}$ in.	$\frac{3}{4}$ in.
16.0 mm	0.625	$\frac{5}{8}$ in.	$\frac{5}{8}$ in.
13.2 mm	0.530	$\frac{1}{2}$ in.	0.530 in.
11.2 mm	0.438	—	$\frac{7}{16}$ in.
9.5 mm	0.375	$\frac{3}{8}$ in.	$\frac{3}{8}$ in.
8.0 mm	0.312	$\frac{5}{16}$ in.	$\frac{5}{16}$ in.
6.7 mm	0.265	$\frac{1}{4}$ in.	0.265 in.
5.6 mm	0.223	—	No. $3\frac{1}{2}$
4.75 mm	0.187	$\frac{3}{16}$ 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 μm	0.0331	No. 18	No. 20
710 μm	0.0278	No. 22	No. 25
600 μm	0.0234	No. 25	No. 30
500 μm	0.0197	No. 30	No. 35
425 μm	0.0165	No. 36	No. 40
355 μm	0.0139	No. 44	No. 45
300 μm	0.0117	No. 52	No. 50
250 μm	0.0098	No. 60	No. 60
212 μm	0.0083	No. 72	No. 70
180 μm	0.0070	No. 85	No. 80
150 μm	0.0059	No. 100	No. 100
125 μm	0.0049	No. 120	No. 120
106 μm	0.0041	No. 150	No. 140
90 μm	0.0035	No. 170	No. 170
75 μm	0.0029	No. 200	No. 200
63 μm	0.0025	No. 240	No. 230
53 μm	0.0021	No. 300	No. 270
45 μm	0.0017	No. 350	No. 325
38 μm	0.0015	—	No. 400
32 μm	0.0012	—	No. 450

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: Engineering Materials **Course Code: CE 201** (Sec B)
Time: 3 hrs **Full Marks: 150**

Section A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Write the names, chemical composition and notation of mineral constituents of clinker. (3)
(b)Draw a flow diagram of dry process of cement manufacture. (5)
(c) What is the purpose of using admixture in concrete? Compare entrapped and entrained air. (3+2=5)
(d) Write a short note on (3+3=6)
i) Hardening of cement
ii) Soundness of cement
(e) What is Fly Ash? What are the benefits of using fly ash? (1+3=4)
(f) What does increase in slump value of concrete indicate for a given w/c ratio? (2)

2. (a) Explain-" Durability of concrete depends on w/c ratio, compaction and curing." (5)
(b) Explain hydration of cement. What changes are needed to be made in the composition of cement clinker for making quick setting, low heating and rapid hardening cement? (3+3=6)
(c) "Lean mix leads to higher strength" – Explain briefly. (4)
(d) W/C ratio, workability and compressive strength of concrete how are they related? (5)
(e) Discuss maturity rule of concrete with example. (5)

3. (a) Discuss each type of single stage and multi stage loading with appropriate examples and figures. (8)
(b) What is spalling of concrete? How does it happen? How can you prevent it? (1+2+1=4)
(c) Write three advantages of using Ferrocement. (3)
(d) Discuss about the reinforcing mesh, cement mortar and aggregates used in Ferrocement with diagram. (6)
(e) What is Corrosion? Explain corrosion of steel exposed to weather with example. (1+3=4)

4. (a) Identify the strain components of material. Draw and name the representative models of each component. (5)
(b) Why slaking of lime is necessary? (2)
(c) In a concrete mix, C: F.A:C.A= 1:1.5:3 (Volume Basis). Determine the quantity of each ingredient for 1 m^3 of concrete. Given, w/c= 0.38, Loose Unit weight of F.A. = 1280 kg/m^3, Loose Unit weight of C.A.= 1300 kg/m^3, Bulk Specific gravity of C.A = 2.67, bulk specific gravity of F.A = 2.57, Entrapped Air = 2% (8)

(d) Describe different types of sand based on source. (4)

(e) Write a short note on aggregate grading. Explain different forms of moisture condition of aggregate. (2+2=4)

(f) Compare workability and consistency. (2)

Section B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is Curing? Why curing is needed? Draw the strength versus time curve for following concrete with different curing conditions (1+1+3=5)

(i) Continuous under water curing

(ii) 3 days under water curing

(iii) No curing

(b) Discuss briefly about efflorescence of brick. (3)

(c) Write down the functions of Silica and lime in brick. Also, mention what will happen if they are used in excess amount. (3+2=5)

(d) Compare segregation, bleeding and laitance of concrete. What are the main causes and remedies of segregation of concrete? (3+3+3=9)

(e)Why is cube strength higher than cylinder strength? (3)

6. (a) What are the advantages of using timber? Write three main causes of timber decay. (2+3=5)

(b) How annual rings are formed in exogenous trees? Compare Sap wood and Heart wood. (2+2=4)

(b) Write the difference between (2+2=4)

i) Varnish and Distemper

ii) Natural and artificial seasoning of timber

(c) Describe the constituents of paint with example. (8)

(d) What is Vulcanization? What is the importance of vulcanization of rubber? (4)

7. (a) Aggregate 1 and Aggregate 2 are combined in a ratio of 1:2 to form a mixture. 100 gm materials from each sand type are sieved separately. Data derived (individual % retained) from the sieve analysis is given below. Determine the Fineness modulus of the combined mixture. (8)

Sieve	Size (mm)	% Materials retained	
		Aggregate 1	Aggregate 2
#4	4.75	0	5
#8	2.36	15	12
#16	1.18	10	13
#30	0.60	20	18
#50	0.30	25	22
#100	0.15	30	30

(b) Define workability. Explain the effect of following factors on the workability of concrete. (1+8=9)

(i) Water content of the mix is increased.

(ii) Brick chips are used instead of stone chips.

(iii) Fine sands are used instead of coarse sand.

(iv) Quantity of cement is less compared to quantity of aggregate.

(c) Describe the role of gypsum in cement. What will happen if gypsum is added with very hot clinker? (2+2=4)

(d) List the five steps in brick manufacture. (2)

(e) Discuss the effect of maximum aggregate size on strength of concrete. (2)

8. A concrete mix is to be designed using trial mix method (ACI volume method) for the construction of a slab of 5 inch thickness. Concrete is required to have design strength of 20 MPa. Required slump value is 2 inch to 4 inch. Effect of absorption and moisture content of CA and FA in site is negligible. Determine mix proportion of concrete for 1st lab trial (mass basis). Use tables below to gather necessary information. (25)

Table 1: Properties of Fine Aggregate

Sl. No.	Property	Test Method	Value	Unit
1	Bulk Specific Gravity (OD basis)	ASTM C127	2.57	-
2	Apparent Specific Gravity (OD basis)	ASTM C127	2.60	-
3	Absorption Capacity	ASTM C127	1.25	%
4	Dry Rodded Unit Weight	ASTM C29	1600	kg/m^3
5	Moisture Content of FA in Laboratory		2.58	%
6	Fineness Modulus (FM)	ASTM C136	2.70	

Table 2: Properties of Coarse Aggregate

Sl. No.	Property	Test Method	Value	Unit
1	Bulk Specific Gravity (OD basis)	ASTM C127	2.67	-
2	Apparent Specific Gravity (OD basis)	ASTM C127	2.68	-
3	Absorption Capacity	ASTM C127	0.43	%
4	Dry Rodded Unit Weight	ASTM C29	1530	kg/m^3
5	Moisture Content of CA in Laboratory	-	0.16	%
6	Maximum Size	-	20	mm

Table 3: Properties of cement

Sl. No.	Property	Test Method	Value	Unit
1	Brand name		Supercrete (composite)	-
2	Clinker		85	%
3	Fly Ash		15	%
4	Compacted Unit Weight		1400	kg/m^3
5	Loose Unit Weight		1100	kg/m^3
6	Specific Gravity of clinker		3.15	
7	Specific Gravity of fly ash		2.40	

Table 4: Properties of water reducing admixture

Sl. No.	Property	Test Method	Value	Unit
1	Brand name		Megaflow 230	-
2	Recommended Dose		1.2 L per 100kg cement	
3	Expected water reduction		20	%
4	Specific Gravity		1.2	kg/m^3

Table 5: ACI recommended w/c ratio for normal strength concrete

Mean Target Strength		w/c ratio
psi	MPa	
6000	41	0.41
5000	34	0.48
4000	28	0.57
3000	21	0.68
2000	14	0.82

Table 6: ACI recommended dry rodded bulk volume of coarse aggregate per unit volume of concrete

Max size of agg	FM of fine aggregate			
mm	2.40	2.60	2.80	3.00
9.5	0.50	0.48	0.46	0.44
12.5	0.59	0.57	0.55	0.53
19	0.66	0.64	0.62	0.60
25	0.71	0.69	0.67	0.65
37.5	0.75	0.73	0.71	0.69
50	0.78	0.76	0.74	0.72
75	0.82	0.80	0.78	0.76
150	0.87	0.85	0.83	0.81

Table 7: First estimate of density of fresh concrete

Nominal Max Size	Density of fresh concrete (kg/m^3)
9.5	2280
12.5	2310
19	2345
25	2380
37.5	2410
50	2445
75	2490
150	2530

Table 8: ACI recommended mixing water content for 1 m^3 fresh concrete

Max size of aggregate (mm)	10	12.5	20	25	40	50	70	150
Slump Value (mm)	Amount of mixing water in kg per 1 m^3 concrete							
25 to 50	207	199	190	179	166	154	130	113
75 to 100	228	216	205	193	181	169	145	124
150 to 175	243	228	216	205	190	178	160	-
Entrapped air (%)	3	2.5	2	1.5	1	0.5	0.3	0.2

Table 9: First Trial Mix Result

Water Added	0.5 kg less water was added than calculated for first trial mix
Slump measured	65 mm
Measured density of fresh concrete	2360 kg/m^3

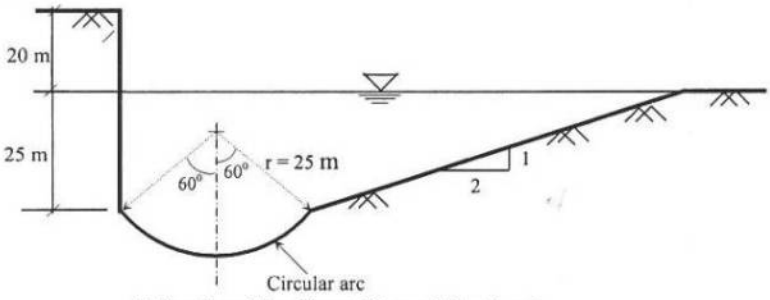
(d) Areas of three basins contribute runoff through a common single outlet. The areas of these basins are 3.0 acres, 10.0 hectors and 0.193 square miles. Co-efficient of runoffs of these basins are 0.1, 0.2 and 0.25 respectively. Estimate the peak runoff in m^3/s, if the intensity of rainfall of all the basins is 0.0042 inch/min. 6

6. (a) Mention the major causes of river erosion. Discuss, in brief, the process of hydraulic lift or saltation. 4

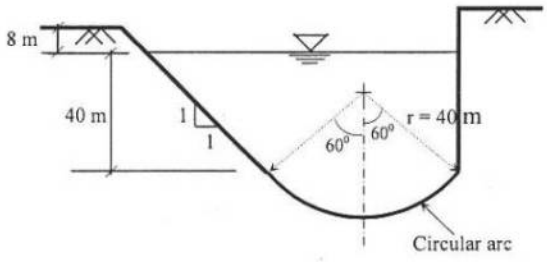
(b) Prove that $\tau = \gamma_\omega R_H s$; where symbols carry their usual meanings. 4

(c) Velocity of flow of one river (R-1) is three times the velocity of flow of another river (R-2). If all other parameters remain same, derive a correlation between the two rivers in terms of their ability of transporting maximum size of sediments. 4

(d) Cross-sectional profiles of two channel section locations are shown as below. The gradients for both the channels bed is 9.33×10^{-5}. Compare the erosional tendencies at both locations on the basis of tractive pressure. 8



X-Sectional Profile at Channel Section 1

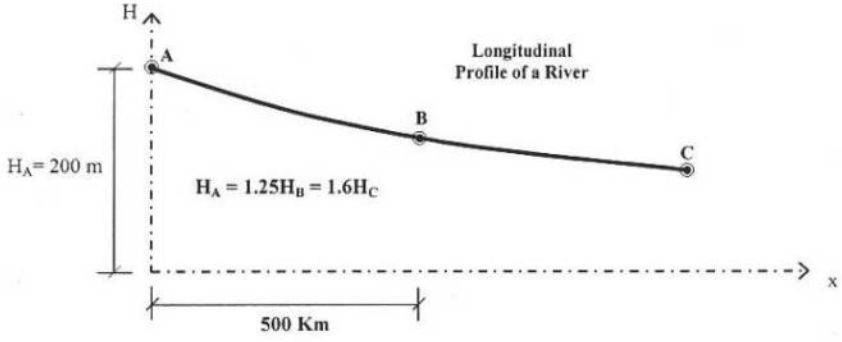


X-Sectional Profile at Channel Section 2

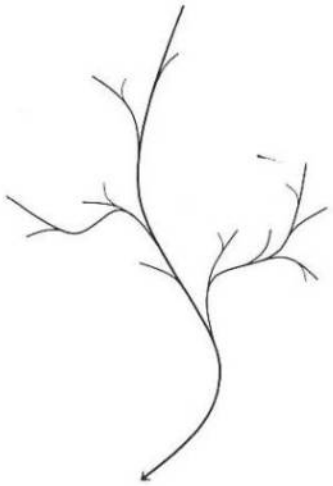
7. (a) Write short notes on various types of loads of a river. 3

(b) Prove that $H = ae^{-bx}$; where symbols carry their usual meanings. 5

(c) From the figure below, calculate the horizontal distance between locations B and C. 5



(d) Rank the streams of the following drainage basin having a total catchment area of 3,559 square miles. The results of the survey are summarized in the table below. 7



Steam Rank	Average Length (mi)
1	4.4
2	11.8
3	28.0
4	62.4

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. Draw sketches of different types of drainage patterns. Write down some major features of Denditric pattern of drainage. 12

(b) Classify (mention names only) valley according to the stage, genesis and controlling structures. 3

(c) Discuss, in brief, the ways valleys are widened. 5

8. Find the least square polynomial approximation of degree two to the data 10

x	0	1	2	3	4
y	-4	-1	4	11	20

Section- B :Answer any 3 (Three) out of 4 (Four)

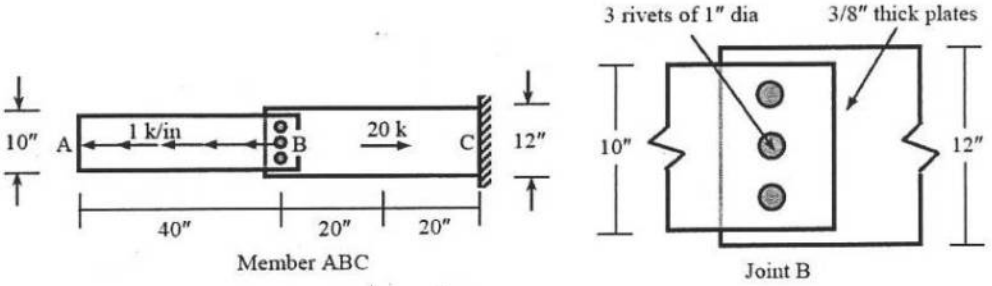
9. Write a program to find the summation of 1+3+5+7+.....+n. 10

10. Write 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

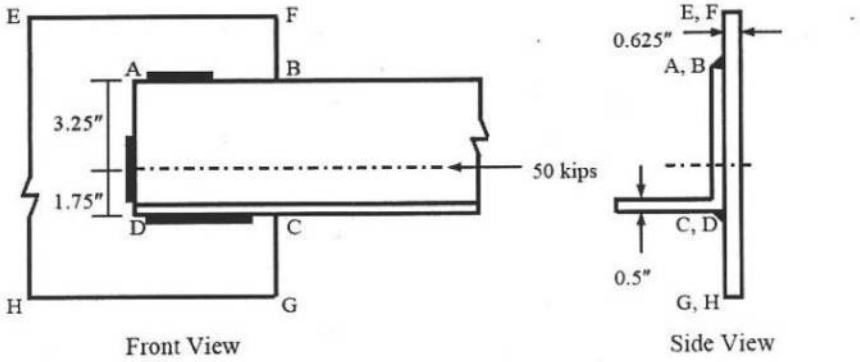
11. Write a program that can calculate the matrix summation of a 3*3 matrix. 10

12. Write a program to determine the bending moment and shear force at a section at a distance from the left support of a simply supported beam subjected to a concentrated load at the mid section of the beam. 10

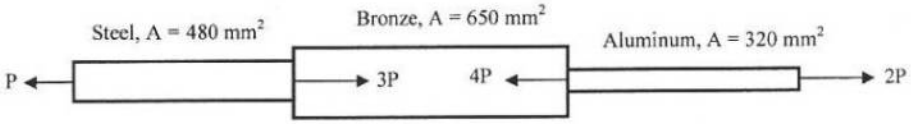
5. Calculate the shearing stress in the rivets and the maximum tearing and bearing stresses in the plates at joint B of the structural member ABC loaded as shown below.



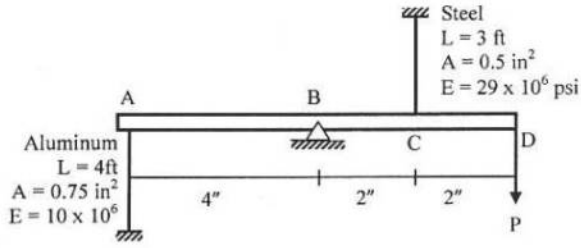
6. In Fig shown below, calculate the length of 3/8-inch weld joints required on sides (i) AB and CD only, (ii) AB, AD and CD to connect the 0.5" thick channel section ABCD to the 0.625" thick plate EFGH. Axial force of 50 kips passes through centroid of ABCD [Given: Allowable shear stress = 16 ksi].



7. A bronze bar is fastened between a steel bar and aluminum bar as shown below. Axial loads are applied at the positions indicated. Determine the largest value of P that will cause no more than 3.0 mm overall deformation or the following stresses: 140 MPa in steel, 120 MPa in bronze and 80 MPa in the aluminum. Use E_{st} = 200 GPa, E_{al} = 70 GPa and E_w = 83 GPa.

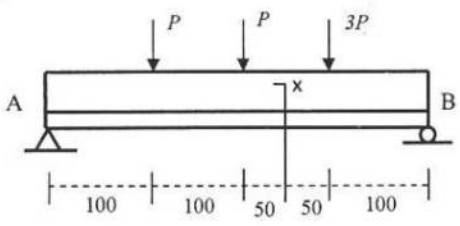


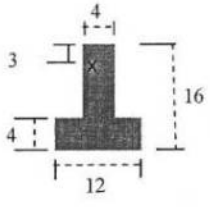
(8) The light rigid bar ABCD is pinned at B and connected to two vertical rods as shown below. Assuming that the bar was initially horizontal and the rods stress-free, determine the stress in each rod after the load P = 20 kips is applied.



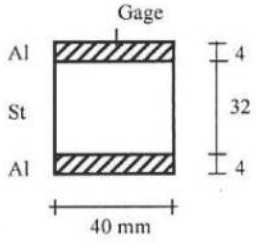
(9) A cylindrical pressure vessel is fabricated from steel plate that has a thickness of 20 mm. The diameter of the pressure vessel is 450 mm and its length is 2.0 m. Determine the maximum internal pressure that can be applied if the longitudinal stress is limited to 140 MPa and circumferential stress is limited to 60 MPa.

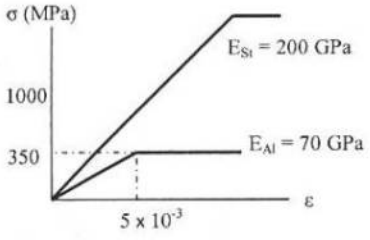
(10) An inverted small steel T beam is supported at A and B as shown below. What is the value of P if a strain gate attached at x point measures 0.0002 mm/mm when the load is applied. All dimensions are in mm. E = 200 GPa. Units are in mm.



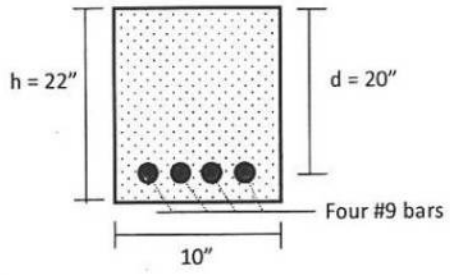


11. A small sandwich beam spanning 400 mm is made up by bonding two aluminum alloy strips to an alloy steel bar as shown below. The idealized stress-strain diagrams are shown in the figure. What is the magnitude of the applied bending moment if it causes -7.5×10^{-3} longitudinal strain in the gage attached on the top of the aluminum alloy strip?

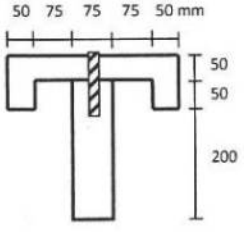




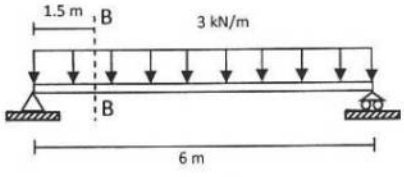
12. Determine the maximum stress in the concrete and the steel for a reinforced concrete beam with the section shown below if it is subjected to a positive bending moment of 50 kip-ft. The reinforcement consists of four #9 steel bars. Assume cracked section and n = 15.



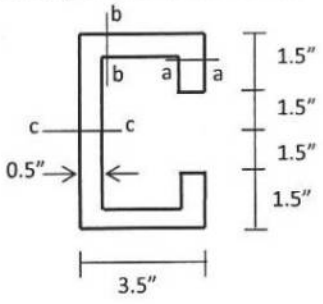
13. A simple beam on 6-m span carries a load of 3 kN/m including its own weight. Specify the spacing of 10-mm screw (as shown) necessary to fasten the parts together. Assume that allowable shear capacity for 10-mm screw is 2 kN.



Section B-B



14. A beam having the cross section with dimension shown below, transmits a vertical shear V = 7 kip. Determine the shear stress at section a-a, b-b and c-c. Also sketch the stress distribution. Moment of Inertia, I around the neutral axis is 35.7 in^4.



5. For the stress condition defined by $\sigma_{xx} = p_0$, $\sigma_{yy} = -3p_0$ and $\tau_{xy} = p_0$
   (i) Determine the maximum allowable value of p_0 using the Von Mises yielding criterion, if the yield strength of the material is 400 MPa.
   (ii) Draw the Mohr's circle of stresses for the value of p_0 calculated in (i) and show the normal and shear stresses acting on a plane defined by $\theta = -30°$.

6. For the beams (Beam 1 and Beam 2) shown in the figures below
   (i) Write down the expressions for loading function $w(x)$ using singularity functions.
   (ii) Write down the corresponding boundary conditions.
   (iii) Determine whether the beams are statically determinate or indeterminate.
   (iv) Draw the qualitative deflected shapes of the beams under the given loads.

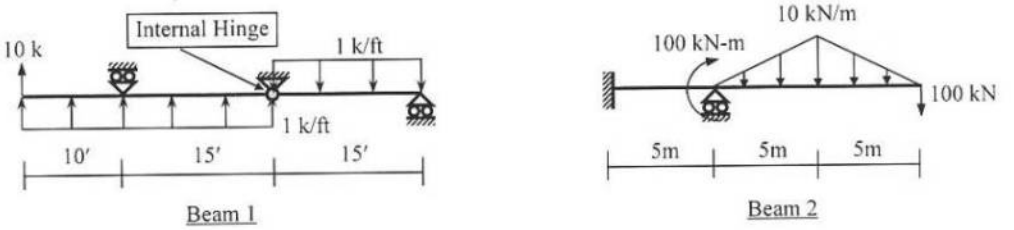


Fig. 4

7. Support a rotates 0.050 radian anticlockwise in the statically indeterminate beam $abcd$ shown in Fig. 5.
   (i) Calculate the reaction at support a.
   (ii) Draw the bending moment diagram of the beam [Given: EI = constant = 40×10^3 kN-m^2].

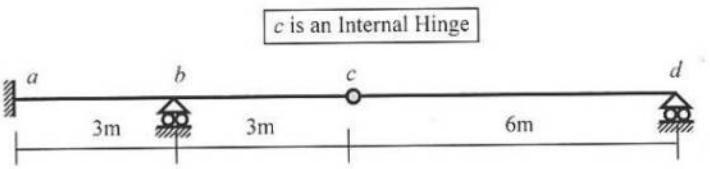
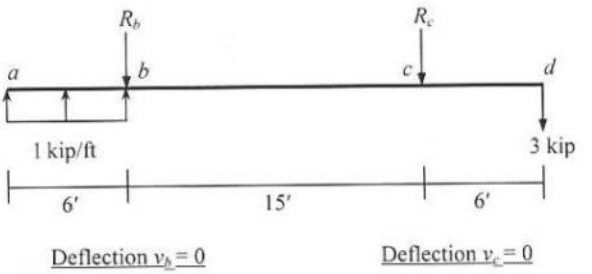


Fig. 5

8. For the beam shown in Fig. 6, use *Singularity Functions* to calculate the vertical deflection at a and d if the deflection at both b and c is zero [Given: EI = constant = 80×10^3 k-ft^2].



Deflection $v_b = 0$ Deflection $v_c = 0$

Fig. 6

9. Answer Question 8 using the *Moment-Area Theorems*.

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

11. Fig. 7(a) shows an initially imperfect simply supported beam [with $v(x) = v_{0i}\ sin(\pi x/L)$] subjected to concentric compressive force $P = 200$ kips while Fig. 7(b) shows an initially straight beam subjected to the same eccentric compressive force ($P = 200$ kips).

If $v_{0i} = 0.10'$, $E = 3000$ ksi, calculate the

(a) Deflection v_{max1} and corresponding bending moment M_{max1} at the beam midspan Fig. 7(a)

(b) Value of e required to make $v_{max2} = v_{max1}$ and value of e required to make $M_{max2} = M_{max1}$ at the beam midspan in Fig. 7(b).

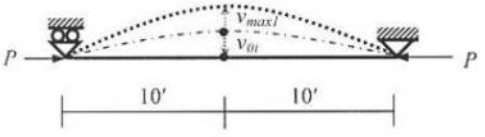


Fig. 7(a)

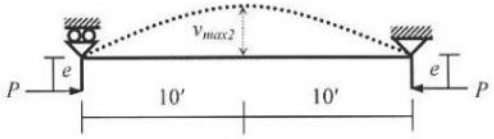
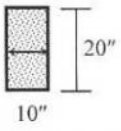


Fig. 7(b)

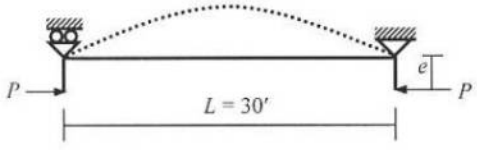


Member Section

12. Fig. 8 shows an elastic fully plastic simply supported straight beam subjected to eccentric axial force P. If $e = 0.10'$, $L = 30'$, $EI = 40 \times 10^3$ k-ft^2, calculate the

(i) Plastic moment M_p of the section if the maximum allowable axial force $P = 100$ kips

(ii) Maximum allowable axial force P' if the plastic moment at midspan M_p' is double the value calculated in (i); i.e., $M_p' = 2M_p$.



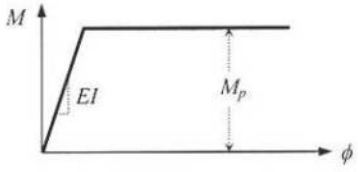
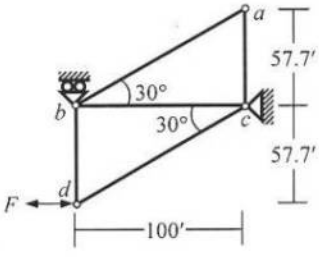


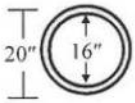
Fig. 8

13. Use the AISC-ASD criteria to calculate the allowable value of F to avoid buckling of any member of the truss *abcd* shown in Fig. 9, if F acts

(i) Rightward, (ii) Leftward

[Given: $E = 29000$ ksi, $f_y = 60$ ksi].





Member Section

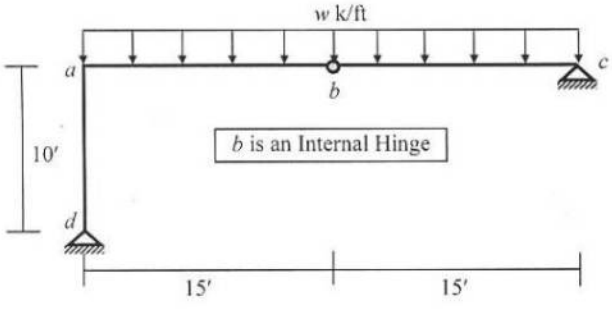
Fig. 9

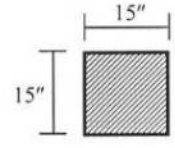
14. For the frame shown in Fig. 10, calculate the

(i) Distributed load (w k/ft) needed to cause buckling of column *ad* and beam *ab*,

(ii) Maximum bending moment in the two members if w is equal to half the load calculated in (i)

[Given: Modulus of elasticity $E = 3000$ ksi].





Cross-section of all members

Fig. 10

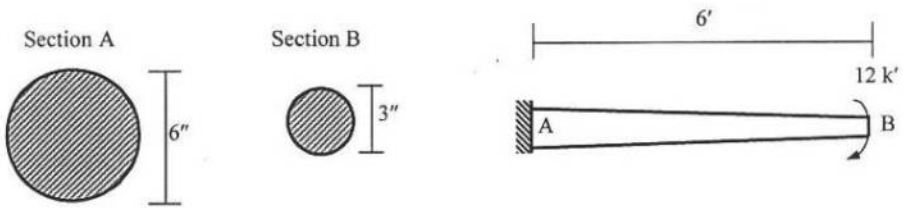
University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title : Mechanics of Solids II
Time : 3 hours

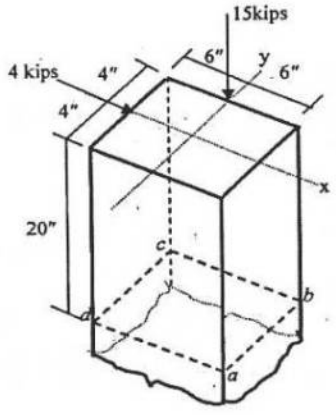
Course Code: CE 213
Full Marks: 10X10=100

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

1. Considering the cantilever beam shown below, calculate the torsional rotation at B if the cross-section diameter varies from 6″ at A to 3″ at B. [Given: G = 12000 ksi]

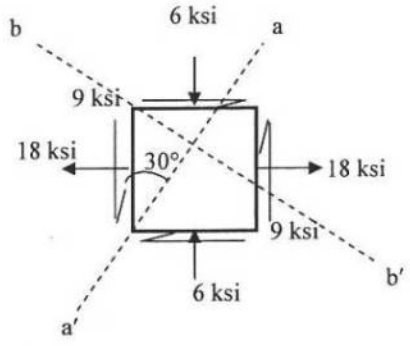


2. A cast iron block is loaded as shown in the following figure. Neglecting the weight of the block, determine the normal stresses acting at section abcd and locate the line of zero stress.



3. What is kern? Prove that Kern of a section is bounded by b/6+h/6=1 lines and also calculate the Kern of a column section of 12″x10″.

4. Use stress transformation formulas 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.



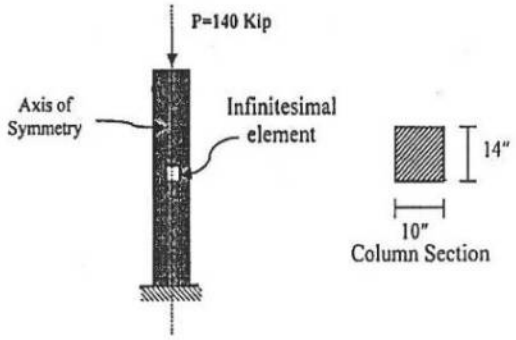
Necessary Formulas:

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

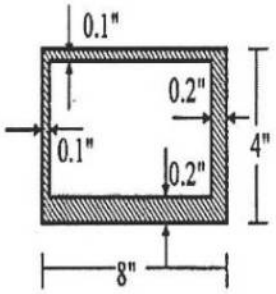
* $\sigma_{xx(max)} = (\sigma_{xx} + \sigma_{yy})/2 + \sqrt{[\{(\sigma_{xx} - \sigma_{yy})/2\}^2 + (\tau_{xy})^2]}$
  $\sigma_{xx(min)} = (\sigma_{xx} + \sigma_{vv})/2 - \sqrt{[\{(\sigma_{xx} - \sigma_{vv})/2\}^2 + (\tau_{xv})^2]};$

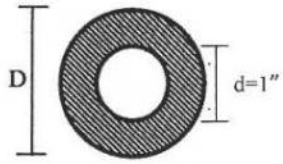
* Direction of max/min normal stress, $tan2\theta_1 = \tau_{xy} \div \left(\frac{\sigma_{xx} - \sigma_{yy}}{2}\right)$

5. Find out the stresses on the infinitesimal element shown in the following figure of column under pure compression. Construct Mohr's Circle and find out the principal stress planes.



6. For member having the cross section as shown in figure, determine the maximum torsional shear stress and angle of twist per unit length when subjected to a torque of 10 k-ft. Also calculate the diameter D of the hollow section that has the same maximum shear stress when subjected to the same torque. [G=12,000 ksi]

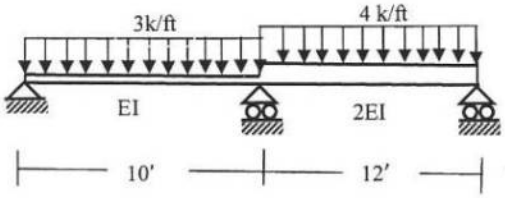




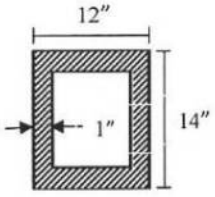
Section	Torsional Shear Stress	J_{eq}
Circular	$\tau = Tc/J$	$\pi d^4/32$
Thin-walled	$\tau = T/(2\text{Ⓐ}\, t)$	$4\text{Ⓐ}^2/(\int ds/t)$
Rectangular	$\tau = T/(\alpha bt^2)$	βbt^3

b/t	1.0	1.5	2.0	3.0	6.0	10.0	∝
α	0.208	0.231	0.246	0.267	0.299	0.312	0.333
β	0.141	0.196	0.229	0.263	0.299	0.312	0.333

7. Draw the Shear Force and Bending Moment diagram for the beam shown below. Use Moment Area Theorem.



8. Check the adequacy of the following column section against buckling using the AISC-ASD criteria when subjected to 1050 kip load. [Given: column's support condition fixed pinned, Length of column =15', E = 29000 ksi, F_y =40 ksi].

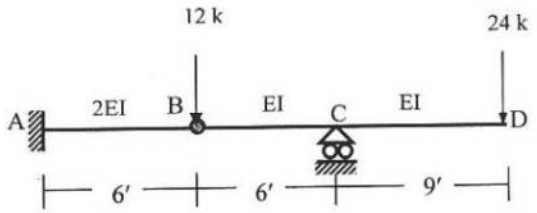


Cross Section

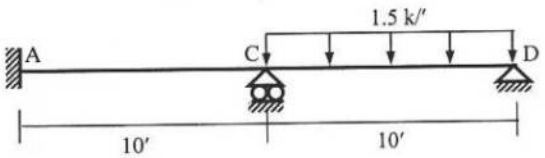
Necessary Formulas:

$$F_a = \frac{\left[1 - 0.5\left(\frac{KL/r}{C_C}\right)^2\right] F_y}{\frac{5}{3} + \frac{3}{8}\left(\frac{KL/r}{C_C}\right) - \frac{1}{8}\left(\frac{KL/r}{C_C}\right)^3} \quad \text{Or,} \quad \frac{12\pi^2 E}{23\left(KL/r\right)^2}$$

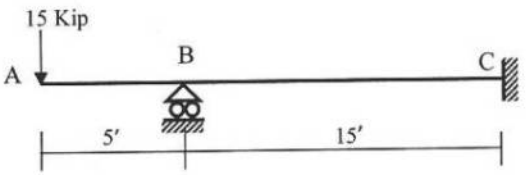
9. For the beam shown below, use Conjugate Beam Method to calculate deflection at D and rotation at C and D. [Given: EI = 40×10^3 kft^2].



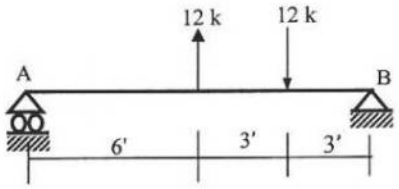
10. Draw shear force and bending moment diagram of the beam shown below. [Given: EI= 40,000 kft^2]. Use Direct Integration method.



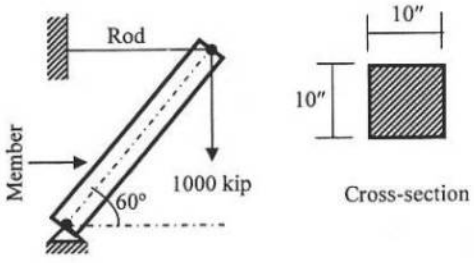
11. Calculate deflection and rotation at A for the beam shown in the figure. Use Conjugate Beam Method. [EI=Constant]



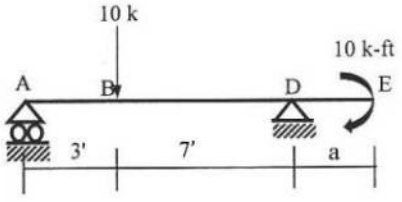
12. Calculate the maximum deflection of the following beam. Given, E=30,000 ksi.



13. Find the length of the member as shown in the following figure having 10″×10″ cross-section for which Euler's buckling formula applies. Given E= 29,000 ksi.



14. For the beam shown below, find the distance 'a' such that the deflection at E would be 0.2 in. [Given: EI = 36,400 kft^2]



(c) A wooden rod weighing 5lb is hinged at one end (Figure - 3).The rod is 10 ft long and uniform in cross section , and the support is 5 ft below the surface of a fresh water pond. At what angle α will it come to rest when allowed to drop from a vertical position? The cross section of the stick is 1.5 in^2 in area. (9)

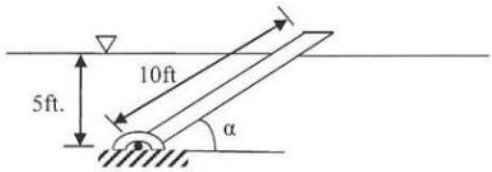


Figure - 3

3.(a) Determine vertical and horizontal components of force acting on radial gate ABC and their line of action. The shape of the gate is a quadrant of a circle of radius 2 m (Figure - 4).The upper portion of the gate is at a depth of 2 m from the free surface. (12)

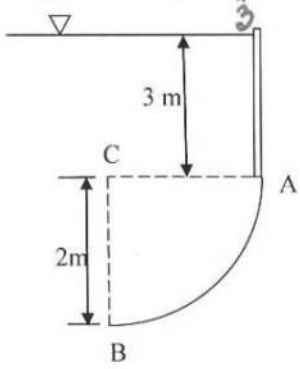


Figure- 4

(b) Figure – 5 shows a pipe discharging oil (specific gravity = 0.84) from a reservoir into open air . If the velocity of flow in pipe is v ,the head loss from point 1 to point 2 is $\frac{2v^2}{2g}$ and the head loss from point 2 to point 3 is $\frac{3v^2}{2g}$. Determine discharge in the pipe and absolute pressure at point 2. Assume an atmospheric pressure of 14.7 psi. (13)

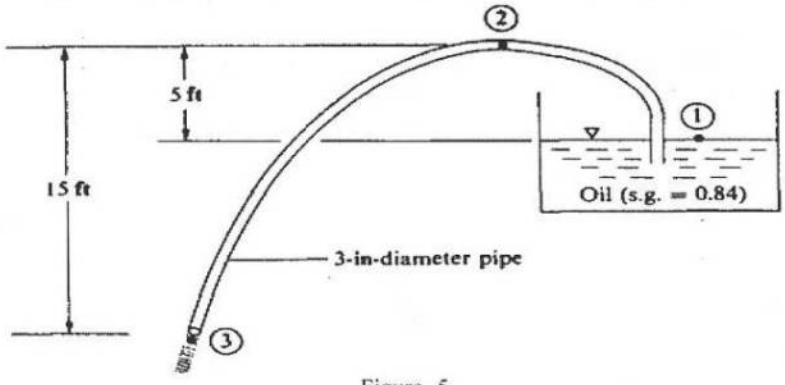


Figure- 5

4.(a) Consider the drag force F_D exerted on a sphere as it moves through a viscous liquid. Certainly, the size of the sphere must influence the drag force. Also, the velocity of the sphere must be important. The fluid properties involved are the density ρ and the viscosity μ. Derive an expression for the drag force on the sphere by Buckingham's π Method. (13)

(b) Distinguish between cohesion and adhesion. (2)

(c) Water flows from section 1 to section 2 in the pipe shown in Figure- 6.Determine the velocity of fluid flow and pressure at section 2. Assume the total head loss from section 1 to section 2 is 3.0 m. (10)

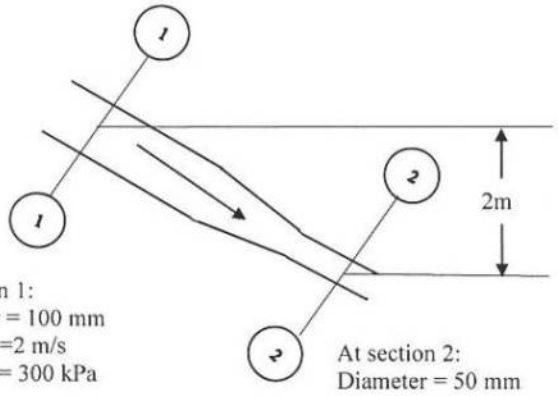


Figure- 6

Section-B

There are **4 (Four)** questions in this section. Answer any **3 (three)** questions.

5.(a) State the relations between absolute and relative velocities with a neat sketch. Derive an expression for force on fluid in a reducing bend in a horizontal plane. (4+7=11)

(b) A 10 cm diameter jet with a velocity of 32 m/s impinges on a single vane moving in the same direction at a velocity of 22 m/s. If $\beta_2 = 135^0$ and friction losses over the vane are such that $v_2 = 0.85v_1$, compute the force exerted by water on the vane. (14)

6.(a) A Centrifugal Pump Impeller has $r_1 = 0.4$ m, $r_2 = 1.2$ m, $\beta_1 = 110^0$, $\beta_2 = 145^0$, and thickness of 0.1 m parallel to the axis of rotation. If it delivers 3.5 m^3/s with no tangential velocity component at the entrance, what is the rotational speed? For this condition calculate: (12)

i. Torque
ii. Power of the machine
iii. Energy given to each Newton of water.

(b) Suppose in Figure 7, the pipes 1, 2 and 3 are 350 m of 30 cm diameter, 200 m of 18 cm diameter and 280 m of 26 cm diameter, respectively of new cast iron (e = 0.25 mm) and are conveying 15^0 C water. If h = 15 m, find the rate of flow from A to B. Use Moody diagram for friction factor (See Figure 10). (13)

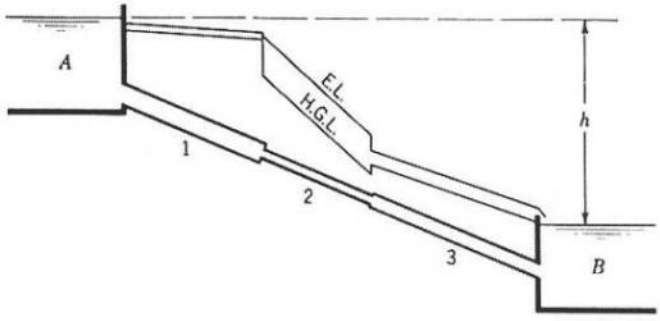


Figure 7

7.(a) A pipeline 50 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 m of its length from the tank, the pipe is 20 cm in diameter and its diameter suddenly enlarges to 35 cm. The height of water level in the tank is 15 m above the center of the pipe. Considering all losses of head that occurs, determine the rate of flow. Assume f = 0.025 for both the pipes. (7)

(b) Two reservoirs with a difference in water surface elevation of 10 m are connected by two pipes in series as shown in Figure 8. The equivalent roughness heights of the two pipes are 2.5 mm and 0.5 mm respectively. Considering all losses of head that occur, find discharge by equivalent velocity head method. Given $\nu = 3\times10^{-6}$ m^2/s. Use Moody diagram for friction factor (See Figure 10). (12)

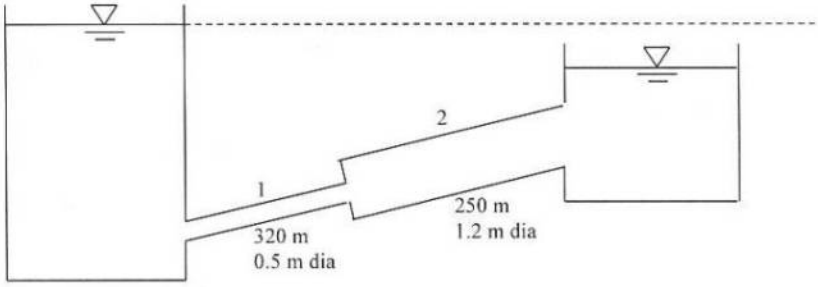


Figure 8

(c) Explain Reynolds experiment in brief to distinguish between laminar and turbulent flow with a sketch. (6)

8. (a) If the flows into and out of a two-loop pipe system are as shown in Figure 9, determine the flow in each pipe. The k-values for each pipe are given in the figure. Use Hardy Cross method. (10)

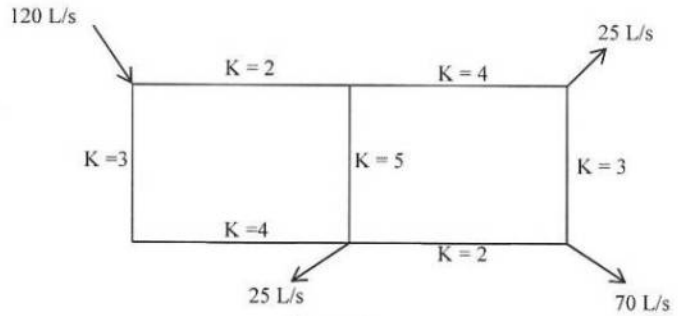


Figure 9

(b) Write short note on the following items: (2X3=6)

i. Pitot tube coefficient
ii. Minor losses in pipe flow
iii. Hydraulically rough boundary.

(c) Prove that theoretical discharge through a venturimeter is given by (9)

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

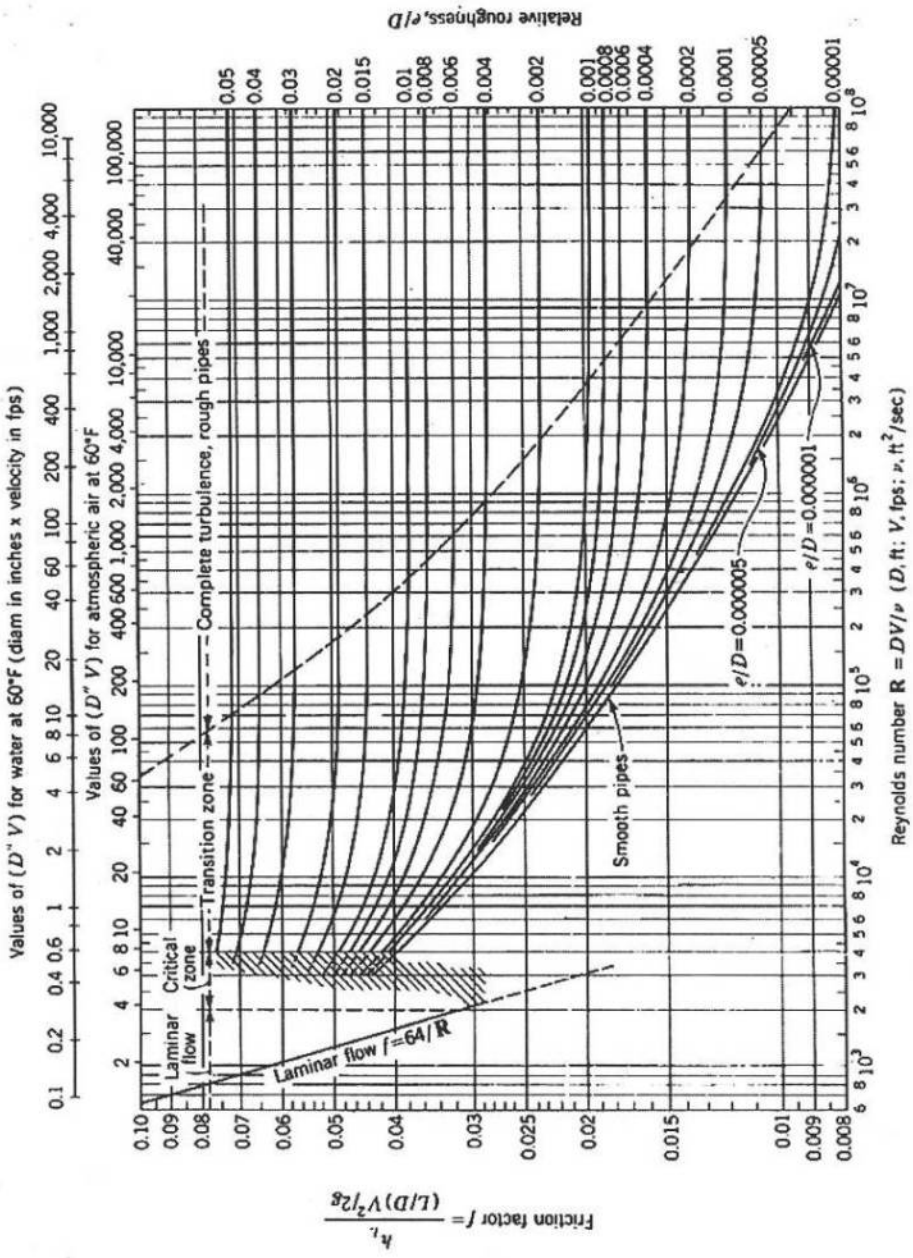


Figure 10: friction factor for pipes (Moody Diagram)

8.

a. What is Communication? [1½]
b. Explain different types of internal operational communication [3]
c. Explain the principles or "Seven C's" of effective written or oral communication. [8]

9.

a. Define Sustainable Development? [1]
b. What are the pillars of Sustainable Development? [1½]
c. "Sustainable development requires that we see the world as a system—a system that connects space; and a system that connects time." – Explain. [3]
d. According to sustainable development concept, how the local "environmental issues" affect globally and how they are linked with social and economic issues? [2+2½+2½]

—

expression for average strain and average stress in steel due to loads.

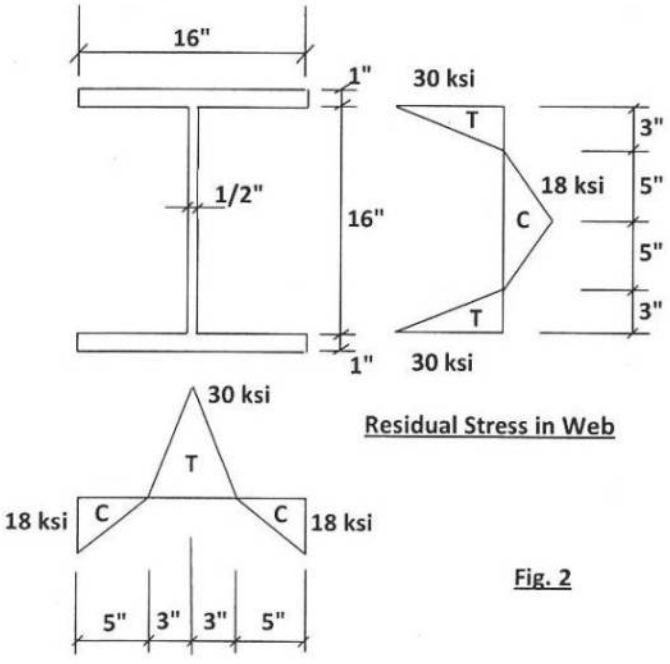
(b) A straight post tensioned concrete member 12.2 m long, with a cross section of 380 mm by 380 mm, is prestressed with 780 mm^2 of steel. The steel is made up of 4 tendons with 195 mm^2 per tendon. The tendons are tensioned one after another to the stress of 1035 MPa. Compute the loss of prestress due to the elastic shortening of concrete. (13)

5 (a) What is partial prestress? How is it obtained? Write down the advantages and disadvantages of partial prestress. (12)

(b) Eighteen 5 mm wires in a cable, 24 m long, are tensioned initially to a total stress of 13.5 KN. What additional elongation of the wires is required to obtain an initial prestress of 1100 MPa? Given that E_s = 193000 MPa. Assume no shortening of concrete during the tensioning process and neglect friction. (7)

(c) Consider a tendon of 24.4 m length. For a unit stress of 1240 MPa applied at the jacking end, a total elongation of 122 mm is obtained. Given E_s = 210000 MPa. Compute the average stress in the tendon. (6)

Compressive strain 0.0010 is to be taken as positive in the above stress-strain equation. 8 ⅓



Residual Stress in Web

Residual Stress in Top & Bottom Flanges

Fig. 2

4. Compute the yield moment and plastic moment capacities and shape factor for major axis (X-axis) bending of the I-section shown in Fig. 3. Given: $F_y = 50$ ksi. 8 ⅓

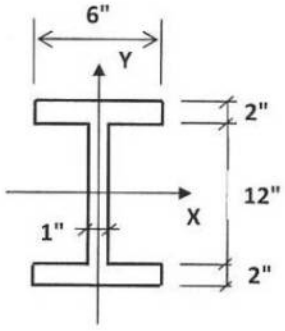


Fig. 3

5. A W10x54 section is used for a 20 ft. long column. The section has an area of 15.8 in^2 and a radius of gyration, $r_x = 4.37$ in. and $r_y = 2.56$ in. about the strong axis X and the weak axis Y respectively. If effective length factor for buckling about major axis X is $K_x = 1$ and that for buckling about minor axis Y is $K_y = 0.5$, calculate the design strength for

the column using AISC/LRFD method. Given: F_y = 36 ksi and E = 29000 ksi. See Annexure-3. 8 ⅓

6. Using ASD method, calculate the allowable load for the column described in question 5 above. All data remains same. See Annexure-4. 8 ⅓

7. Determine the effective length coefficients for the columns of the frame shown in Fig. 4. The moments of inertia in inch^4 for the columns and beams are shown in the figure. Annexure-5 provides necessary nomographs. 8 ⅓

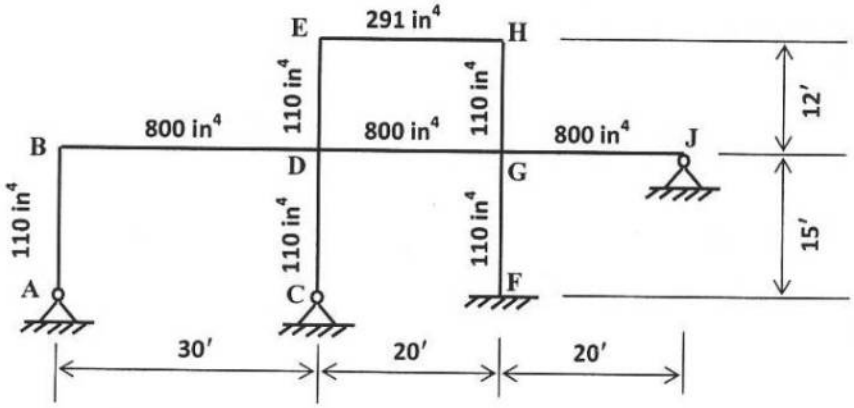


Fig. 4

8. The residual stress for a 16x1-in. plate to be used as a tension member is shown in Fig. 5. Determine the average stress in the plate at an imposed tensile strain of 0.0014. Given: F_y=36 ksi; E=30000 ksi. 8 ⅓

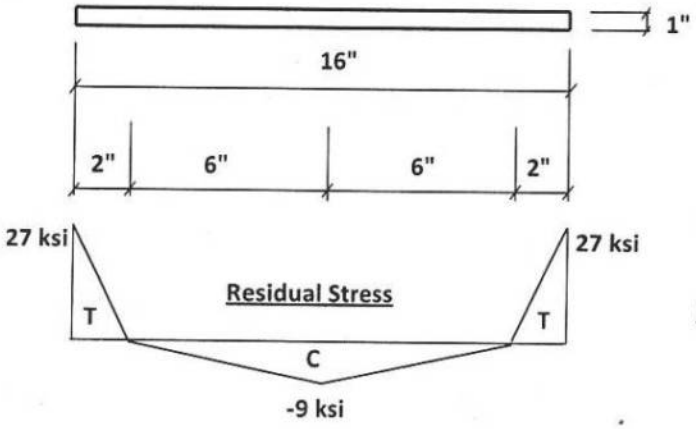


Fig. 5

ANNEXURE-1

For block shear in AISC/ASD, allowable stress in shear on net shear area, $F_v = 0.3F_u$ and allowable stress in tension on net tension area, $F_t = 0.5F_u$.

ANNEXURE-2

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:

Compact section: $F_b = 0.66F_y$ (5-16*a*)

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:

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

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

DEFLECTION CRITERIA FOR LIVE LOAD STRESS F_b:

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

ANNEXURE-3

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

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

in which

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

ANNEXURE-4

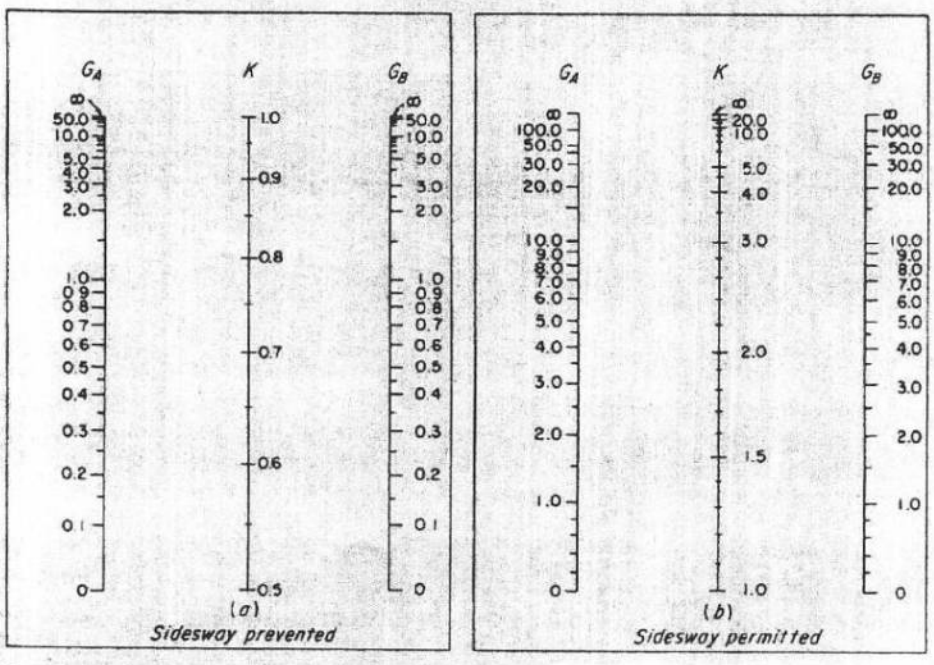
The AISC/ASD formulas for allowable stress F_a on axially loaded compression members are

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

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

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

ANNEXURE-5



Nomograph for effective length of columns.

4. A 12 in. wide by 16 in. deep (including 6 in slab) reinforced concrete beam spans between two interior columns in a building frame designed for a region of high seismic risk. The clear span of the beam is 18 ft and the c/c spacing of the beams is 20 ft. **(10)**

The longitudinal reinforcement at the face of the support consists of three No. 9 top bars (in one layer) and three No. 8 bottom bars (in one layer).

Design the shear reinforcement of the beam (for the regions adjacent to the column faces) if it is subjected to DL = 1.0 kip/ft and LL = 1.8 kip/ft and also draw the configuration of hoop reinforcement for the beam

[Given: $f_c' = 4000$ psi and $f_y = 60{,}000$ psi].

5. **Figure 2** shows the top view of an exterior joint which is part of a reinforced concrete frame designed to resist earthquake loads. **(10)**

A 6 in. slab (not shown in the figure) is reinforced with No. 4 bars spaced 8 in. centre to centre at the same level as the flexural steel in the beams.

The member section dimensions and reinforcements are as shown.

The frame story height is 10 ft.

The maximum factored axial load on the upper column framing into the joint is 2000 kips, and the maximum factored axial load on the lower column is 2200 kips.

Check if the joint satisfies weak beam-strong column design criterion (ACI 21.6.2.2)

[Given: $f_c' = 4000$ psi and $f_y = 60{,}000$ psi].

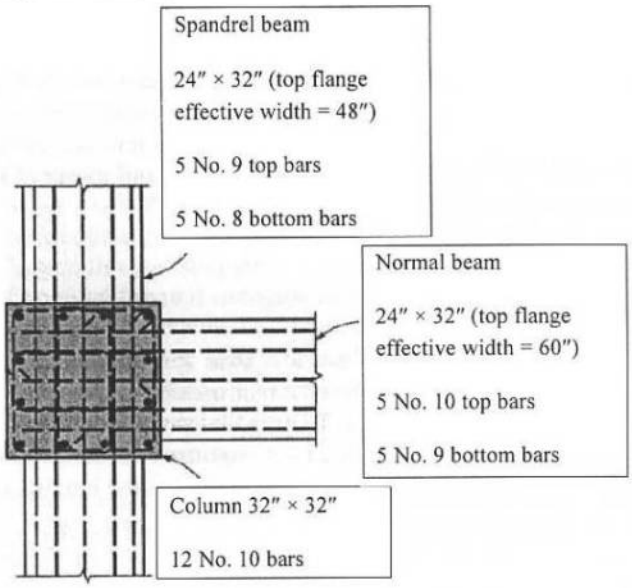
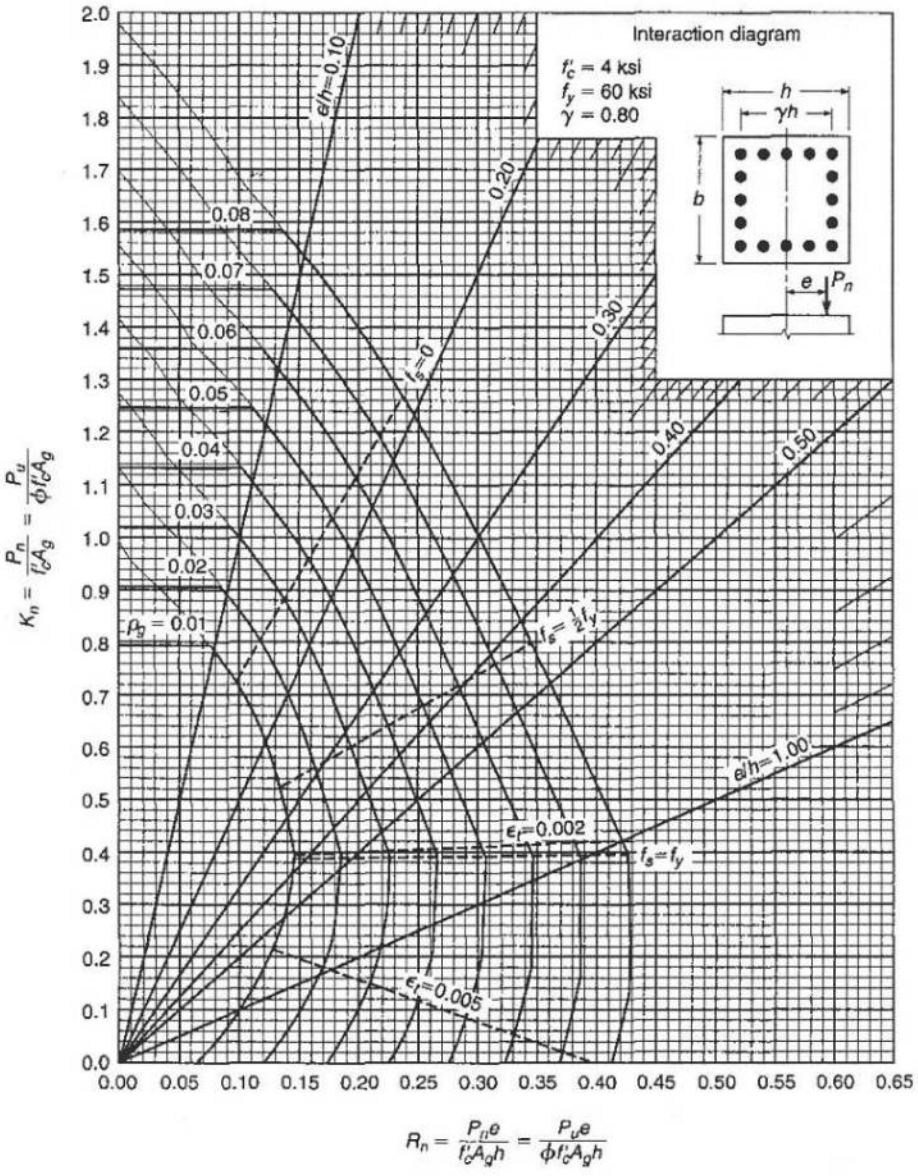
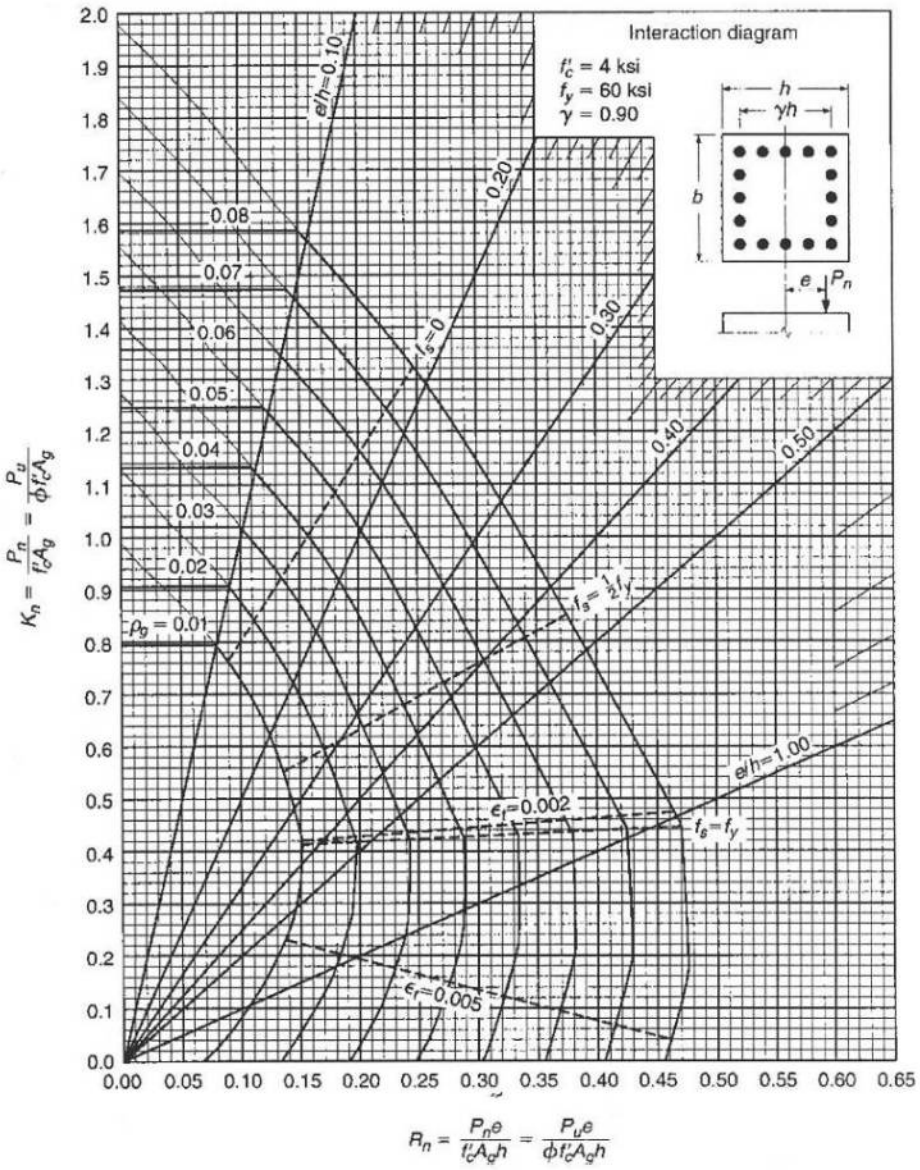


Figure 2

6. Design the transverse reinforcement for the same column described in **Question 5**. **(10)**



GRAPH A.7
Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.80$.



GRAPH A.8
Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.90$.

I. Transportation costs:
   i. Stationary-container system using an 18-m^3 compactor = \$20 / hr
   ii. Tractor-trailer transport unit with a capacity of 120 m^3 = \$ 25/hr

II. Other costs:
   i. Transfer station operating cost, including amortization =\$ 0.40/m^3
   ii. Extra cost for unloading facilities for tractor-trailer transport unit= \$ 0.05/m^3

III. Other data:
   i. Density of wastes in compactor = 325 kg/m^3
   ii. Density of wastes in transport units = 150 kg/m^3

3. (a) What are the present practices of recycling in developing countries ? (5)

   (b) Write down the environmental justification of recycling and reuse. (7)

   (c) Write down the main objectives of composting. (5)

   (d) A recent study on recycling at the Los Angeles International Airport (LAX) generates about 19,000 tons of solid waste per year (1.3 pounds per passenger). On the annual basis, LAX recycles 12 tons of aluminum; 2,021 tons of cardboard ; 527 tons of office paper, 89 tons of newspaper, 17 tons of glass and 921 tons of plastic. In addition, they compost 271 tons of food waste. (8)

      i. Find the equivalent greenhouse gas savings associated with these recycled and composted materials assuming they would have all gone to a landfill if they hadn't been recycled.

      ii. If the landfill charges \$80/ton (called the tipping fee), how much money is saved in tipping fees by recycling and composting?

      iii. If, in the future, there is a carbon tax \$10 per metric ton of carbon dioxide, how much would LAX save in carbon taxes at the current recycling rate?

4. (a) What are the differences between the methods of biogas generation and composting? (3)

   (b) Discuss the storm water management in landfill site? (6)

   (c) Write short notes on the following: (2x3) (6)
   i) Refuse - derived fuel (RDF) system ii) Underground injection of hazardous waste
   iii) Hazardous waste minimization

   (d) 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 formulas of the typical waste is $C_{60.0}H_{94.3}O_{37.8}N$. Given that the total weight of organic material in 100 lb of solid waste is equal to 75.0 lb including moisture. (10)

5. (a) Which land disposal technique is suitable for the hazardous waste of Bangladesh? Give appropriate judgment against the answer. (8)

(b) Do you suggest ocean can be a place for dumping hazardous waste ? Justify your answer. (5)

(c) Discuss the hospital waste management system. (12)

Formulae:

$$M_v = M_W \times \frac{P_C}{P_W}$$

$$C_aH_bO_cN_d + \left(\frac{4a-b-2c+3d}{4}\right)H_2O \rightarrow \left(\frac{4a+b-2c-3d}{8}\right)CH_4 + \left(\frac{4a-b+2c+3d}{8}\right)CO_2 + dNH_3$$

Sources of leachate	Typical value	Normal range	Governing factor
Precipitation losses from:	900 mm	400-1200 mm	Location (climate)
Evapotranspiration	*70%	40-90%	Humidity
Surface runoff	20%	10-45%	Soil type
Water retained (% by volume) Saturated soil	30%	10-40%	Soil type
Refuse in place	30%	20-30%	Refuse

* The loss of 70% of precipitation by evapotranspiration applies to open land with vegetation. In a landfill, the loss might only be one-half to two-thirds this value or in this case 35-45% of the total precipitation.

TABLE 9.8

Net Greenhouse Gas Emission Reductions Compared to Landfilling for Source Reduction, Recycling, Composting, or Combustion in Metric Tons of Carbon Equivalents Per Ton of Material (MTCE/ton)

Materials	Source Reduction: Current Mix of Inputs	Source Reduction: 100% Virgin Inputs	Recycling or Composting versus Landfilling	Combustion versus Landfilling
Aluminum cans	2.28	4.28	3.71	−0.01
Corrugated cardboard	1.63	2.32	0.96	0.29
Fly ash	0.01	0.01	0.25	0.01
Food waste composted	NA	NA	0.25	0.25
Glass	0.88	1.02	0.50	0.43
HDPE	0.50	0.55	0.39	−0.24
Magazines	2.28	2.36	0.76	0.05
Mixed metals	NA	NA	1.44	0.30
Mixed MSW	NA	NA	NA	0.15
Mixed paper	NA	NA	1.06	0.27
Mixed plastics	NA	NA	0.42	−0.26
Mixed recyclables	NA	NA	0.83	0.20
Newspapers	1.09	1.39	0.52	−0.03
Office paper	2.71	2.79	1.31	0.70
Personal computers	15.14	15.14	0.63	0.06
PET	0.58	0.60	0.43	−0.28
Steel cans	0.88	1.02	0.50	0.43
Textbooks	3.03	3.11	1.38	0.70
Tires	1.10	1.10	0.51	−0.04
Yard trimmings	NA	NA	−0.01	0.00

Source: U.S. EPA, 2006b.

(b) Explain the effects of temperature on DO sag curve with relevant figure. (4)
What are the drawbacks of Streeter-Phelps oxygen-sag curve. (3)

(c) What is eutrophication? How does it affect water quality? (5)
Briefly describe the control measures for eutrophication. (6)

4. (a) Classify lakes according to nutrient enrichment. (3)

(b) A lake of 100×10^6 m^2 area is being fed by a stream flow of 20 m^3/s. Phosphorus (P) concentration in the stream water is 0.05 g/m^3. The lake also receives a wastewater flow of 0.4 m^3/s, which contain 10.0 mg/l (= 10.0 g/m^3) of phosphorus. P settling rate is given by 10 m/yr (= 3.17×10^{-7} m/s).
(i) Estimate average P concentration in lake. (3)
(ii) Estimate P removal rate at a treatment plant to keep P concentration below 0.01 mg/L. (4)

(c) Define thermal stratification. (2)
Briefly describe the layers in a stratified lake with necessary figure. (4)
Explain the effects of summer stratification on DO level in a lake. Draw necessary figures. (6)
Between summer and winter stratification, which one imposes more severe effects? Justify your answer. (3)

5. (a) Briefly explain the impacts of oxygen demanding wastes on stream self-purification process. (4)

(b) Briefly describe the toxicological effects of arsenic. (4)
Mention the treatment methods for removal of arsenic from groundwater. (5)

(c) Define critical DO. What is the significance of critical DO. (5)
Just below the point where a continuous discharge of pollution mixes with a river, the BOD is 10.9 mg/L and DO is 7.6 mg/L. The river and waste mixture has a temperature of 20°C, a de-oxygenation constant k_d of 0.20/day (at 20°C), an average flow speed of 0.30 m/s and an average depth of 3.0 m.
(i) Find the time and distance downstream at which the oxygen deficit is the maximum. (4)
(ii) Find the minimum value of DO. (3)

Formulae:

$F = gr^2 v_s (1 - T_a/T_s)$

$$\Delta h = \frac{1.6F^{1/3}x_f^{2/3}}{u}$$

$x_f = 120\ F^{0.4}$ if $F \geq 55\ m^4/s^3$

$x_f = 50\ F^{5/8}$ if $F < 55\ m^4/s^3$

$$\bar{u}(z) = \bar{u_0}\left(\frac{z}{z_0}\right)^{\rho}$$

$$d_p = \left(2\frac{18\mu \cdot v_h \cdot H}{g \cdot \rho_p \cdot L}\right)^{1/2}$$

$$\eta = \frac{L \cdot g \cdot d_p^2 \cdot \rho_p}{H \cdot v_h \cdot 18\mu}$$

$BOD_t = L_0 (1 - e^{-kt})$

$$P = \frac{S}{Q + \upsilon_s \cdot A}$$

$$D = \frac{k_d L_0}{k_r - k_d}\left(e^{-k_d t} - e^{-k_r t}\right) + D_0 e^{-k_r t}$$

$$k_r = \frac{3.9u^{1/2}}{H^{3/2}} \qquad t_c = \frac{1}{k_r - k_d}\ln\left[\frac{k_r}{k_d}\left(1 - \frac{D_0[k_r - k_d]}{k_d \cdot L_0}\right)\right]$$

$$D_{max} = \frac{k_d L_0}{k_r - k_d}\left(e^{-k_d t_c} - e^{-k_r t_c}\right) + D_0 e^{-k_r t_c}$$

$DO_{(sat)} = 14.62 - 0.39\ T + 0.007714\ T^2 - 0.0000646\ T^3$

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

[a]Surface wind speed is measured at 10 m above the ground.
[b]Corresponds to clear summer day with sun higher than 60° above the horizon.
[c]Corresponds to a summer day with a few broken clouds, of a clear day with sun 35–60° above the horizon.
[d]Corresponds to a fall afternoon, or a cloudy summer day, or clear summer day with the sun 15–35° above the horizon.
[e]Cloudiness is defined as the fraction of sky covered my clouds.
[f]For A–B, B–C, or C–D conditions, average the values obtained for each.
Note: A, Very unstable; B, moderately unstable; C, slightly unstable; D, neutral; E, slightly stable; F, stable. Regardless of windspeed, class D should be assumed for overcast conditions, day or night.
Source: Turner (1970).

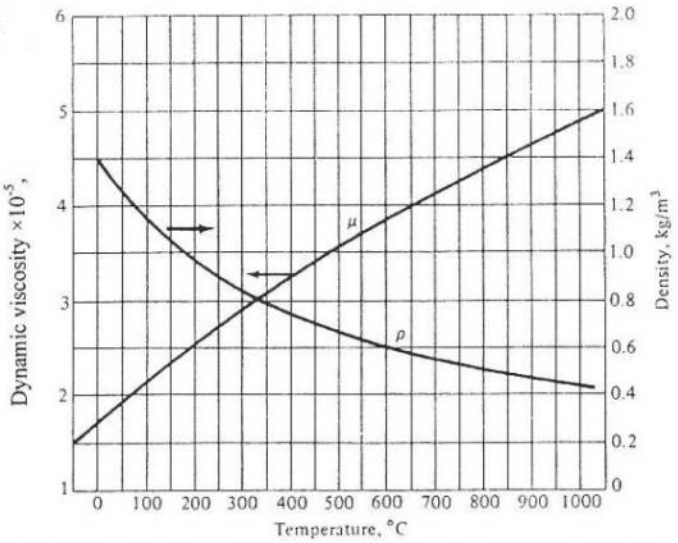


Figure C-2 Density and dynamic viscosity of pure air at 1.0 atm pressure as a function of temperature. (*Adapted from Martin Crawford: Air Pollution Control Theory, McGraw-Hill, New York, 1976.*)

planning/initiation phase, *at implementation/construction phase* and *at operational phase/after construction phase* etc.)

4. A) What are the typical parameters (impact characteristics) that need to be taken into account for impact prediction and decision-making in an EIA process? 4

   B) Produce an EIA sample impact identification checklist for your own group work's project. 8

   For one of the following projects: a) Rampal Thermal Power Plant b) Padma Multipurpose Bridge Project c) Mass Rapid Transit in Dhaka City d) Rooppur Nuclear Power Plant.

5. A) Draw the figure showing three steps (or main elements) of impact mitigation. 4

   B) Government is proposing to construct a new export processing zone (EPZ) in an area covering 267 Acres. After completion, the EPZ will have 250 industrial plots. The area proposed for the new EPZ is located in a rural area mainly used for agriculture and there is a river nearby. 8

   For this project, write the benefits of public participation during EIA process for the following stakeholder groups (write five benefits for each stakeholder group):

   - The proponent/supporter
   - The decision-maker
   - Affected communities

6. A) What are the different components of Environmental Management Plan (EMP) and explain how to address those EMP components. 2+4

   B) What are the objectives of EIA Review? 2

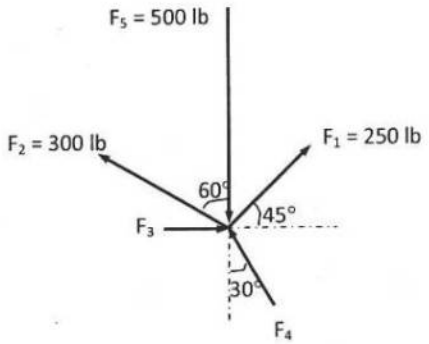
   C) Graphically show three different steps of Environmental Auditing (EA). 4

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

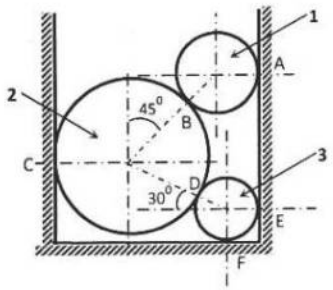
Course Title: Engineering Mechanics I — Course Code: CE 101
Time: 3:00 hours — Full Marks: 10 x 10 = 100

Answer any 10 (Ten) of the following 14 questions

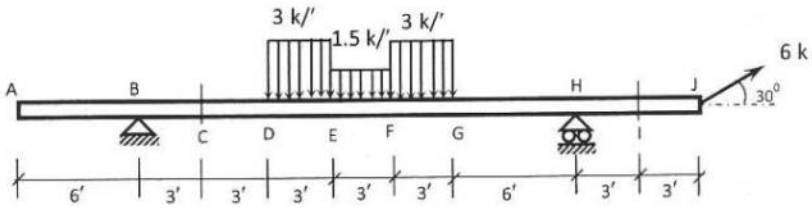
1. In the figure below the forces F_1, F_2, F_3, F_4 & F_5 are in equilibrium. Calculate the magnitudes of F_3 and F_4.



2. Three spheres 1, 2 and 3 are at equilibrium as shown in Fig. below. W_1 = 40 lb, W_2 = 100 lb and W_3 = 20 lb. Find the reaction at F.



3. In the beam shown below, calculate the reactions at supports B and G and also calculate axial force, shear force and bending moments at C and I.

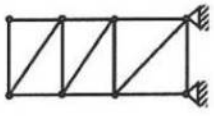


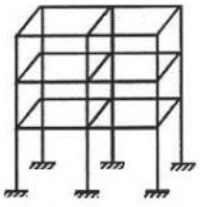
University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: Structural Engineering I — Course Code: CE 311
Time: 3:00 hours — Full Marks: 10 x 10 = 100

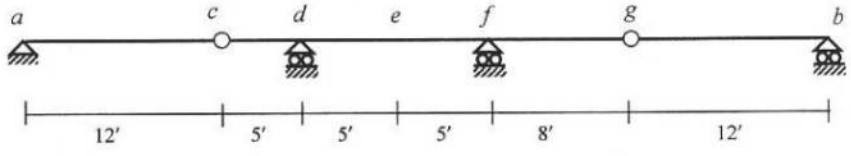
Answer any 10 (Ten) of the following 14 Questions

1. Determine the degree of statical indeterminacy (dosi) for the following (i) 2 dimensional truss and (ii) three dimensional frame.

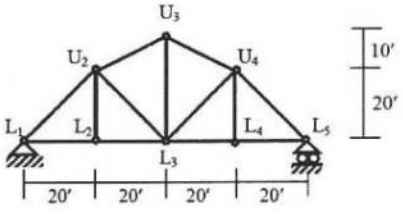




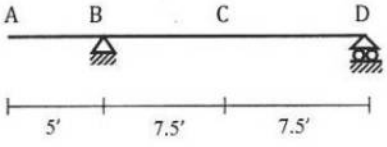
2. Draw influence line for R_d, V_e, $V_{d(r)}$, M_e and M_f. for the beam *ab*. c and g are internal hinge.



3. Draw influence line for forces in members U_2U_3, U_2L_3 and L_2L_3 [Note: There are floor-beams over the bottom-cords].



4. Calculate the maximum shear force at B, D and bending moment at B, C for the beam shown below, for a Dead Load of 1.25 k/ft, and moving Live Load of 1.0 k/ft.



University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013 (Set A)
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering II | Course Code: CE 313
Time: 3 hours | Full Marks: 10 × 10 = 100

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

1. For the 2-storied frame loaded as shown in Fig.1, (i) Use the Portal Method to draw the SFD of the columns and BMD of the beams, (ii) Use the Cantilever Method to draw the axial force diagram of the columns. Assume all column areas are equal.

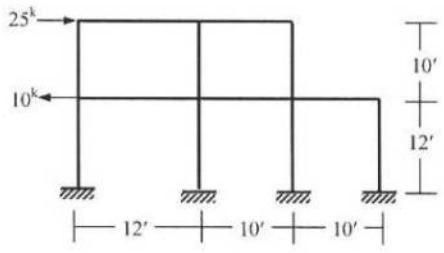


Fig. 1

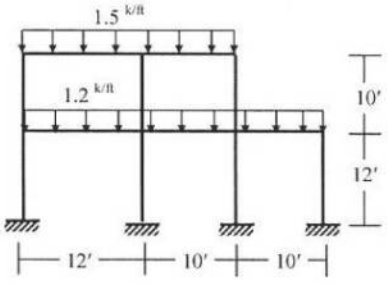


Fig. 2

2. For the 2-storied frame structure loaded as shown in Fig. 2, use the approximate location of hinges to draw the SFD and BMD of the beams and columns. Assume equal I for all columns.

3. Use Virtual Work Method for Fig. 3 to determine the relative deflection of joints A and G along line AG due to (i) Applied load, (ii) Rise in temperature of 50°F in top members and fall in temperature 25°F in bottom cord members. Parenthesis values indicate area of members in square inches [Given, E = 30 × 10^3 ksi, α_t = 1/150000/°F].

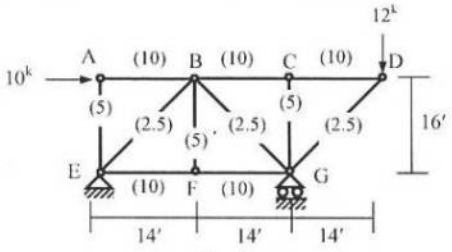


Fig. 3

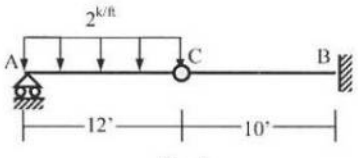


Fig. 4

4. Calculate the vertical deflection at point C of the beam shown in Fig. 4 using Virtual Work Method [Given EI = 40,000k-ft^2].

5. Use the Virtual Work Method to calculate the horizontal deflection at point E of the frame shown in Fig. 5 [Given, EA = 400×10^3k, GA* = 125×10^3 k, EI = 40×10^3 k-ft^2].

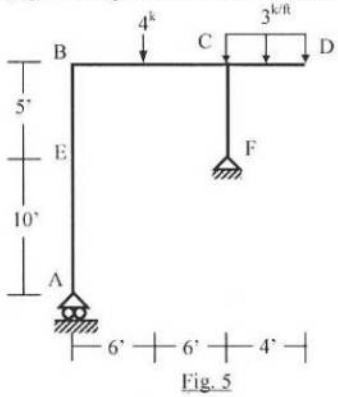


Fig. 5

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program : B.Sc Engineering (Civil)

Course Title: Design of Concrete Structure I | **Course Code : CE 315**
Time : 3 hr | **Full Marks : 60**

Answer any 3 Questions from each section (Assume any missing data)

Section A

1. a) Write down the basic design concepts of USD and WSD methods of RCC design. (3)

   b) The following beam is subjected to a DL of 3.5 k/ft (including beam self wt.) and a LL of 9 k/ft over its entire span (Fig 1). Design the beam with $\rho = 0.0120$, $f_y = 60000$ psi and $f'_c = 4000$ psi. Also draw the final section with the reinforcement and dimensions. (7)

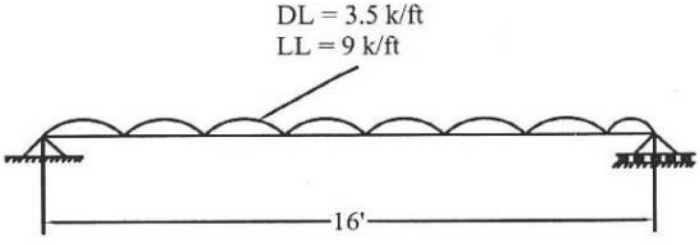
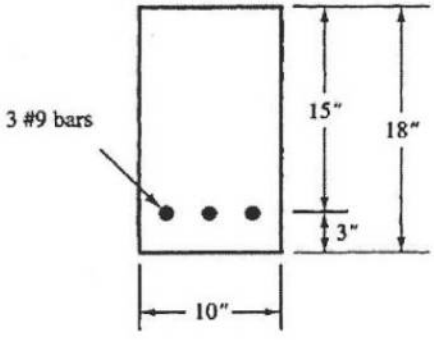


Fig 1

2. a) Calculate the design moment capacity of the following rectangular beam (Fig 2). (6)



$f'_c = 4000$ psi

$f_y = 60000$ psi

Fig 2

3-2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

(A)

Course Title: Design of Concrete Structures II — Course Code: CE 317
Time: 3hrs — Full Marks: 10X10=100

There are two parts of this question. (Part A and Part B)

PART A

[There are 10 (ten) questions. Answer any **7 (seven)**]

1. Use WSD method to design a two way slab of 22'X16' panel supported by a 20"X12" beam and having one short and one long edge continuous. [Given, Slab thickness 7", FF = 25 psf, RW=25 psf, LL = 40 psf, f_c'= 3 ksi, f_s = 20 ksi, n = 9, k = 0.378, j = 0.874, R = 223 psi]

2. A building is to be designed as a flat plate structure. A plan of the building is shown in *Fig 1*. The columns are 20"X 20" in size. Use WSD to calculate the column strip and middle strip moments of Panel A and Panel B [Given, FF = 25 psf, RW = 30 psf, LL = 50 psf, f_c' = 4 ksi, and f_y = 60 ksi].

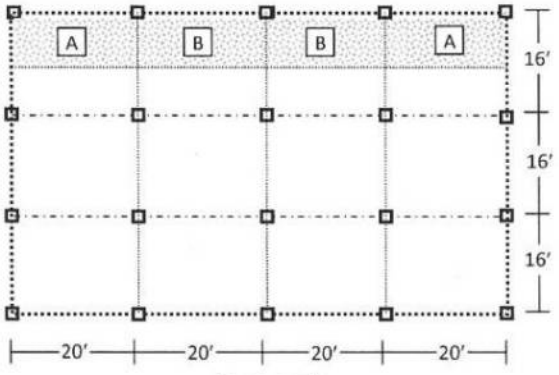


Fig. 1

3. For the tied column section shown below in *Fig. 2* [with f_c'= 3 ksi, f_y = 60 ksi] , use the WSD to
   i. Draw the interaction diagram about y-axis
   ii. Calculate the allowable moment of the section if it is subjected to axial force
   a. P = 200 k and b. P = 600 k

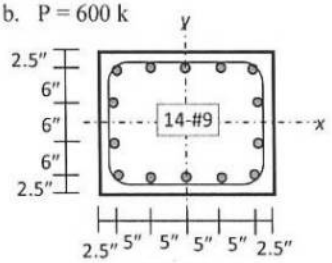


Fig. 2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering I **Course Code: CE 331**
Time: 3 hour **Full marks: 100**

Question No. 6 is compulsory. Answer any FOUR from the rest.
(Assume any missing data)

1. (a) State the objectives of water supply system. (3)

   (b) Write down the merits and demerits of ground water over surface water as a source of drinking water supply. (5)

   (c) Define rain water, ground water, potable water and palatable water. (4)

   (d) For water supply system of a small town, water is required to be pumped from a tubewell to an overhead tank. Work out the capacity of the pump and the motor. (8)

   Given,
   Daily requirement of water = 550000 liters
   Hours of daily pumping = 6
   Height of CL of pump above ground level = 0.75 m
   Water table below ground level = 9 m
   Fluctuations in the water table at different periods = 2 m
   Maximum depression on the pumping level = 3 m
   Height of the tank above ground level = 13.5 m
   Maximum depth of water in the tank = 2 m
   Height of inlet above the maximum water level = 0.25 m
   Loss of head in the pump and rising main = 1.5 m
   Efficiency of the pump= 65%
   Efficiency of the motor = 80%

2. (a) Explain , why chlorine in its various forms are used for disinfecting public water supplies. (3)

   Discuss briefly the disinfecting action of chlorine in water treatment process. (6)

   (b) Define pre chlorination, post chlorination and break point chlorination. (3)

   (c) Write down the water quality standard values of both WHO and Bangladesh (ECR' 97) guide lines for : p^H, color, turbidity, hardness, iron, arsenic, chloride and PO_4^-. (4)

   (d) Chlorine usage in the treatment of 40,000 cubic meter water per day is 12 kg/day. The residual after 10 min. contact is 0.20 mg/L. Calculate the dosage in milligrams per liter and chlorine demand of the water. (4)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering II | Course Code: CE 333

Time: 3.0 hours | Full Marks: 150 (=6×25)

[Assume reasonable values for any missing data]

SECTION –A

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

1. (a) In an area having only domestic sewerage and no provision of storm sewer, what will be your recommendation for storm water conveyance and final disposal system? Justify your answer. (3)

   (b) A Residential area (shown in figure 1) is severed by sewer P1. At present it has a total of 100 nos 5 storied building with two flats on each floor. The average occupancy is 5 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 serving the area using the following data: (17)
   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 m^3/ha/day;
   v) Area = 200 ha [Assume reasonable value for missing data.]
   vi) Minimum velocity through sewer = 0.75 m/s
   vii) Manning's roughness coefficient for sewer is 0.013. The nomograph is attached with this question paper.

   (c) What are the basic functional elements of the conventional sewerage system? (5)

2. (a) Write down the environmental significance of the following contaminants: (3)
   (i) Biodegradable organic matter (ii) Nutrients (iii) Pathogens

   (b) In a 5 unit apartment building, 40 residents are generating an average wastewater flow rate of 180 liter per capita per day. Design a double chamber septic tank for the building that will be desludged every 3 years. For ensuring better effluent quality, it is recommended that the minimum hydraulic retention time for the tank be 1.0 (one) day. Due to space constraints, specific tank area has to be restricted within 12 m^2. Assume wastewater temperature within the tank to be 25°C. Check clear space depth. Draw a net sketch showing details of septic tank dimensions and depth of different zones. (18)

   (c) Write down the advantages of preaeration of sewage prior to primary treatment. (4)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Geotechnical Engineering I — Course Code: CE 341
Time: 3 hours — 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) Swelling Index 3
   b) Derive the expression relating bulk unit weight, dry unit weight and water content. 4
   c) Discuss on different types of tri-axial tests and their applications. 3

2. a) Define: (i) Effective size, (ii) Plasticity Index, (iii) Equipotential line in flownet 3
   b) Derive the expression: $S \cdot e = w \cdot G_s$ 4
   c) Write the expressions (including K and σ'_v) for lateral earth pressure under active and passive conditions for cohesive soil. 3

3. a) Define: (i) OCR, (ii) Time factor (T_v) 2
   b) Describe (with sketch) the boundary condition of a saturated clay layer for one way and bothway drainage in relation to the time required for 100% consolidation. 5
   c) Compute the coefficients of passive and active earth pressure. Given, coefficient of earth pressure at rest is 0.4. 3

4. a) Write on the Mohr-Coulomb failure criteria. Draw typical failure envelopes for sand and clay. 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 (φ) for cohessionless soil. 5

5. a) Derive two independent expressions for settlement calculation (i) using coefficicient of compressibility (a_v) and (ii) coefficient of volume compressibility (m_v) from the expression given below.

$$S = H.\ \Delta e/(1+e_0)$$ 3

   b) Sketch the Mohr circles representing active, passive and at-rest conditions and the Mohr-Coulomb failure envelop for a cohessionless soil. 3
   c) Discuss on different types of clay based on the loading/stress condition. Consider pre-consolidation pressure in this classification. Sketch Mohr-Coulomb failure envelops and e-logσ' curve for all types of clay. 4

University of Asia pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: Transportation Engineering 1 **Course Code: CE 351**
Fuil Marks: 150 **Time: 3 Hours**

Instructions:

1. Use separate scripts for each section.
2. Figures in the right margin indicate marks for each question.
3. Notations and symbols used here carry their usual meanings.
4. Assume reasonable values for missing data.

Section-A

(Answer any three questions)

1. a) The following spot speeds (km/hr) were observed for 20 vehicles traversing a segment of a highway. 20
40,31,49,63,45,63,54,46,70,32,44,43,37,47,44.58,52,56, 68,64.
Calculate the design speed, safe speed, median speed and lower limit of speed.
b) Define time-mean speed and space-mean speed. 5

2. a) What is the scope of traffic volume study? 10
b) Design a two-phase signal of a cross-junction for the data given below: 10

Amber	3 sec
Red-amber	2 sec

	N-S	E-W
Inter green	8	7
Lost time	3	2

	Approaches			
	North	South	East	West
Flow, veh/hr	720	750	855	780
Saturation flow veh/hr	2210	2190	2540	2410

Draw the phase diagram.
c) Briefly describe mandatory traffic sign. 5

3. a) What is Traffic Calming Device? Enumerate some traffic calming devices. 13
b) Write down the negative effects/impacts of traffic congestion in Dhaka City and suggest remedial measures. 12

4. a) What are the requirements for an effective bus terminal? 8
b) Write down the objectives of street lighting? 5
c) What are the installation requirements of street lighting? 4
d) An urban primary road with 60 ft pavement width having a reflectance of 12% 8

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013

Course Title: Open Channel Flow **Course No: CE 361**

Time: 3.0 hour **Full Marks: 150**

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

Section A

Marks in this Section: 75

There are **Four (4)** questions in this section. Answer any **Three (3).**

1(a).Prove that the critical depth for triangular channel, $y_c = \sqrt[5]{\frac{2\alpha Q^2}{gz^2}}$. (5)

1(b). Water is flowing at a velocity of 3.0m/s and a depth of 3.5m in a long rectangular channel 6.0mwide. Compute (i) the height of a smooth upward step in the channel bed that will produce critical flow in the channel, and (ii) the depth and change in water level produced by (a) a smooth upward step of 0.4m, (b) a smooth upward step of 0.9m and (iii) a smooth downward step of 0.4m. In all cases, neglect energy losses and take $\alpha = 1.10$. (20)

2(a).Derive the momentum equation for open channel flow. (8)

2(b).Prove that for a hydraulic jump in a horizontal rectangular channel the energy loss (8)

$$h_L = \frac{(y_2 - y_1)^3}{4y_1y_2}$$

2(c).Write short note on (i) submerged jump, (ii) oscillatory jump, (iii) specific force. (9)

3(a).The values of initial depth and the initial velocity in connection with a hydraulic jump in ahorizontal rectangular channel are 0.22m and is 15.58m/s, respectively. Compute the values of y_2 (m), V_2 (m/s), q (m^2/s), Fr_1, Fr_2 and h_L. (12)

3(b). Write down the design steps for the design of a trapezoidal channel by "Tractive Force Method". (8)

3(c).Show that the best hydraulic rectangular section is half of a square. (5)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc in Engineering (Civil)

Course No: CE 363
Full Marks: 150

Course Title: Engineering Hydrology
Time: 3hr

SECTION A

There are **Four (4)** questions and answer any **Three (3)** questions

1. (a)Write short notes on (any four) (i) Climate of Bangladesh. (4×3=12)
   (ii) Consistency test for rainfall records
   (iii) Depth-Duration-Frequency Curve
   (iv) Pan coefficient
   (v) Depression storage

   (b) Distinguish between the following (any two) (3×2=6)
   (i) Cold and warm fronts
   (ii) Infiltration capacity and infiltration rate
   (iii) Field Capacity and Permanent Wilting Point

   (c) Show with neat diagram (any two) (2×3.5=7)
   (i) Life cycle of a frontal cyclone
   (ii) Longitudinal cross section of the general atmospheric circulation
   (iii) How water droplets in clouds form by nucleation

2. (a) A catchment area has six rain gauge stations. In a year the annual rainfall recorded by the gauges are as follows: (10)

Station	P	Q	R	S	T	U
Rainfall(cm)	82.6	102.9	180.3	110.3	98.8	136.7

For a 10% error in the estimation of the mean rainfall, calculate the optimum number of stations in the catchment area.

(b) For a catchment of 600 km^2, Isohyetal drawn for a storm gave the following data: (10)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Project Planning and Management | Course Code: CE401
Time: 3 hour | Full Marks: 50

Section 'A"

(Answer Question No. 4 and any two from this section)

1. (a) What is CPM? Write down the differences between PERT and CPM in a tabular form. (3)
   (b) What is meant by WBS? Why is WBS important in project planning? (2)
   (c) Draw the figure of Project life Cycle and briefly describe each phase. (3)

2. (a) What do you understand by Gantt chart? What is its limitation? (2)
   (b) Write down the major causes of project failure? (3)
   (c) What do you understand by TQM? Describe its features. What are the advantages of having ISO 9000 for an organization? (3)

3. (a)Briefly describe each phases of Quality Improvement (P-D-C-A) Methodology. (2)
   (b) Write down the 7 Principles of Avoiding Accidents of construction industry. (3)
   (c) Name 3 types of procurement method. Describe which procurement method is most acceptable and preferred in general by International Financial Institutions (i.e. World Bank, ADB etc.) and why? (3)

4. (a) What do you understand by 'Time Value of Money'? Describe with example. (2)
   (b)Dr. Chowdhury purchased a car 10 years back at a cost of Tk 5.10 lac whose market value is Tk 6 lac now. It can be used for 3 more years at which time its value will be Tk 3.5 lac. Operation and maintenance expenses are Tk 1.80 lac per year.
   Dr. Chowdhury can purchase reconditioned car with the same functionality for Tk 15 lac. In 3 years the value of this car is estimated to be Tk 8.0 lac. Operation and maintenance expenses will be Tk 36000 per year.
   Should Dr. Chowdhury replace the old car using before Tax MARR of 10%? (6)

Section "B"

(Answer Question No.6 and 8 and any one from this section)

5. (a) From the video of "Burj-Al-Arab" you have seen in the class, state 3 challenges that were encountered by the engineers during its construction. (3)
   (b) What are the points needed to be considered during procurement? (2)
   (b) The following figure shows the cost control of a project. Do the cost analysis and state whether the project cost is overrun or under-run. (3)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering III
Time: 3hrs

Course Code: CE 411 (A)
Full Marks: 10x10=100

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

1. For the truss shown below in *Fig 1*, ignore the zero-force members and apply the boundary conditions to assemble the global stiffness matrix and the global load vector.

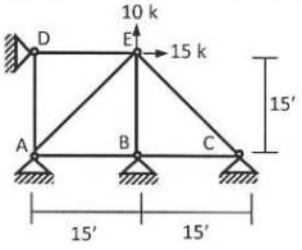


Fig. 1

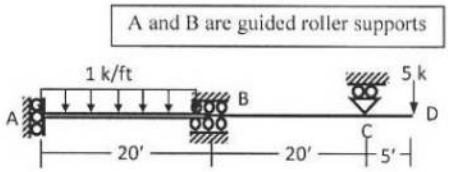


Fig. 2

2.Use Stiffness Method (neglecting axial deformations) to calculate the joint deflection and rotation of the beam shown in *Fig. 2* [Given, EI = $40x10^3$ k-ft^2, $EI_{AB} = 2EI_{BCD}$].

3.For the frame shown below in *Fig. 3*, calculate joint deflections and rotations considering boundary conditions and neglecting axial deformation [Given, E = $500x10^3$ksf, A = 1ft^2, I = 0.10 ft^4].

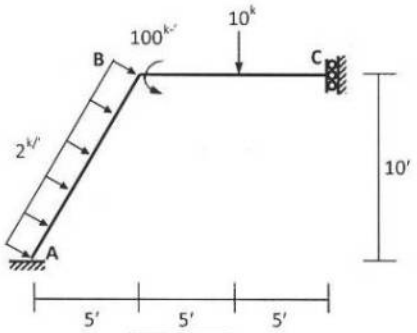


Fig. 3

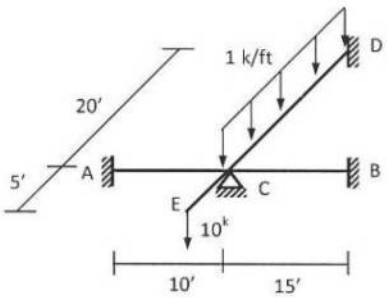


Fig. 4

4.For the grid loaded as shown in *Fig. 4*, use the stiffness method to calculate the rotations at joint C [Given, EI = $40x10^3$ k-ft^2, GJ = $30x10^3$ k-ft^2].

5. In the three-dimensional truss ABCD shown in *Fig. 5*, ignore zero-force members and formulate the stiffness matrix, load vector and write down the boundary conditions [Given, EA/L = constant = 500 k/ft]

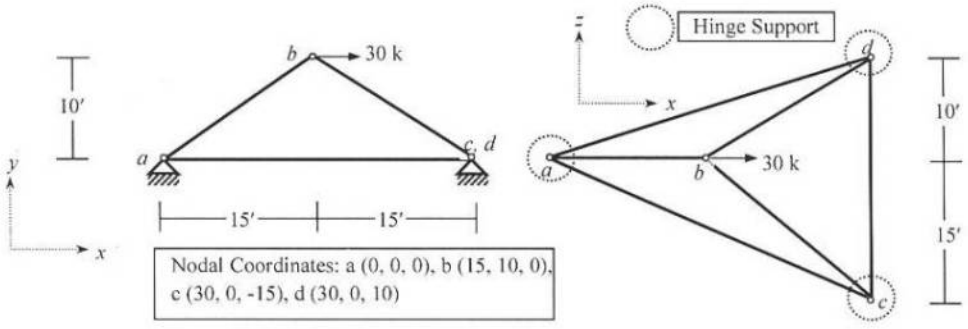


Fig. 5

6.Use Stiffness Method to calculate the deflection and rotation of beam ABC loaded as shown below in *Fig. 6*, considering flexural deformations only with geometric nonlinearity[Given: EI = $54x10^3$ k-ft^2].

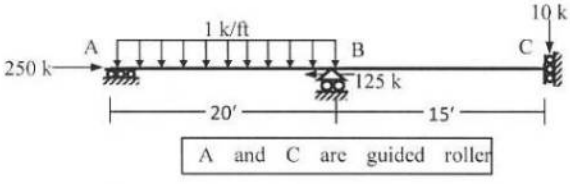


Fig. 6

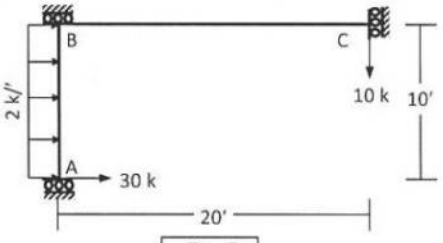


Fig. 7

7. Use the Stiffness Method (considering geometric nonlinearity) to calculate the joint deflections and rotations of the frame loaded as shown below in *Fig. 7* [Given: EI = 50×10^3 k-ft^2].

8. Use the Energy Method to calculate the plastic moment M_p needed to prevent the development of plastic hinge mechanism in the beam ABCD loaded as shown in *Fig. 8* [Given, $M_{p(AB)} = M_{p(BC)} = M_p$, $M_{p(CD)} = 2M_p$].

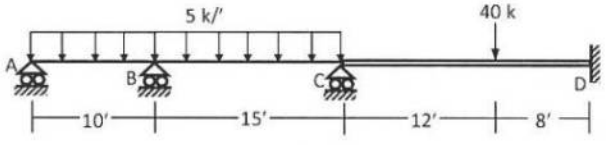


Fig. 8

9. Use bending moment diagram of the beam ABCD loaded as shown in *Fig. 9* to calculate the force P needed to develop plastic hinge mechanism [Given, $\sigma_{yp} = 40$ ksi].

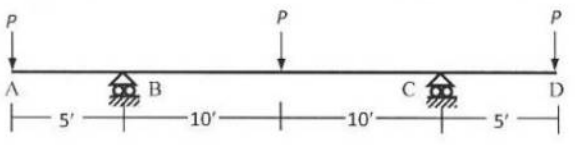
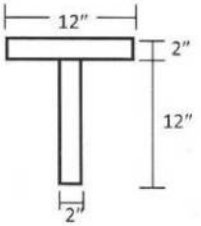


Fig. 9



10. For the plane truss shown in *Fig. 1*, ignore zero-force members to calculate its natural frequencies using consistent mass matrices [Given, E = 30000 ksi, A = 2 in^2, m = 1.5×10^{-6} k-sec^2/in^2].

11. For the beam shown in *Fig. 6*, calculate the approximate first natural frequency in transverse direction using lumped mass matrices [Given, EI = $54X10^3$ k-ft^2 ,m = 0.0045 k-sec^2/ft^2].

12. For the beam loaded as shown in *Fig. 10*, use the Stiffness Method to calculate vertical deflections (with no rotation) at joint A and B, if A is supported by a circular foundation of radius 3-ft on sub-soil (half-space) [Given, Unit weight of soil = 0.12 k/ft^2, shear wave velocity (v_s) = 1000 ft/sec ,Poisson's ratio =0.25, EI = 40×10^3 k-ft^2].

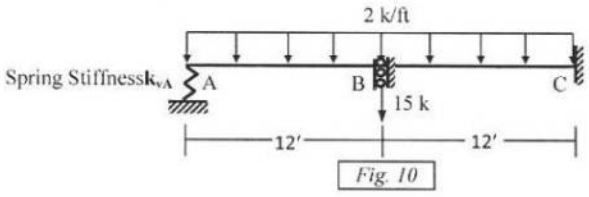


Fig. 10

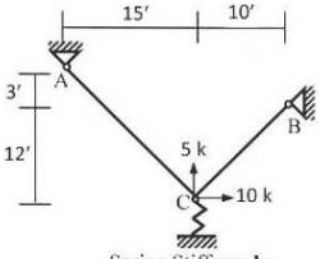


Fig. 11

13. Use the Stiffness Method to calculate the horizontal and vertical deflections at joint *C* of the plane trusses loaded as shown in *Fig 11*, if A is supported by a circular foundation of radius 2-ft on sub-soil (half-space) [Given, Unit weight of soil =0.12 k/ft^2, Poisson's ratio =0.25, shear wave velocity (v_s) = 500 ft/sec, S_x of truss members = 10×10^3 k/ft].

14. Determine the size of the stiffness matrices (with and without considering boundary conditions) of the 2D frame and 3D frame shown in *Fig. 12*. Also determine the size of the stiffness matrices if axial deformations are neglected.

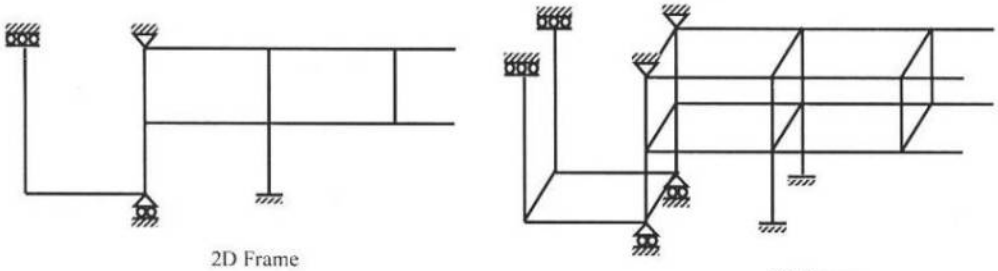


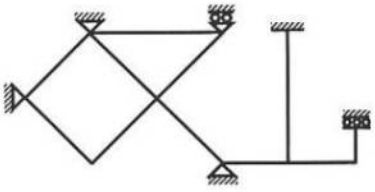
Fig. 12

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013 (Set 2)
Program: B. Sc. Engineering (Civil)

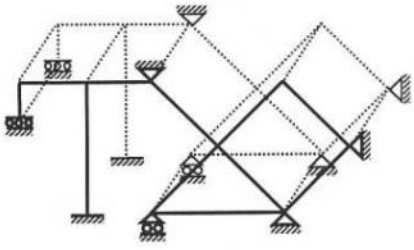
Course Title: Structural Engineering III | Credit Hours: 3.0 | Course Code: CE 411 (B)
Time: 3 hours | Full Marks: 100 (= 10 × 10)

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

1. Determine the degree of kinematic indeterminacy (*doki*) and show the corresponding deflections and rotations of the 2D frame and 3D frame shown in Fig. 1 as per the following conditions
   (i) With and without considering the boundary conditions
   (ii) If axial deformations are neglected.



2D Frame



3D Frame

Fig. 1

2. Fig. 2 shows a plane truss whose joints *b* and *h* deflect 0.50′ to left and right respectively due to the forces applied.

   Calculate the

   (i) Axial force in all members,

   (ii) Applied forces P_1 and P_2

   [Given: S_x = constant = 500 k/ft].

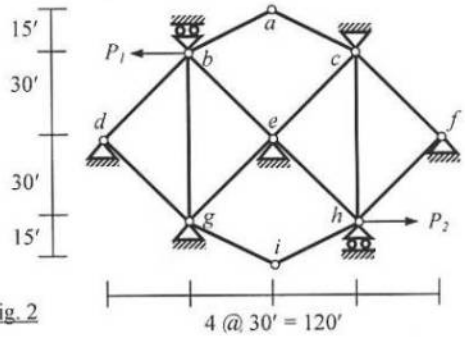
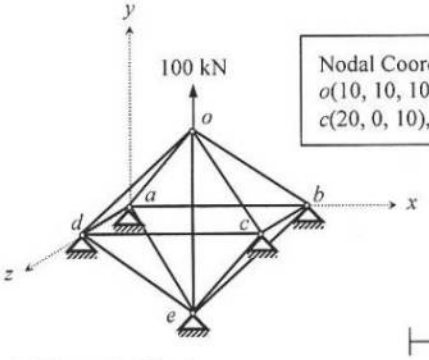


Fig. 2

3. Ignore zero-force members to form the stiffness matrix, load vector and write down the boundary conditions of the 3D truss *oabcde* shown in Fig. 3

   [Given: S_x = constant = 10 kN/mm].



Nodal Coordinates (m) are
o(10, 10, 10), *a*(0, 0, 0), *b*(20, 0, 0),
c(20, 0, 10), *d*(0, 0, 10), *e*(10, −10, 10)

Fig. 3

4. Formulate the stiffness matrix of grid *abcdef* shown in Fig. 4

   [Given: $EI = 80 \times 10^3$ k-ft^2, $GJ = 60 \times 10^3$ k-ft^2].

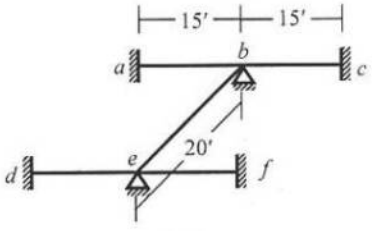


Fig. 4

5. Consider axial and flexural deformations to assemble the stiffness matrix, load vector and specify boundary conditions of the beam *abc* loaded as shown in Fig. 5, if $P = 10$ k, $E_{(abc)} = 400 \times 10^3$ k/ft^2 and springs at *a*, *b*, *c* represent circular foundations of radius 2-ft on the surface of sub-soil (half-space) with shear modulus $G_s = 150$ k/ft^2 and Poisson's ratio $\nu = 0.30$.

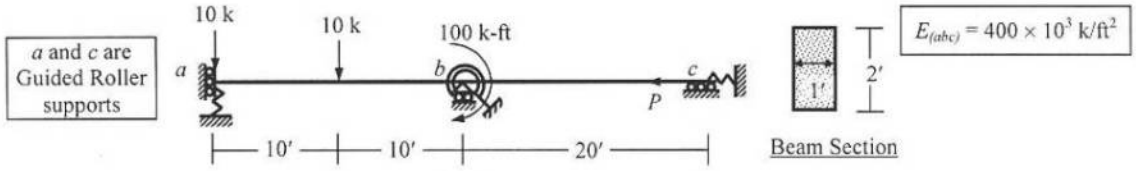


Fig. 5

6. Depending on the stiffness of springs at *a*, *b* and *c*, the beam *abc* in Fig. 5 can take the forms shown in Fig. 6(i) and 6(ii). Determine the
   (A) Stiffness of springs at *a*, *b*, *c* for *abc* to take the forms shown in Fig. 6(i) and 6(ii)
   (B) Axial deformations at the joints in Fig. 6(i) and 6(ii), if $P = 10$ k.

Beam Section

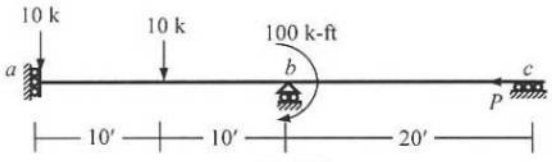


Fig. 6(i)

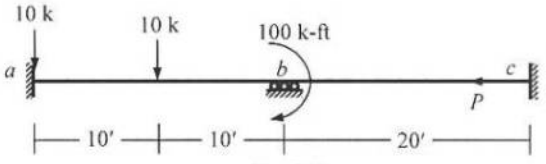


Fig. 6(ii)

7. Consider flexural deformations and geometric nonlinearity to calculate the joint deflections and rotations of the beam *abc* shown in Fig. 6(i), if $P = 300$ k.

8. Consider flexural deformations and geometric nonlinearity to calculate the critical buckling force *P* of the frame *abcde* shown in Fig. 7.

9. Consider flexural deformations only to calculate the natural frequencies of the frame *abcde* shown in Fig. 7
   [Given: Weight per unit length = 1 k/ft].

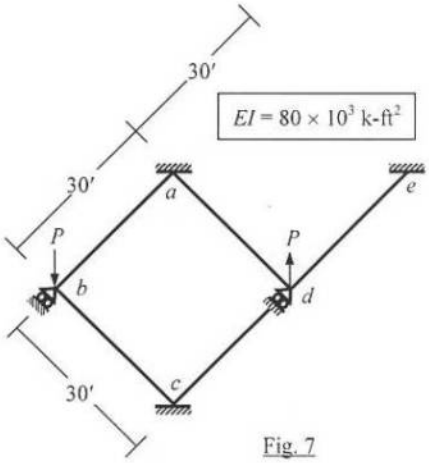


Fig. 7

10. Fig. 8 shows a 6-in thick (20′ × 10′) rigid concrete flat slab being supported by four 10-ft long concrete columns of 10-in diameter. If the slab also carries additional weight of 150 psf, calculate the
    (i) Axial force on each column (if $V = 0$),
    (ii) Natural frequency of the slab-column system for horizontal vibration (considering flexural deformations and geometric nonlinearity).

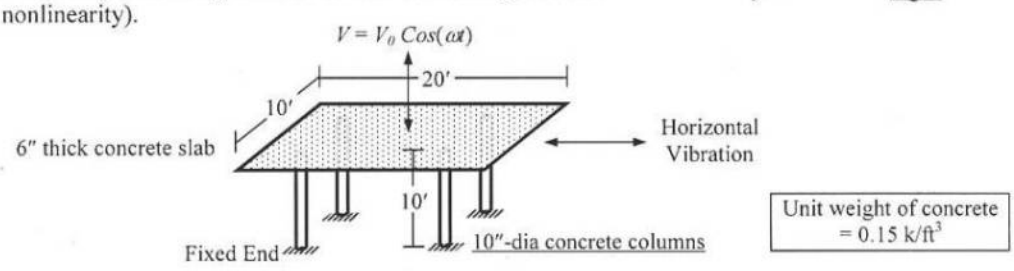


Fig. 8

11. Use Constant Average Acceleration (*CAA*) Method (considering axial deformations only) to calculate the vertical deflection of the column-supported rigid concrete slab shown in Fig. 8, at time $t = 0.01$ sec after starting from rest, if it is subjected to vertical force $V = 50 \, Cos(10t)$
    [Given: Damping ratio of the slab-column system = 5%, Unit weight of concrete = 0.15 k/ft^3].

12. For the frame *abcde* loaded as shown in Fig. 9, use the Energy Method to calculate the required
    (i) Loads F_0, w_0 and P_0 to form plastic hinge mechanism of beam *bcd* and columns *ab*, *ed*
    (ii) Yield strength (f_y) of the material.

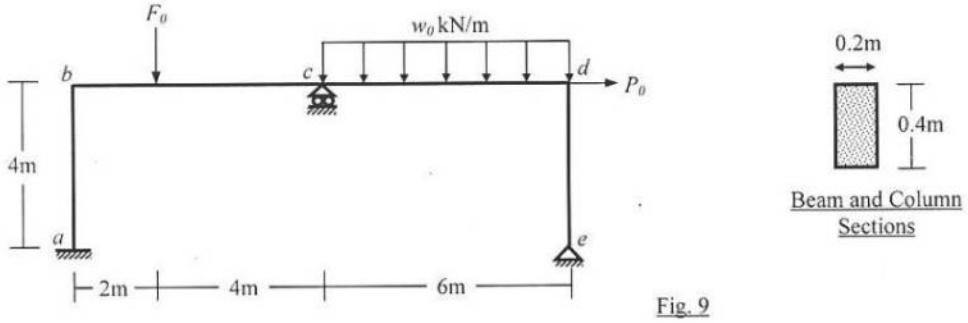


Fig. 9

13. Use bending moment diagram to calculate the force P needed to develop plastic hinge mechanism in the (statically indeterminate) reinforced concrete beam *abc* loaded as shown in Fig. 10 [Given: $f_c' = 4$ ksi, $f_y = 60$ ksi].

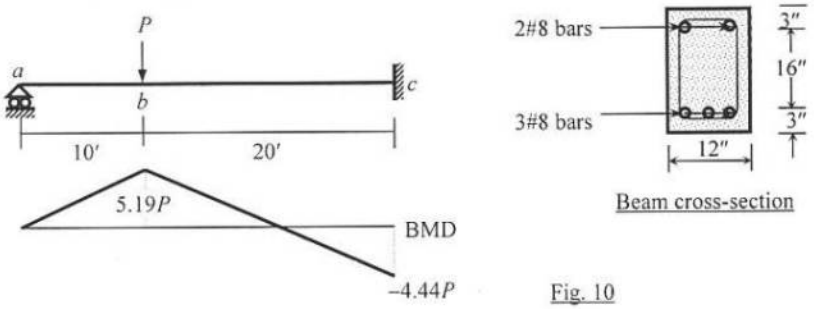


Fig. 10

14. Briefly explain the
    (i) Difference between the structural analysis of a 3D truss and grid (considering member properties and joint deflections/rotations)
    (ii) Basic difference between linear and nonlinear analysis of structures
    (iii) Process to calculate the plastic moment (M_p) of a cross-section
    (iv) Basic assumption of the Constant Average Acceleration method of numerical time-step integration
    (v) Parameters required to calculate the stiffness of foundations.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall – 2013
Program: B. Sc. Engineering (Civil)

Course Title: Geotechnical Engineering II | Course Code: CE 441
Time: 3 hours | Full Marks: 120 (20 X 6 = 120)

Answer any 6 (six) of the following 8 (eight) questions

1. (a) What is subsurface exploration in terms of geotechnical engineering? Give two reasons as to why subsurface exploration is required in geotechnical engineering. 4

   (b) Write down the preliminary information that would be important to execute geotechnical subsurface exploration for a building and for a bridge project. 4

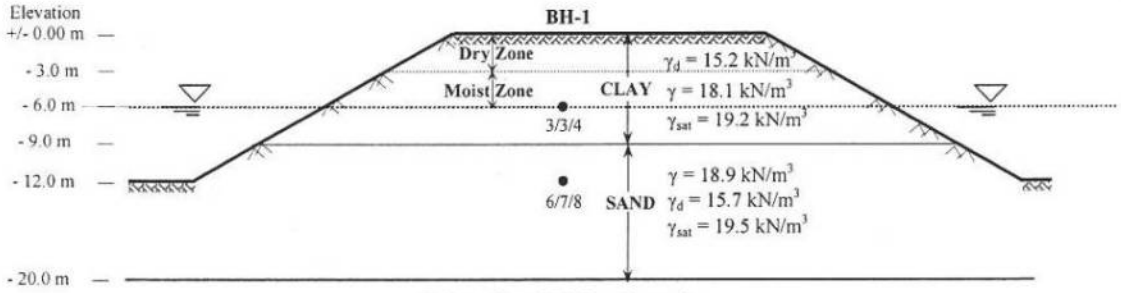
   (c) Write down any two general guidelines used for the selection of depth and location of boreholes for typical civil engineering projects. 4

   (d) Write short notes on (any two): 4 x 2=8

   (i) Wash Boring (ii) Dilatometer Test (iii) Ground Water Table

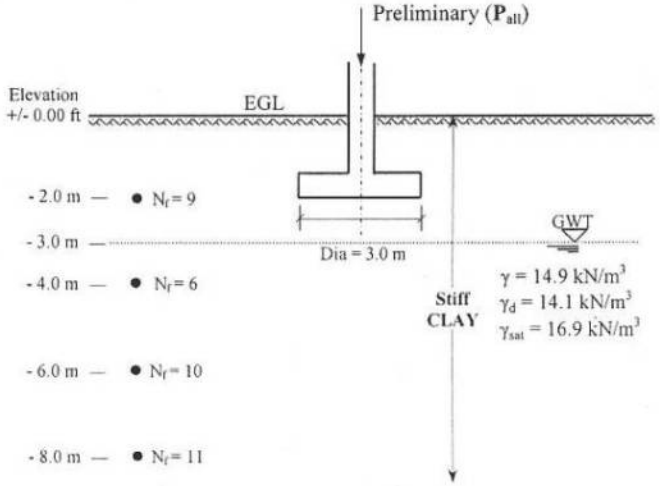
2. (a) Discuss, in brief, Standard Penetration Test (SPT). 4

   (b) A borehole was advanced as a part of a preliminary geotechnical investigation for a site in Bangladesh as shown below. Determine cohesion and angle of internal friction at corresponding depths of the clay and sand deposits, respectively, based on the available data (Use empirical correlations as provided in **Appendix**). Use hammer efficiency as 57%. 9



Subsurface Soil Stratigraphy

   (c) Using Terzaghi's bearing capacity equation (as appropriate), calculated the preliminary allowable column load for the conditions as shown below. Use FS = 3. Note that no laboratory test was conducted to obtain the shear strength of the clay formation. So, use empirical correlation to estimated design shear strength. Assume CF60 = 1.0. 7



University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: Transportation Engineering II: Highway Design & Railways — Course Code: CE 451
Time: 3 Hours — Full Marks: 150

Section- A :Answer any 3 (Three) out of 4 (Four)

1. (a) Define Gauge. Why a country should have a uniform gauge? (3+10)
   (b) Write down the functions of the rail. What are the advantages of flat footed rail? What does it mean by 45 kg rail and what will be the maximum axle load for it? (5+4+3)

2. (a) Why coning of the wheel is done? What are the advantages of tilting of the rail? What are the advantages and the disadvantages of the concrete sleeper? (3+3+8)
   (b) What are the functions of the ballast? Write short note on Marshaling yard? If the sleeper spacing is found to be 20 in. for 10 in. wide sleeper, what will be the required depth of the ballast? (5+4+2)

3. (a) Why a curve is provided on the railway track? Write down the relationship between radius and versine of a curve. What is Cant deficiency and Cant excess? (3+5+3)
   (b) What is the function of points and crossing? Sketch a right hand turnout showing different parts of it. (2+6)
   (c) A 5 degree curve branches off from a 3 degree main curve in an opposite direction in the layout of a B.G yard. If the speed on the branch line is restricted to 40 kmph, determine the speed restriction on the main line. Assume permissible deficiency in cant as 76 mm. (6)

4. (a) Write short note on Semaphore signal, Permissive signal and Calling-on signal. What are the essential principles of Interlocking? (9+4)
   (b) Why a track should be maintained properly? Why low cost road is important? Write short note on Bituminous soil stabilized road and Cement stabilized road. (4+3+5)

Section- B :Answer any 3 (Three) out of 4 (Four)

5. (a) Write down the types of the pavement. Define reliability and serviceability concept? What should be the desirable characteristics of the pavement? (2+8+5)
   (b) What is ESAL? What does it mean by CMS-2h? (2+3+5)
   From a California Bearing Ratio (CBR) test the load against the penetration of 0.1 in. and 0.2 in. was found to be 150 lb and 250 lb respectively. If the diameter of the penetrating piston is 1.95 in. then calculate the CBR value for the sub-grade soil sample.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course title: Irrigation and Flood Control | Course code: CE 461
Time: 180 minutes | Full marks: 100

There are TWO sections in the question paper namely "SECTION A" and "SECTION B". You have to answer from the both sets according to the instruction mentioned on each section.

SECTION A
MARKS: 72

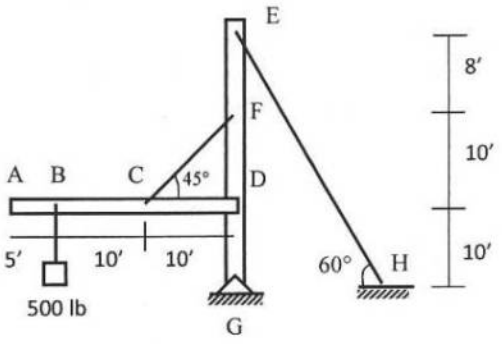
There are SIX (6) questions. Answer question no. 01 (COMPULSORY) and any THREE (3) from the rest. (Assume any missing data.)

1. a) Define irrigation. Write the benefits of irrigation and the harmful effects of excess irrigation. 2+4
   b) What are the different methods of irrigation water distribution? Describe sprinkler irrigation method along with its advantages and disadvantages. 2+4
   c) Explain the delta formation process and how delta formation process relates to flood. 6

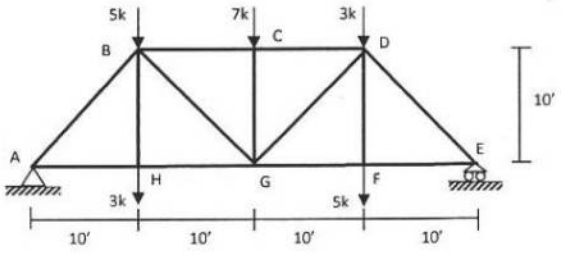
2. a) Explain marginal bunds. What are the purposes of marginal bunds? 2+2
   b) Determine the volume of water required to be diverted from the head works to irrigate an area of 5000 hectares using the data given in the table below. Assume 80% as the effective precipitation to take care of the consumptive use of the crop. Also assume 50% efficiency of water application in the field and 75% as the conveyance efficiency of canal. 14

Month	Temperature (°F)	% hours of sunshine	Rainfall (mm)	Consumptive Coefficient or Crop factor (k)
June	70.8	9.90	75	0.80
July	74.4	10.20	108	0.85
August	72.8	9.60	130	0.85
September	71.6	8.40	115	0.85
October	69.3	7.86	105	0.65
November	55.2	7.25	25	0.65
December	47.1	6.42	0	0.60
January	48.8	8.62	0	0.60
February	53.9	9.95	0	0.65
March	60.0	8.84	0	0.70
April	62.5	8.86	0	0.70
May	67.4	9.84	0	0.75

4. Calculate the force in cables EH and CF in the structure shown below (Neglect the self-weight of the members).

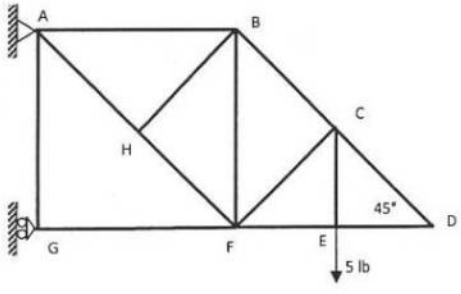


5. Find the forces in members AB, BG, DG and DE of the following truss.

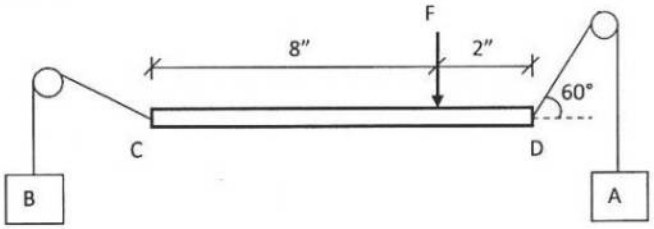


6. A cable weighing 2 lb per ft. is 400 ft long. The distance between the points of support, which are on a horizontal, is 398 ft. Compute the sag and the maximum tension in the cable.

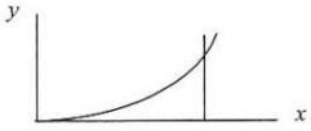
7. Determine the member forces in CD, ED, EF, BH and AG for the following truss.



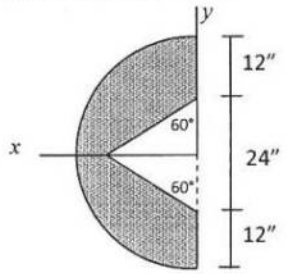
8. In the Fig. below, A is a weight of 100 lb., CD is a rigid, uniform body weighing 50 lb., and the pegs are smooth. If CD remains in horizontal position, determine F and the weight B for equilibrium.



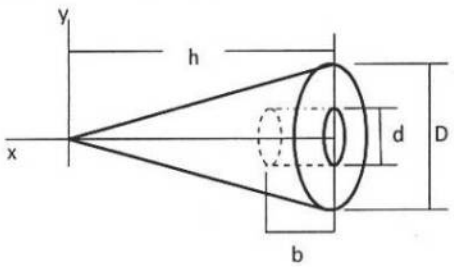
9. Locate the centroid of the area included between the parabola $x^2 = 4y$ and the line $x = 9$.



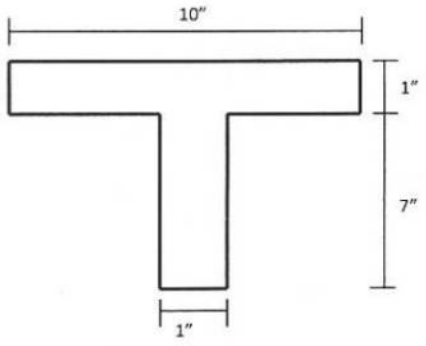
10. Determine $\bar{x}$ for the shaded area shown below.



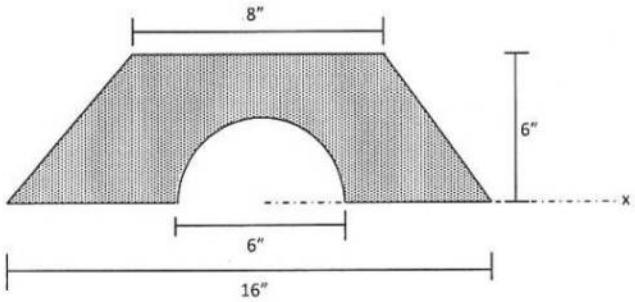
11. A right circular cone of homogenous material has a diameter D = 20″, a height h = 30″. A cylindrical hole, whose geometric axis is coincident with that of cone, is bored in the base. This hole has a diameter d = 8″ and a depth b = 6″. Locate the center of gravity of the cone with the hole. Figure is given below.



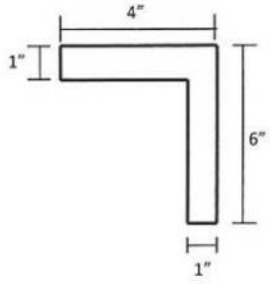
12. Find the moment of inertia of a T-section shown below about centroidal x axis.



13. For the shaded area shown below compute I_x.



14. For angle section shown in Fig below has $\overline{I_x}$ = 30.8 in4 and $\overline{I_y}$ = 10.8 in^4 and $\overline{P_{xy}}$= -10 in^4. Determine the minimum radius of gyration.



b) Write down ten indicators of global warming. 2

c) Draw the schematic diagram of "Earth climate system and greenhouse effect". 2

5. a) What is renewable energy? What are the different sources of renewable energy? 2

b) Explain TWO sources of renewable energy that, in your opinion, have the potential for meeting long term energy demands in Bangladesh. Justify why these two selected renewable energy sources are economically, socially and environmentally suitable for Bangladesh. 4

SECTION B
MARKS: 25

Answer any FIVE (5) from the following SIX (6) questions

1. a) What do you understand by sustainability and sustainable construction? Explain the effect of fly ash in cement. 3

b) What are the disciplines of Civil Engineering? 2

2. a) What is procurement? What are the 3 types of procurements? Discuss the process of engaging a Contractor for a Bridge Construction Project. 3

b) What are the structures Transportation Engineers normally design and construct? 2

3. a) Draw a complete Road Section showing layers and materials. 2

b) Modulus of elasticity of a rubber is 15 MPa and the rubber is pulled to elongate 20 mm. The original length of the rubber is 100 mm. Using Hook's Law find out the stress at which the rubber was pulled. 3

4. a) Define civil engineering processes. Explain the importance of Civil Engineering. 2

b) Explain with examples the reasons for collapse of buildings in civil engineering point of view 3

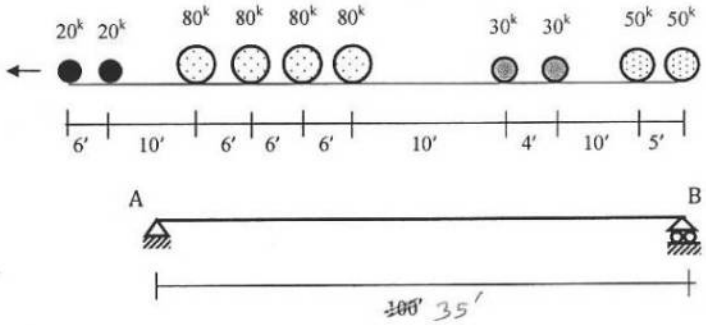
5. a) Discuss the role of Geotechnical Engineers. Why do we need to construct piles for foundation? 3

b) Explain different types of foundations for buildings and bridges? 2

6. Write short note on any TWO of the following 5

a) Soil classification, b) Construction management, e) Roof truss.

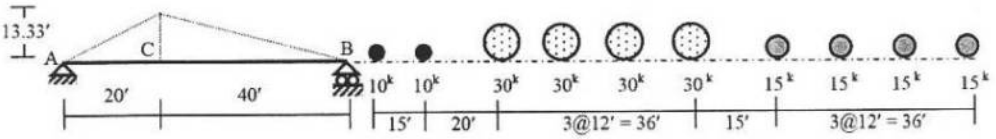
5. Calculate the maximum reaction at support A of the beam due to the moving series load shown below.



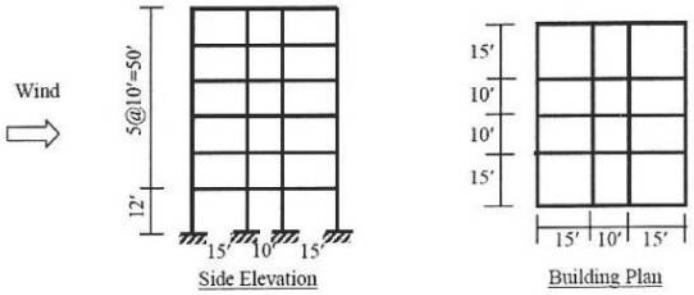
6. Calculate the maximum shear at 25' right of support A for the beam and the moving loads in question no. 5.

7. Calculate the maximum moment at mid span of the beam of question no. 5 for the moving loads in that question.

8. Calculate the *Greatest Maximum Moment* and its location for the wheel load arrangement shown below. Influence line for M_c is shown.

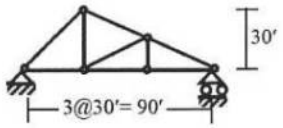


9. Calculate the wind load at each story of a six-storied hospital building (shown below) located at a flat terrain in Dhaka. Assume the structure to be subjected to Exposure B.

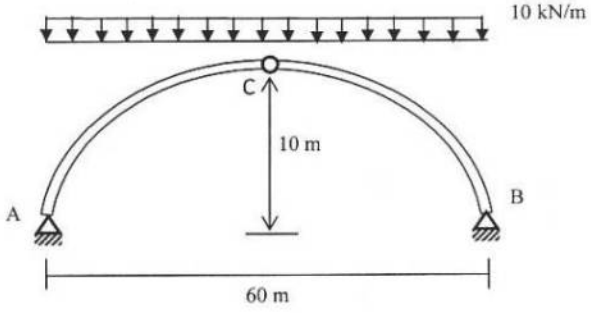


10. Use the Equivalent Static Force Method to calculate the seismic load at each story of a six-storied hospital building (question no. 9) located in Chittagong. Assume the structure to be an Ordinary Moment Resisting Frame (OMRF) built on soil condition S_2, carrying a Dead Load of 150 lb/ft^2 and Live Load 40 lb/ft^2.

11. Calculate the wind load at each joint on the industrial truss shown below if it is located at a flat terrain in Khulna at Exposure B and the wind blows (i) from left, (ii) from right.

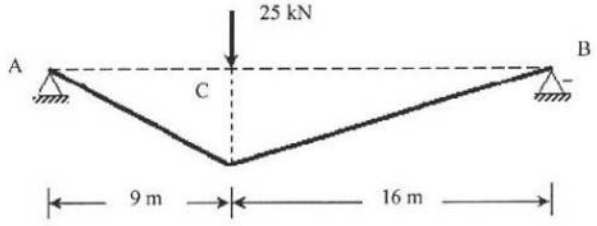


12. A three-hinged parabolic arch of uniform cross section has a span of 60 m and a rise of 10 m. It is subjected to uniformly distributed load of intensity 10 kN/m as shown below. Show that the bending moment is zero at any cross section of the arch.



13. Derive the *General Cable Theorem.*

14. A 35 m cable is supported at ends A and B which are at the same horizontal level and are 25 m apart. A vertical load of 25 kN is acting at point C which is at a distance of 9 m from A. Calculate the horizontal reaction at A and the dip at C.



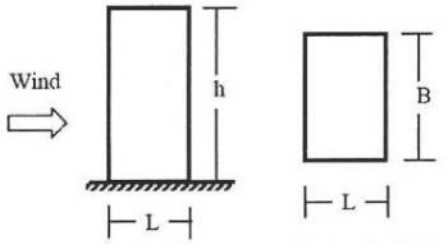
Useful Data:

Height z (ft)	C_G (for non-slender structures)		
	Exp A	Exp B	Exp C
0~15	1.654	1.321	1.154
50	1.418	1.215	1.097
100	1.309	1.162	1.067
150	1.252	1.133	1.051
200	1.215	1.114	1.039
300	1.166	1.087	1.024
400	1.134	1.070	1.013
500	1.111	1.057	1.005
650	1.082	1.040	1.000
1000	1.045	1.018	1.000

Height z (ft)	C_z		
	Exp A	Exp B	Exp C
0~15	0.368	0.801	1.196
50	0.624	1.125	1.517
100	0.849	1.371	1.743
150	1.017	1.539	1.890
200	1.155	1.671	2.002
300	1.383	1.876	2.171
400	1.572	2.037	2.299
500	1.736	2.171	2.404
650	1.973	2.357	2.547
1000	2.362	2.595	2.724

Category	C_I
Essential facilities	1.25
Hazardous facilities	1.25
Special occupancy	1.00
Standard occupancy	1.00
Low-risk structure	0.80

Location	V_b (mph)
Dhaka	130
Chittagong	160
Rajshahi	95
Khulna	150



h/B	L/B					
	0.1	0.5	0.65	1.0	2.0	≥ 3.0
≤ 0.5	1.40	1.45	1.55	1.40	1.15	1.10
1.0	1.55	1.85	2.00	1.70	1.30	1.15
2.0	1.80	2.25	2.55	2.00	1.40	1.20
≥ 4.0	1.95	2.50	2.80	2.20	1.60	1.25

Table 4: Response Modification Coefficient, R for Structural Systems

Basic Structural System	Description Of Lateral Force Resisting System	R
(a) Bearing Wall System	Light framed walls with shear panels	6~8
	Shear walls	6
	Light steel framed bearing walls with tension only bracing	4
	Braced frames where bracing carries gravity loads	4~6
(b) Building Frame System	Steel eccentric braced frame (EBF)	10
	Light framed walls with shear panels	7~9
	Shear walls	8
	Concentric braced frames (CBF)	8
(c) Moment Resisting Frame System	Special moment resisting frames (SMRF)	
	(i) Steel	12
	(ii) Concrete	12
	Intermediate moment resisting frames (IMRF), concrete	8
	Ordinary moment resisting frames (OMRF)	
	(i) Steel	6
	(ii) Concrete	5
(d) Dual System	Shear walls	7~12
	Steel EBF	6~12
	Concentric braced frame (CBF)	6~10
(e) Special Structural Systems	According to Sec 1.3.2, 1.3.3, 1.3.5 of BNBC	

Table 5: Site Coefficient, S for Seismic Lateral Forces

Site Soil Characteristics		Coefficient, S
Type	Description	
S_1	A soil profile with either: A rock–like material characterized by a shear–wave velocity greater than 762 m/s or by other suitable means of classification, or Stiff or dense soil condition where the soil depth exceeds 61 meters	1.0
S_2	A soil profile with dense or stiff soil conditions, where the soil depth exceeds 61 meters	1.2
S_3	A soil profile 21 meters or more in depth and containing more than 6 meters of soft to medium stiff clay but not more than 12 meters of soft clay	1.5
S_4	A soil profile containing more than 12 meters of soft clay characterized by a shear wave velocity less than 152 m/s	2.0

The pressure coefficient C_p for the windward surfaces of trusses

$C_p = -0.7$, for $0 \le \alpha \le 20°$

$C_p = (0.07\alpha - 2.1)$, for $20° \le \alpha \le 30°$

$C_p = (0.03\alpha - 0.9)$, for $30° \le \alpha \le 60°$

$C_p = 0.9$, for $60° \le \alpha \le 90°$

For leeward surface, $C_p = -0.7$, for any value of α

6. Use Flexibility Method to calculate the forces in all members of the truss *abcdefg* shown in Fig. 6, if support *d* settles 0.03-m downward [Given: EA/L = constant = 5000 kN/m].

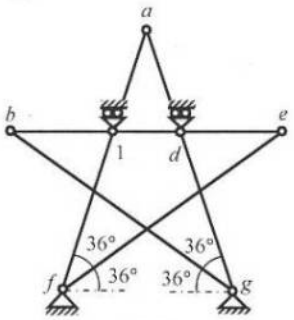


Fig. 6

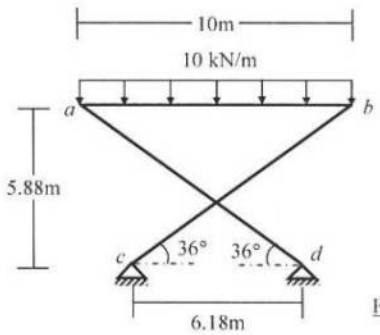


Fig. 7

7. Use the Flexibility Method (considering flexural and axial deformations only) to draw the Bending Moment Diagram of the frame *abcd* loaded as shown in Fig. 7
[Given: EI = constant = 40×10^3 kN-m^2, EA = constant = 4×10^6 kN].

8. Use Flexibility Method (considering flexural deformations only) to draw the bending moment diagram of the beam loaded as shown in Fig. 8 Given: $EI_{efg} = 2EI_{abcde} = 40 \times 10^3$ k-ft^2].

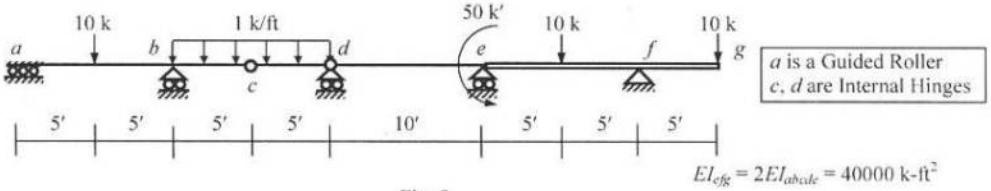


Fig. 8

9. Use the Moment Distribution Method to calculate the joint moments and draw the bending moment diagram of beam *abcdefg* loaded as shown in Fig. 8.

10. For the beam *abcdefg* shown in Fig. 9, draw the qualitative influence lines of support reactions R_a, R_e, shear forces $V_{b(Left)}$, $V_{b(Right)}$ and bending moments M_a, M_e, M_f.

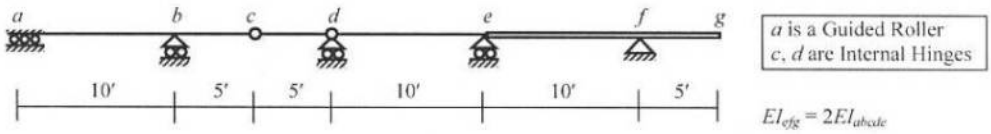


Fig. 9

11. For the beam *abcdefg* shown in Fig. 9, calculate the maximum value of R_d (reaction at support *d*) for a uniformly distributed dead load of 1 k/ft, a moving uniformly distributed load of 0.5 k/ft and a moving concentrated load of 5 k.

12. Use the Moment Distribution Method to calculate the joint moments and draw the bending moment diagram of the frame *abcd* shown in Fig. 10, if in addition to the applied load, supports *a* and *d* both settle 0.03-m downward.

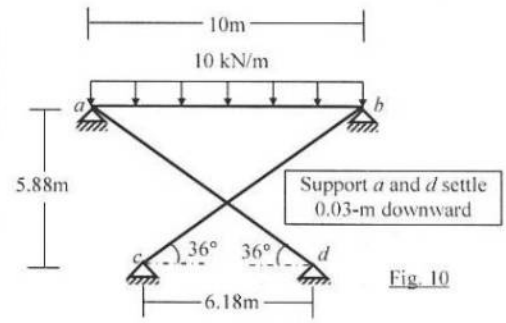
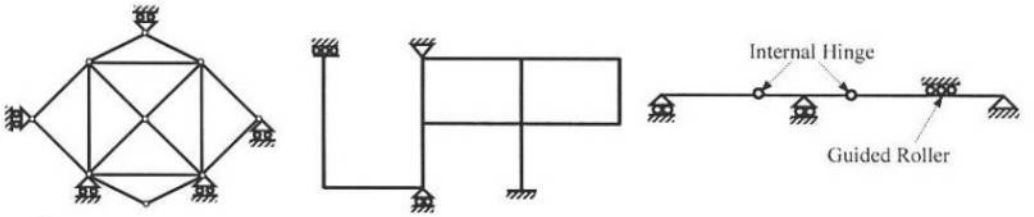


Fig. 10

13. Determine the size of flexibility matrix for the structures shown in Fig. 11.
Also convert them to statically determinate structures to be used in 'Case 0' of Flexibility Method.



2D Truss 2D Frame Beam

Fig. 11

14. (i) Mention the main advantage and limitation of the Moment Distribution Method.
(ii) What is the advantage of using modified stiffness in the Moment Distribution Method?
(iii) What is the difference between statically determinate and indeterminate structures in terms of the effect of support settlement?
(iv) Mention two differences between the Flexibility Method for 3D Trusses and 3D Frames (in terms of *dosi* and the forces/moments calculated).
(v) Explain (using influence line) why the placement of live load is different for calculating maximum positive moments and negative moments in a continuous beam.

b) What is the purpose of Strength reduction factor (φ)? Why φ is lesser for shear than bending? (2)

c) Calculate the value of β_1, if (i) $f'_c = 6000$ psi and (ii) $f'_c = 3000$ psi. (2)

3. Design a T beam for the floor system shown in Fig 3. Given, $M_D = 200$ k-ft, $M_L = 425$ k-ft, $f'_c = 3000$ psi, $f_y = 60000$ psi and simple span= 18 ft. (10)

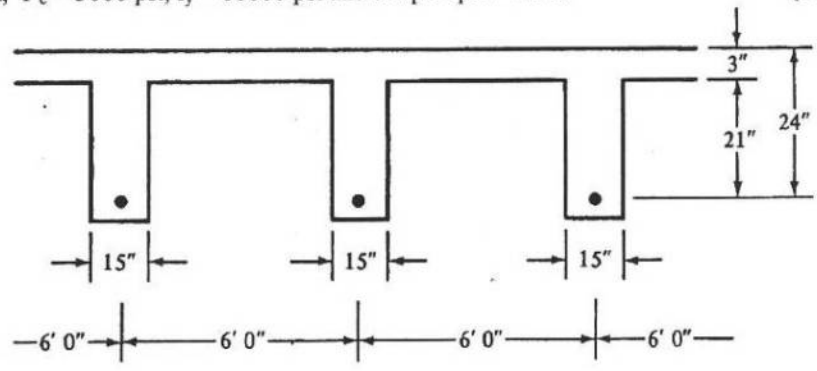


Fig 3

4. Design the beam (Fig 4) for shear with a 4 k/ft DL over entire span and two concentrated 20 kip LL. Also show the stirrup spacing over the longitudinal half section. Use #3 U stirrups. Given, $f'_c = 4000$ psi, $f_y = 60000$ psi. (10)

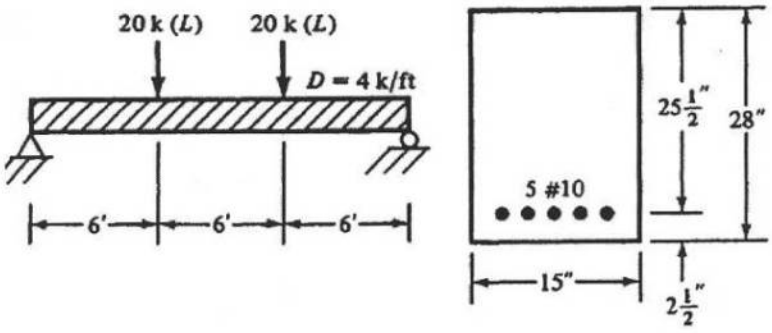


Fig 4

Section B

5. a) Compute the design strength of the beam shown in Fig 5, if , $f'_c = 4000$ psi, $f_y = 60000$ psi. (6)

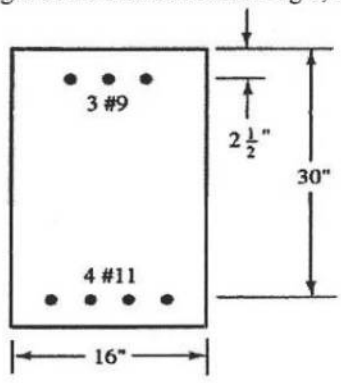


Fig 5

b) Calculate the theoratical cut-off points for first 2 bars out of total 6-#9 bars on each end of the beam shown in Fig 6. Given, $f'_c = 4000$ psi, $f_y = 60000$ psi. (4)

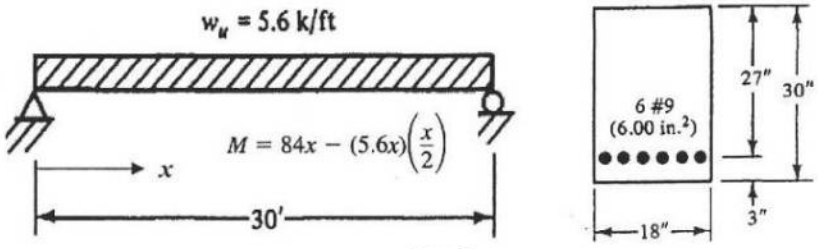


Fig 6

6. a) Calculate the value of V_c at a distance 4 ft from the left end of the beam shown in Fig 7. Given, DL = 4 k/ft, LL = 6 k/ft, $f'_c = 4000$ psi, $f_y = 60000$ psi. Use the ACI equation. (5)

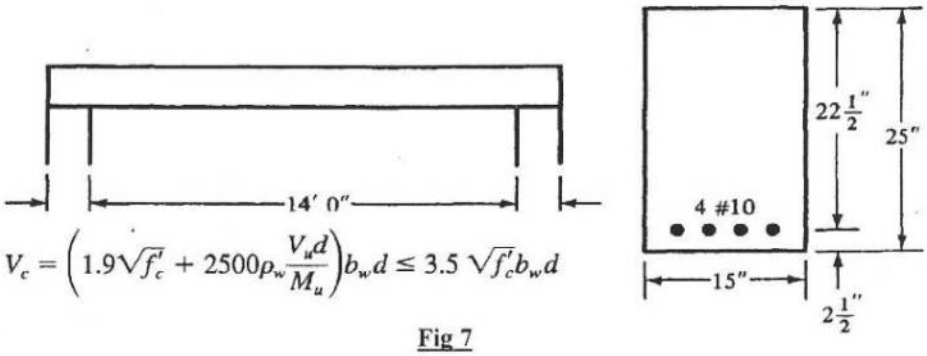


Fig 7

b) Define development length. Explain the relationship of (i) location of reinforcement (ii) Coating of bars and (iii) size of reinforcing with development length by means of the factors Ψ_t, Ψ_e and Ψ_s. (5)

7. Determine the development or embedment length required for the epoxy-coated bars of the normal weight concrete beam shown in Fig 8. Given, $f'_c = 4000$ psi, $f_y = 60000$ psi.
   a) If the bars are straight, assuming $K_{tr} = 0$. (2)
   b) If a 90° hook is used. (show the hook dimensions beyond critical section) (4)
   c) If a 180° hook is used. (show the hook dimensions beyond critical section) (4)

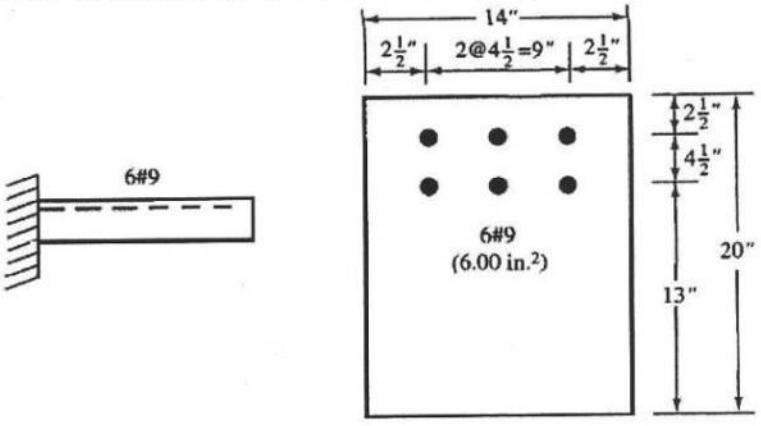


Fig 8

8. A reinforced concrete one way slab is built integrally with its supports and consists of two equal spans. The slab panels are continuous in one direction and each panel has a clear span of 15 ft (Fig 9). The service live load is 120 psf and 4000 psi concrete is specified for use with steel with a yield stress equal to 60000 psi. Design the slab and show the reinforcement detailing. Note, this slab is okay for serviceability. Use, ACI moment co-efficient (shown on the top of the longitudinal slab sections). (10)

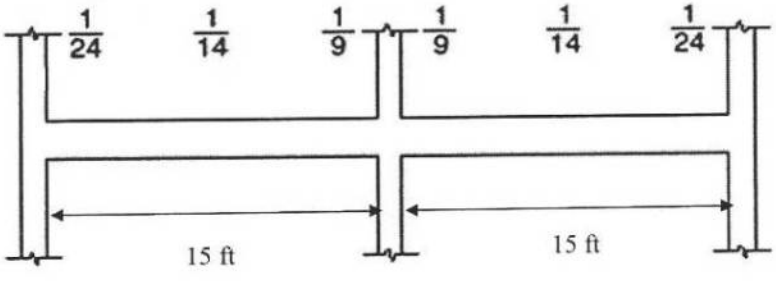


Fig 9

Formulae:

$$\phi M_n = M_u = \phi A_s f_y d\left(1 - \frac{1}{1.7}\frac{\rho f_y}{f_c'}\right)$$

$$\rho = \frac{0.85 f_c'}{f_y}\left(1 - \sqrt{1 - \frac{2R_n}{0.85 f_c'}}\right)$$

$$\phi = 0.65 + (\varepsilon_t - 0.002)\left(\frac{250}{3}\right)$$

$$\frac{M_u}{\phi b d^2} = \rho f_y\left(1 - \frac{1}{1.7}\frac{\rho f_y}{f_c'}\right)$$

$$A_{s\,\min} = \frac{3\sqrt{f_c'}}{f_y} b_w d$$

nor less than $\dfrac{200 b_w d}{f_y}$

$$A_s f_y = 0.85 f_c' \beta_1 c b + A_s'\left(\frac{c - d'}{c}\right)(0.003)(29{,}000)$$

$$M_n = A_{s1} f_y\left(d - \frac{a}{2}\right) + A_{s2} f_y (d - d')$$

$$\beta_1 = 0.85 - \left(\frac{f_c' - 4000}{1000}\right)(0.05) \geq 0.65$$

$$\frac{\ell_d}{d_b} = \frac{3}{40}\frac{f_y}{\sqrt{f_c'}}\frac{\psi_t \psi_e \psi_s \lambda}{\dfrac{c + K_{tr}}{d_b}}$$

$$\ell_{dh} = \frac{0.02\,\psi_e \lambda f_y d_b}{\sqrt{f_c'}}$$

$$V_s = \frac{V_u - \phi V_c}{\phi}$$

$$s = \frac{A_v f_y d}{V_s}$$

$$s = \frac{A_v f_y}{0.75\sqrt{f_c'} b_w}$$

$$\leq s = \frac{A_v f_y}{50 b_w}$$

4. Design a tied column supporting a DL = 450 k and LL=250 k assuming 2 % of steel by both WSD and USD method. Give your comments on the designs [Given: f_c' = 3.5 ksi, f_y= 60 ksi, f_s=24 ksi].

5. Using USD method, check the thickness and calculate the necessary reinforcements for a 8'X16' rectangular footing having thickness of 25"and supporting a 16"X16" column with working loads of P_{DL}=180k and P_{LL}=120k [Given, f_c' =3 ksi, f_y=50 ksi, f_s=20 ksi, k=0.378, j=0.874, R=223 psi].

6. The loads (including self-weight) and arrangement of columns of size 12"x12" of the combined footing are shown in *Fig 3*. Use WSD to
   i. Draw the shear force and bending moment diagram of the footing.
   ii. If the thickness of the footing is 25", check the adequacy of the thickness for punching shear, beam shear and bending.

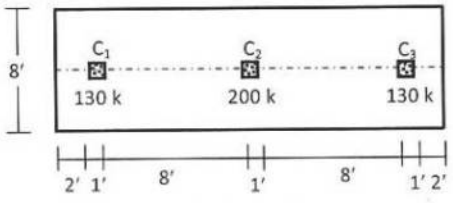


Fig. 3

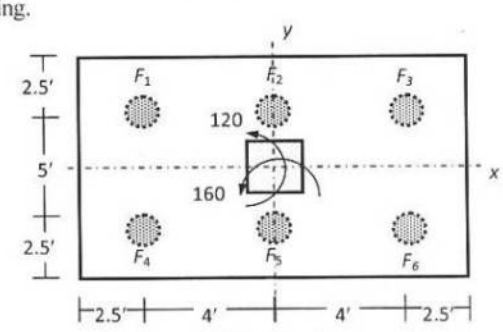


Fig. 4

7. A 24"×24" column carrying working loads of DL = 200 k, and LL = 150 k with biaxial moments (due to LL) of M_x= 120 k-ft and M_y = 160 k-ft is shown in *Fig 4*. Design the pile foundation by WSD method and show the reinforcement in neat sketch [Given: allowable bearing capacity of soil= 2 ksf, f_c'=3 ksi, f_y =50 ksi].

8. A section of a gravity retaining wall as shown in *Fig. 5* 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.
[Given, γ_s= 120 pcf, φ= 30°, f_{base}= 0.5, Allowable bearing pressure= 4 tsf.]

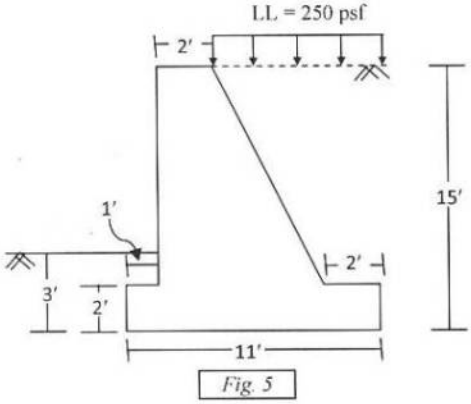


Fig. 5

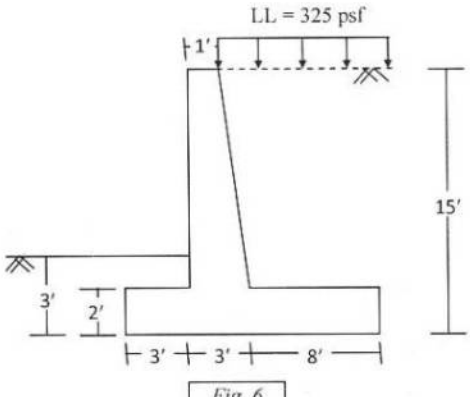


Fig. 6

9. A cross section of a cantilever retaining wall is shown in *Fig 6*. Use WSD to calculate the vertical component of reaction and design the heel slab of the footing. [Given, γ_s= 120 pcf, f_c'= 3 ksi, f_s = 24 ksi, n=9, R=223 psi].

10. A post-tensioned bonded concrete beam has a prestress of 1500 kN in the steel immediately after prestressing, which eventually reduces to 1350 kN due to losses. The beam carries load of 35 kN/m including its own weight. Use 'First Concept' to compute the extreme fiber stress at the section A-A shown in *Fig. 7* for both initial and final condition.

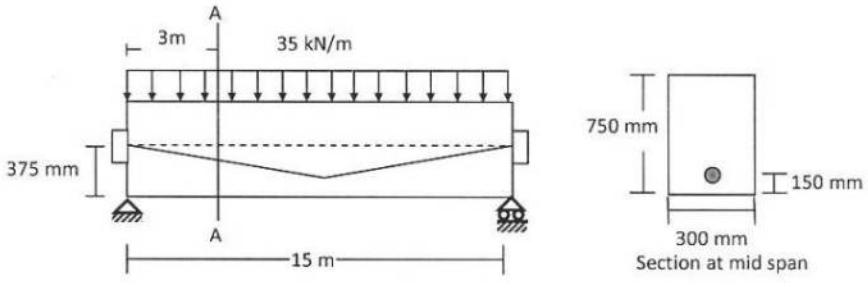


Fig. 7

PART B

[There are 4 (four) questions. Answer any **3 (three)**]

11. a) What is two-way slab? Mention the differences between one-way and two-way slabs.
    b) What is flat slab? Mention role of Drop Panel, Column Capital, Longitudinal and Transverse Beam in structural design of flat slabs.

12. a) Mention different types of RC foundations and also mention when they are used.
    b) Define the band-width in placing reinforcements for rectangular footings and explain why it is used.

13. a) Explain why the factors ϕ and α are used for column design. Also explain why is it not advisable to use single piles under columns?
    b) What is retaining wall? Explain the importance of shear key for the stability of retaining walls.

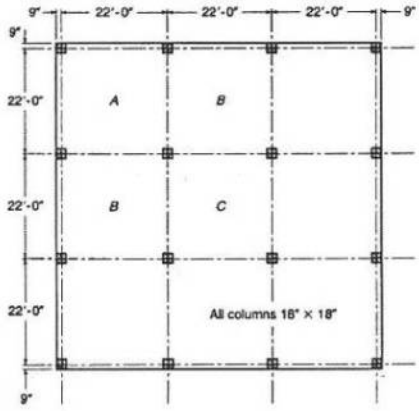
14. a) What is pre-stressed concrete? Write down the advantages and limitations of prestressing.
    b) Define: i. External Prestressing and Internal Prestressing, ii. Full, Limited and Partial Prestressing.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: Design of Concrete Structures II | Course Code: CE 317 (B)
Time: 3 Hours | Full Marks: 150

Section- A :Answer any 3 (Three) out of 4 (Four)

1. A flat plate floor system shown below consists of three panels in each direction with a floor dimension of 22 ft X 22 ft. All the panels are supported by 18 inch X 18 inch column, 12 ft. long. The slab carries a uniform service live load of 120 psf and a service dead load that consist of 25 psf of floor finish in addition of self-weight. Design only the negative steel of the column strip of an interior panel (panel C) using the direct design method (DDM). Consider $f_c' = 4$ ksi and $f_y = 60$ ksi. Use the attached chart if required. (25)



2. (a) Design a circular spiral column for carrying a total factored load of 1000 k. Use 2% steel ratio. Also design necessary spiral. ($f_c' = 4$ ksi and $f_y = 60$ ksi). (15)

   (b) What are the ACI provisions for the corner reinforcement in slab and tie bar arrangement in column. Draw a typical interaction diagram showing different points on it. (5+5)

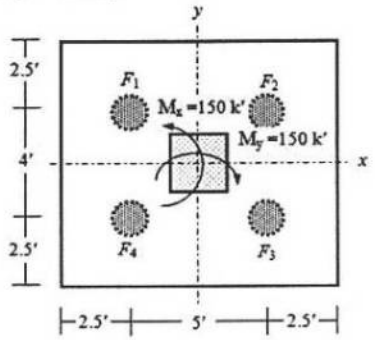
3. (a) Show the arrangement of steel (detailing of the steel) in one direction only of a 20 ft X 20 ft exterior slab panel having a negative steel requirement of 0.1 in^2/ft at discontinuous edge, positive steel requirement of 0.2 in^2/ft and negative steel requirement of 0.3 in^2/ft at continuous edge. The minimum steel requirement is 0.15 in^2/ft. (Slab thickness = 6 inch) (12)

(b) Distribute the moment in different zone of the slab panel for an interior span having a moment of 400ft-kips in one direction. Use the Direct Design Method. Consider $l_2/l_1 = 1.5$ and $\alpha_1 l_2/l_1 > 1$. Use the chart if required. (9)

(c) What are the functions of foundation? (4)

4. (a) Why pile is used? Write the types of pile. (5)

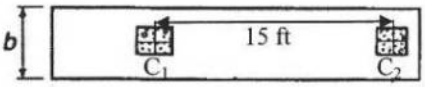
(b) Design the piles shown below for supporting a column having service dead load of 250 k and service live load of 200 k. The column also carries biaxial moments (due to *LL*) of M_x= 150 k-ft and M_y = 150 k-ft. [Given: f_c' = 3 ksi, f_y = 50 ksi, allowable bearing capacity = 2 ksf]. (20)



Section- B :Answer any 3 (Three) out of 4 (Four)

5. Design a square footing to support a 16 inch x 16 inch column with dead load of 200 kips and live load of 150 kips. The allowable soil pressure is 6 kips/ft^2. Consider the base is 5 ft. below the grade. (f_c'= 4 ksi and f_y = 60 ksi). Also consider that the effective depth, d should not be less than 16 inch. (25)

6. (a) Find the rectangular dimension of a combined footing to carry a dead load of 150 k and live load of 120 k from the column 1 (C_1) and a dead load of 200 k and live load of 180 k from the column 2 (C_2). The bottom of the footing is 5 ft below the grade. The site is restricted by the condition that the footing cannot extent beyond 2 ft right from the center of the column 2 (C_2). Both columns are 24 inch X 24 inch and c/c distance of the column is 15 ft. (allowable soil pressure is 6000 psf). (18)



Also draw the shear force diagram along the long direction of the footing.

(b) What will be the values of the moment in the mid span of a beam according to the third concept of pre-stressing (pre-stressing to achieve load balancing) if the beam is uniformly loaded with 50 KN/m. The pre-stressing load is 2000 KN and the sag is 0.15 m for the 8 m long simple span. (7)

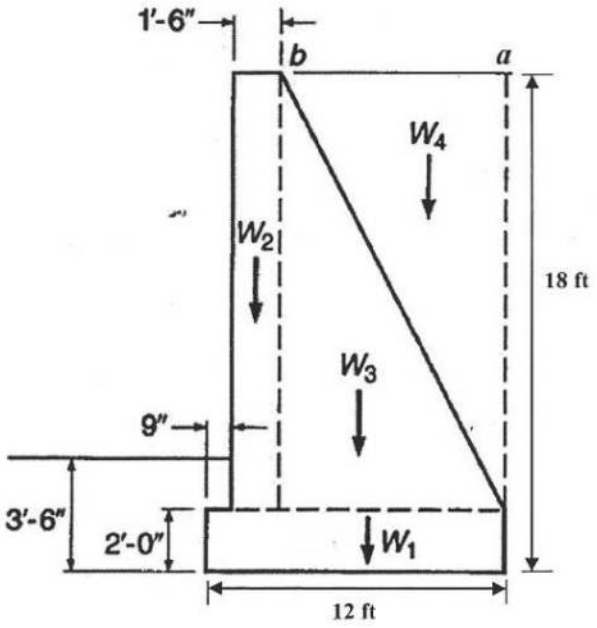
7. (a) A post-tensioned bonded concrete beam has a pre-stress of 1600 KN in the steel after considering the losses. The beam carries uniformly distributed live load in addition to its own weight of 5 KN/m. What will be the values of the maximum live load to be carried for cracking in the bottom fibers at a modulus of rupture of 4.2 MPa assuming that the concrete can take tension up to this value? The 400 mm by 600 mm beam has a simple span of 6 m whereas the tendon is located 150mm above the base of the beam in the mid-section. (15)

(b) What are the advantages and the disadvantages of pre-tensioning? (5)

(c) Write down the classification of the pre-stressed concrete structure. What types of losses occur in case of pre-stressing? (5)

8. (a) Describe different types of retaining wall. (5)

(b) Check the stability of the following retaining wall section against overturning and sliding. Consider live load surcharge of 400 psf which extends to point a. (20)
Given that, $\gamma_s = 120$ lb/cft, $\varphi = 30^0$, $f_{base} = 0.5$.



General Formulas	Formulas for retaining wall	Formulas for pile
$P_u = \alpha\varphi\ [0.85f_c'\ (A_g - A_{st}) + f_y\ A_{st}]$	$P_a = 0.5 * k_a\ \gamma_s h(h+2h')$	$F(x, y) = P/N + M_y\ x/(\Sigma x_i^2) + M_x\ y/(\Sigma y_i^2)$
$= \alpha\varphi A_g\ [0.85f_c'\ (1-\rho_g) + f_y\ \rho_g]$	$P_p = 0.5 * k_p\ \gamma_s h^2$	$F = \phi\ (a_p\ f_{call} + a_s\ f_{sall})$
$\rho_s = 0.45(A_g/A_{core} - 1)\ (f_c'/f_y)$	$Y = (h^2 + 3hh')/\ \{3(h + 2h')\}$	$a_s = (P/\phi - a_p\ f_{call})/f_{sall}$
$\rho_s = 4A_{sp}/\ (S*d_{core})$	$h' = s/\gamma_s$	$S_t = (100/0.2)(a_t/a_p)\pi d_c$ (considering 0.2% of Pile volume)
$M_u = \varphi A_s f_y\ (d - a/2)$	$k_a = (1\text{-}\sin\varphi)/\ (1+\sin\varphi)$	$L_p = P/\{\alpha_2\ (\pi d_p)\tau_u\}$
$= \varphi\rho f_y bd^2(1-\ 0.59\rho f_y/\ f_c')$	$k_p = 1/\ k_a$	
$a = (A_s f_y)/(0.85f_c'b)$		
$\varphi V_c = 2\varphi(\sqrt{f_c'})bd$		
$\varphi V_c = 4\varphi(\sqrt{f_c'})b_0 d$(for punching shear)		

GRAPH A.4
Interpolation charts for lateral distribution of slab moments.

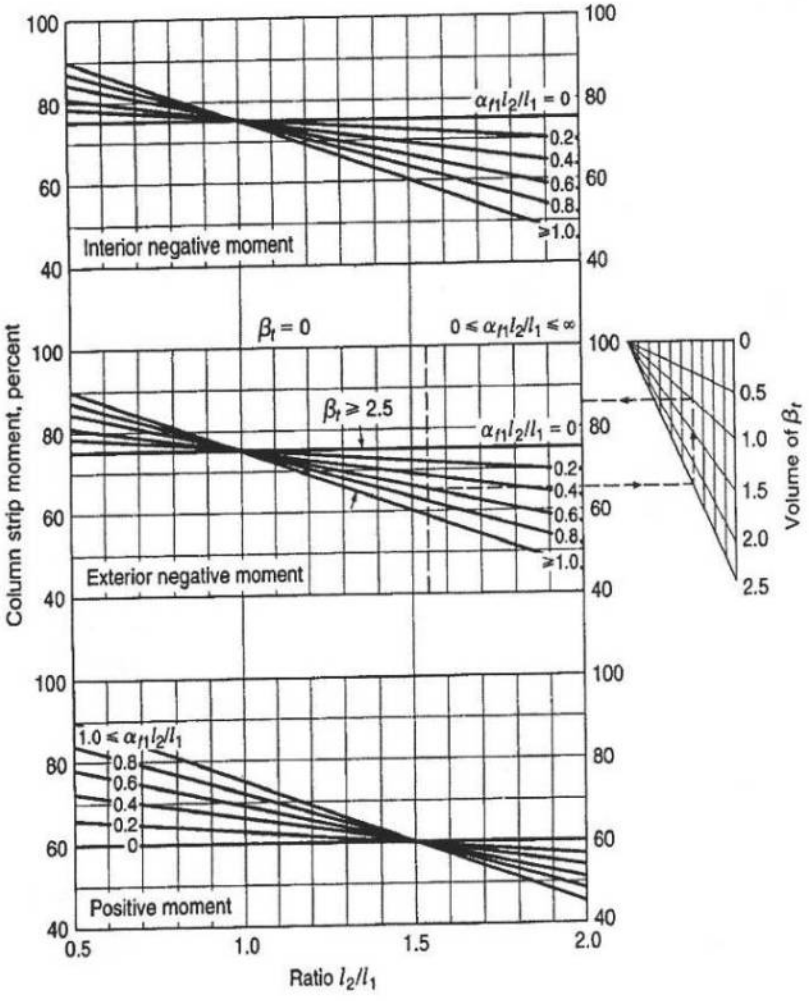


TABLE A.5a
Flexural resistance factor: $R = \rho f_y\left(1 - 0.588\,\frac{\rho f_y}{f'_c}\right)$ psi

	f_y = 40,000 psi				f_y = 60,000 psi			
	f'_c, psi				f'_c, psi			
ρ	3000	4000	5000	6000	3000	4000	5000	6000
0.0005	20	20	20	20	30	30	30	30
0.0010	40	40	40	40	59	59	60	60
0.0015	59	59	60	60	88	89	89	89
0.0020	79	79	79	79	117	118	118	119
0.0025	98	99	99	99	146	147	147	148
0.0030	117	118	118	119	174	175	176	177
0.0035	136	137	138	138	201	204	205	206
0.0040	155	156	157	157	229	232	233	234
0.0045	174	175	176	177	256	259	261	263
0.0050	192	194	195	196	282	287	289	291
0.0055	211	213	214	215	309	314	317	319
0.0060	229	232	233	234	335	341	345	347
0.0065	247	250	252	253	360	368	372	375
0.0070	265	268	271	272	385	394	399	403
0.0075	282	287	289	291	410	420	426	430
0.0080	300	305	308	310	435	446	453	457
0.0085	317	323	326	329	459	472	479	485
0.0090	335	341	345	347	483	497	506	511
0.0095	352	359	363	366	506	522	532	538
0.0100	369	376	381	384	529	547	558	565
0.0105	385	394	399	403	552	572	583	591
0.0110	402	412	417	421	575	596	609	617
0.0115	419	429	435	439	597	620	634	643
0.0120	435	446	453	457	618	644	659	669
0.0125	451	463	471	476	640	667	684	695
0.0130	467	480	488	494	661	691	708	720
0.0135	483	497	506	511	681	714	733	746
0.0140	499	514	523	529	702	736	757	771
0.0145	514	531	540	547	722	759	781	796
0.0150	529	547	558	565	741	781	805	821
0.0155	545	563	575	582	760	803	828	845
0.0160	560	580	592	600		825	852	870
0.0165	575	596	609	617		846	875	894
0.0170	589	612	626	635		867	898	918
0.0175	604	628	642	652		888	920	942
0.0180	618	644	659	669		909	943	966
0.0185	633	660	676	686		929	965	989
0.0190	647	675	692	703		949	987	1013
0.0195	661	691	708	720		969	1009	1036
0.0200	675	706	725	737		988	1031	1059

3. (a) Differentiate between : (Any two=2x3) (6)
   (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) Design pressure and working pressure in pipe network.

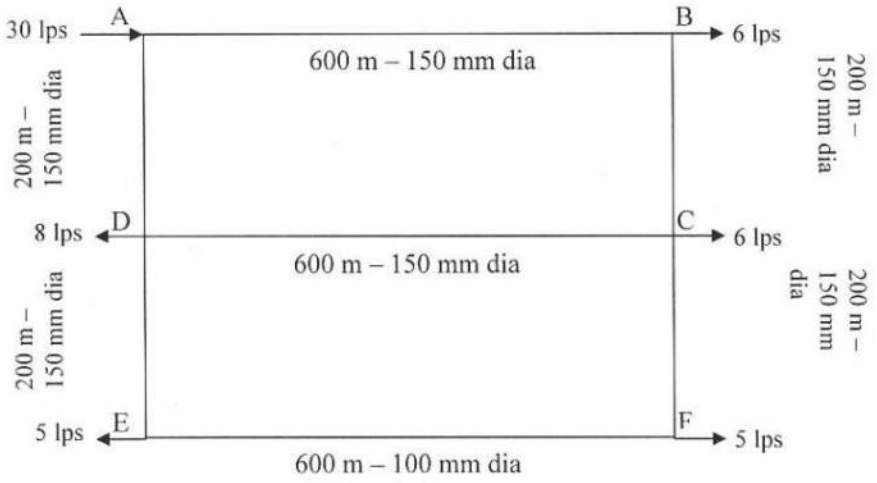
   (b) Write down the important considerations for selection of a site for intake structures. (6)

   (c) What are the main purposes of the construction of water transmission and distribution pipe-lines ? (3)

   (d) A rectangular sedimentation tank is to treat 4, 00,000 gpd of raw water. The detention period is to be 4 hours, the velocity of flow is 3 inch per minute and the depth of water and sediment is 14 ft. If the allowance of 4 ft. for sediment is made, what should be the length and width of the sedimentation tank ? (5)

4. (a) What are the advantages and disadvantages of a looped network system ? (5)

   (b) Calculate the flow in each of the pipes in the following looped pipe network (using Hardy Cross method and two trials are required): (15)



5. (a) Write explanatory notes on the following: (Any two) (6)

   (i) Water use and re-use (ii) Artificial recharge of groundwater (iii) Water pricing (iv) Water ethics

   (b) Explain the arsenic removal technologies of water with appropriate equation. (5)

   (c) How calcium non-carbonate hardness can be removed from water ? Explain with appropriate equation. (4)

(d) A rapid sand filter is to be designed for a capacity of 30,000 m^3/day. What should be the number and size of the units ? Calculate the percentage of filtered water required to wash the filter bed and the capacity of the wash water tank. (5)

[Assume : Rate of filtration : 5 $m^3/hr/m^2$
Rate of washing : $35m^3/hr/m^2$
Length of the filter run: 23.67 hrs while 8 min. and 12 min. are required. for filter washing and resettlement of sand bed respectively]

6. (a) Design a tube well of a suitable aquifer for extracting drinking water at a depth from 280 ft to 340 ft. (20)
In the following graph, the co-ordinates should be identified and attach the graph with the exam paper.
(Summary of grain size test report, gradation chart & all relevant data are given below).

The necessary equations are given below:

I. Water Horse Power of pump = (w. Q. H) / 75
Where, w = Specific weight of water in kg/m^3
Q = Pump discharge in m^3/ sec

II. Brake Horse Power of pump = Water Horse Power / (efficiency of pump) x (efficiency of motor)

Summary of Grain Size Test Results:

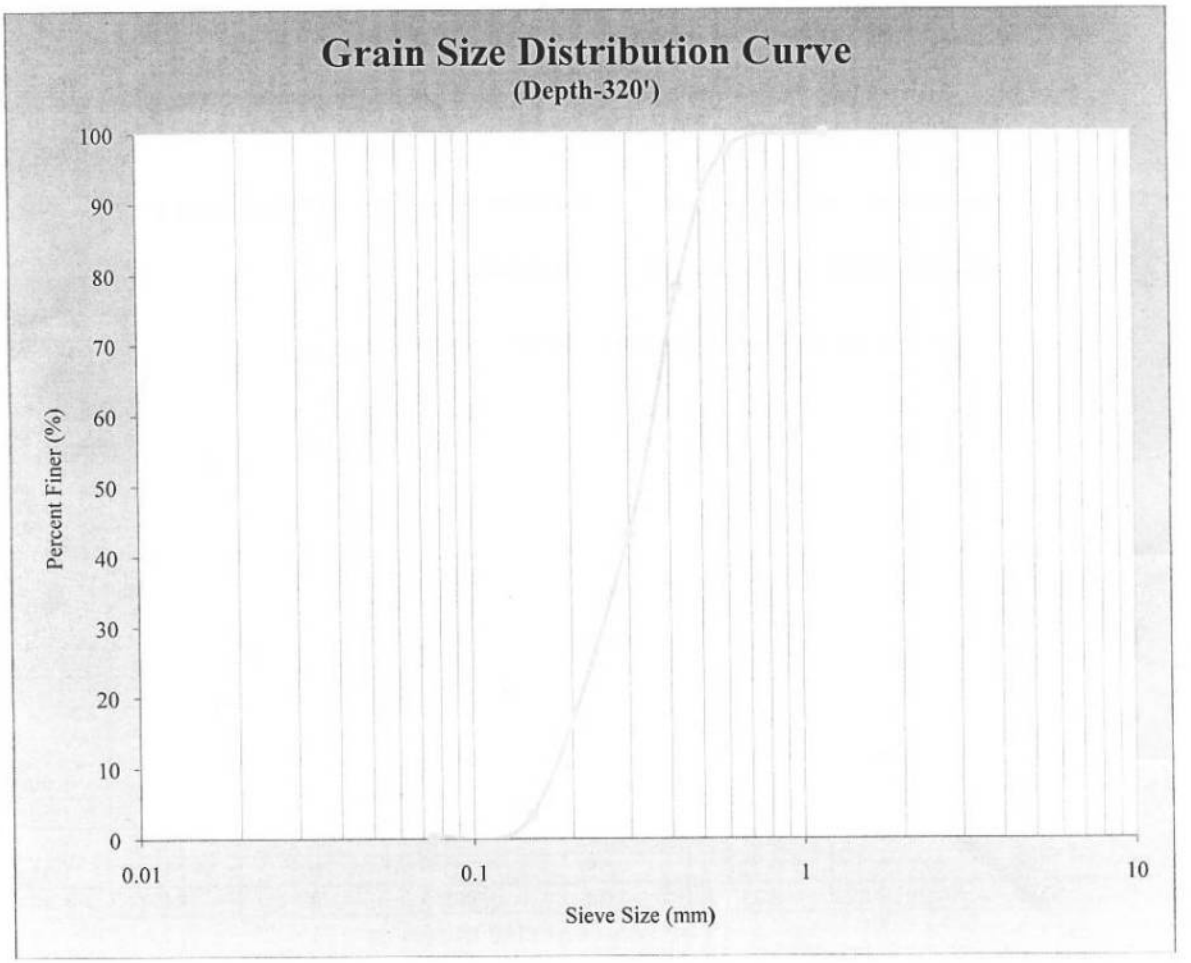
Sample depth	D_{10}	D_{30}	$U= D_{60}/D_{10}$	% of Coarse Sand	% of Medium Sand	% of Fine Sand	FM
(ft)	mm	mm		%	%	%	
240	0.17	0.25	1.4	0.5	89.5	20	1.5
260	0.18	0.24	1.46	0.5	89.5	20	1.49
280	0.2	0.3	1.3	4	86	10	1.68
300	0.15	0.24	1.58	12	68	20	1.60
320	0.18	0.25	1.52	2	82	16	1.56
340	0.18	0.27	1.11	10	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 the gradation chart and attach it with the exam paper.

(The co-ordinates should be identified in graph.)



3. (a) Briefly describe the advantages and disadvantages of a VIP latrine. (5)

(b) Does pour-flush latrine provide hygienic sanitation? Justify your answer. (4)
Also briefly explain the advantages and disadvantages of pour-flush technologies over simple pit latrine. (4)

(c) 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)

4. (a) What are the basic differences between suspended and attach growth processes. Give examples of these treatment processes. (5)

(b) Draw typical bacterial growth pattern and indicate different phases. (5)
Which phase of bacterial growth is important for sewage treatment and why? (3)
Explain the relation between food/microorganism ratio and biomass settling characteristics with figure. (7)

(c) Calculate the effluent BOD from a trickling filter having a depth of 2 m and a recirculation rate of 120 percent of the flow. The influent BOD is 200 mg/L following primary treatment. Laboratory determined value of k is 0.23. Also calculate the BOD removal efficiency of the filter. (5)

SECTION –B

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

5. (a) Define plumbing system of a building. What are the functions of plumbing in a building? (5)

(b) A drainage area, having rain falls during four months of the year only, has an area of 15 ha, with 30 houses/ha. The area has the following surface characteristics: (8)

- The average area of the roof is 80 m^2/house, with runoff coefficient of 0.9.
- The roads occupy 25% of total area. Impermeability factor for these roads could be taken as 0.6.
- The remaining area is open space whose coefficient of runoff may be taken as 0.12.

(i) If the rainfall records show that the intensity of an ordinary rainstorm is 4.5 cm/h, what will be the discharge from this district?
(ii) Determine the dry weather flow from the area if the population is 300 persons/ha and the rate of water supply is 250 lpcd.
(iii) Also find the ratio of storm sewage to dry weather flow and indicate the suitability of separate sewerage scheme in the area in preference to combined sewerage scheme.

(c) What are the basic components of Small Bore Sewerage (SBS) system? (2)
What are the basic differences between SBS and Conventional Sewage System (4)
Also write down the advantages of SBS over Conventional Sewage System. (6)

6. (a) Which type of bacteria is important for aerobic treatment of sewage? (2)
Briefly describe the role of bacteria in sewage treatment. (4)

(b) What are the functions of aeration in activated sludge process? (3)

(c) Design a waste stabilization pond system to treat 2000 m^3/d of domestic sewage with a BOD contribution of 400 mg/l. The mean temperature of the coolest month is 20°C and 25°C during irrigation season. It is desired that the final effluent can be used for crop irrigation. Assume faecal coliform concentration in raw waste water to be 1×10^8 per 100 ml. The required effluent standards are FC < 1000 per 100 ml. Assume k and k_b as 0.3 d^{-1} and 2.6 d^{-1} respectively at 20 °C. (16)

7. (a) What are the advantages and disadvantages of disposal for sewage effluent on land by irrigation? (8)

(b) Briefly explain the importance of sludge management. (5)
Mention the methods commonly used for sludge treatment and disposal. (5)

(c) Describe the stages in anaerobic digestion of sludge. (7)

8. (a) Explain the suitability of different types of pour-flush latrines. (3)
Write down the most important processes occurred in a septic tank. (4)

(b) Write down the conditions where separate and combine sewer systems are suitable. (8)
Define – (i) Black water (ii) Grey water. (2)

(c) 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 10 inch. Given, n= 0.013 and slope S = 0.015. (8)
[Attach the diagram page (Figure 3) for this problem with your answer script]

Formulae:

$$C_e = \left(\frac{C_i + rC_e}{1+r}\right)e^{-kD}$$

$V_{sc} = 0.4\ V_{sl}$, $t_h = 1.5 - 0.3 \log (Pq)$, $V_h = 10^{-3}\ P\ q\ t_h$

$t_d = 30(1.035)^{35-T}$, $V_d = 0.5 \times 10^{-3}\ P\ t_d$, $V_{sl} = C \times P \times N$

$Q = FCIA$

$\lambda_v = L_i\ Q / V_a$, $\lambda_s = 10\ L_i\ Q / A$,

$$N_e = \frac{N_i}{1 + k_b t} \qquad N_e = \frac{N_i}{(1 + k_b t_a) \times (1 + k_b t_f) \times (1 + k_b t_m)^x}$$

$t_m = \{[N_i / N_e (1+k_b t_a) (1+k_b t_f)]^{1/n} - 1\} / k_b$

$k_{b(T°C)} = k_{b(20°C)} \times (1.19)^{T-20}$, $\quad k_{(T°C)} = k_{(20°C)} \times (1.05)^{T-20}$

$V = 1.486(R^{2/3}S^{1/2})/n$, $\quad D = (2.16Qn/\sqrt{S})^{3/8}$

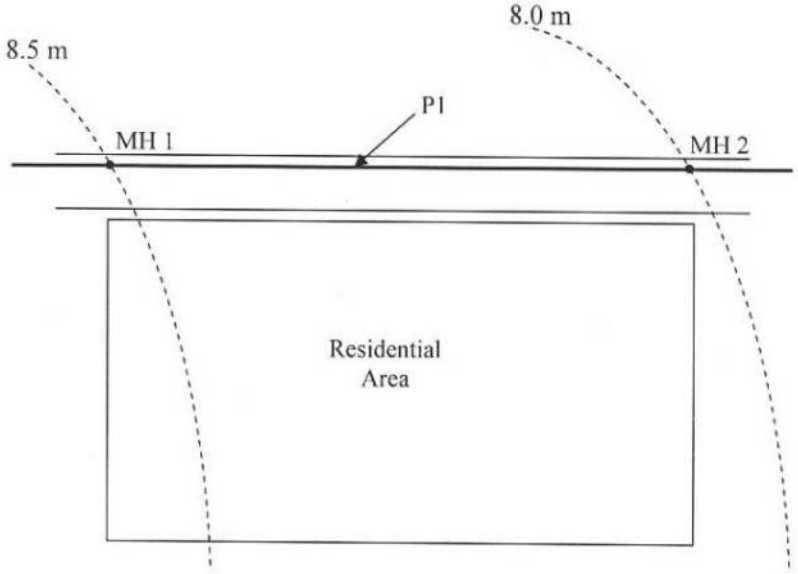


Figure 1: For Problem 1 (b)

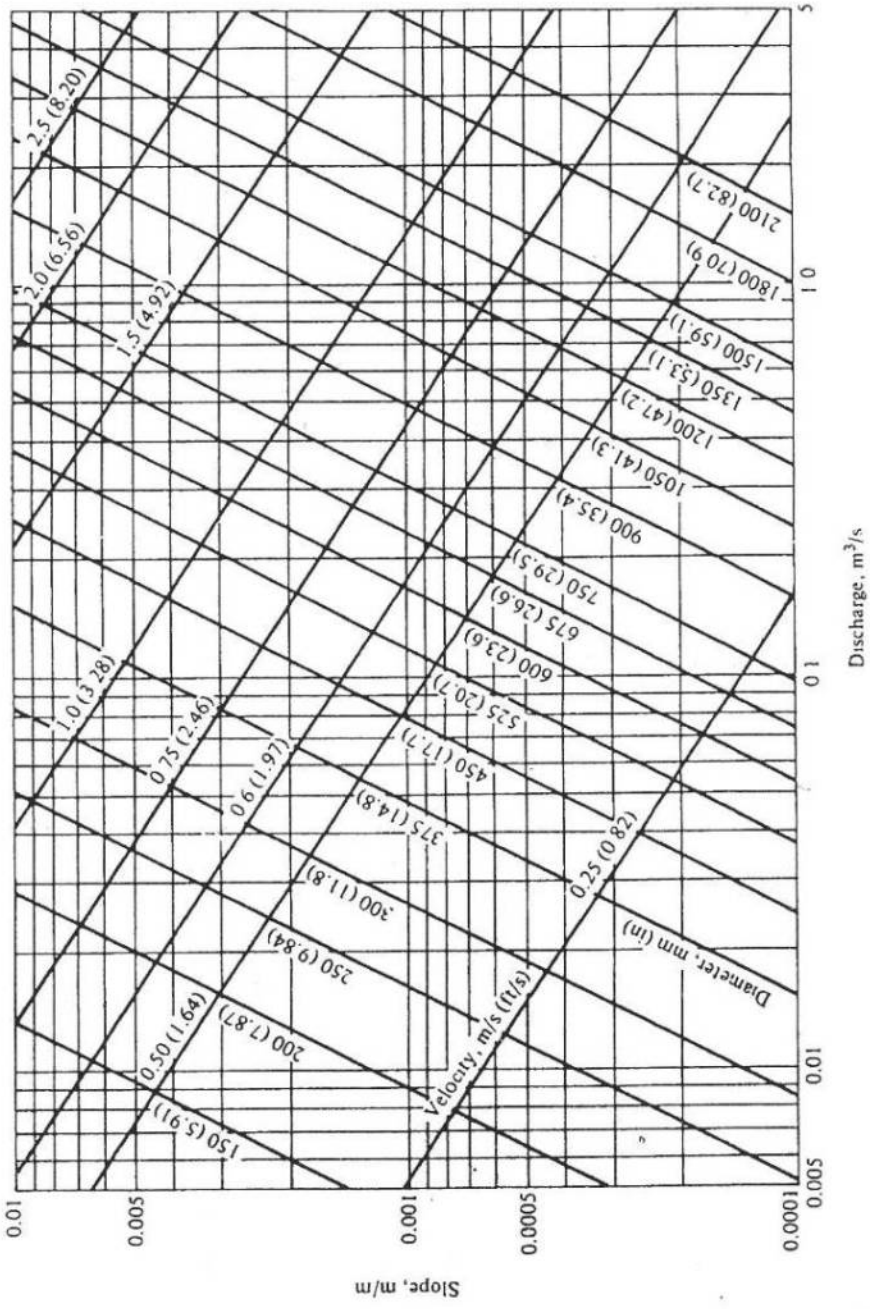


Figure 2: Nomograph for solution of Manning's equation for n = 0.013

Table 1: Design values of λ_v and BOD removal rate at various temperatures

Temperature (° C)	Volumetric Loading Rate, λ_v (g/m^3 d)	BOD removal (%)
≤ 10	100	40
11	120	42
12	140	44
13	160	46
14	180	48
15	200	50
16	220	52
17	240	54
18	260	56
19	280	58
20	300	60
21	300	62
22	300	64
23	300	66
24	300	68
≥ 25	300	70

Table 2: Design values for surface BOD loading rates for facultative ponds at various temperatures

Temperature (°C)	Surface loading rate, λ_s (kg/ha d)	Temperature (°C)	Surface loading rate, λ_s (kg/ha d)
10	100	20	253
11	112	21	272
12	124	22	292
13	137	23	311
14	152	24	331
15	167	25	350
16	183	26	369
17	199	27	389
18	217	28	406
19	235	29	424

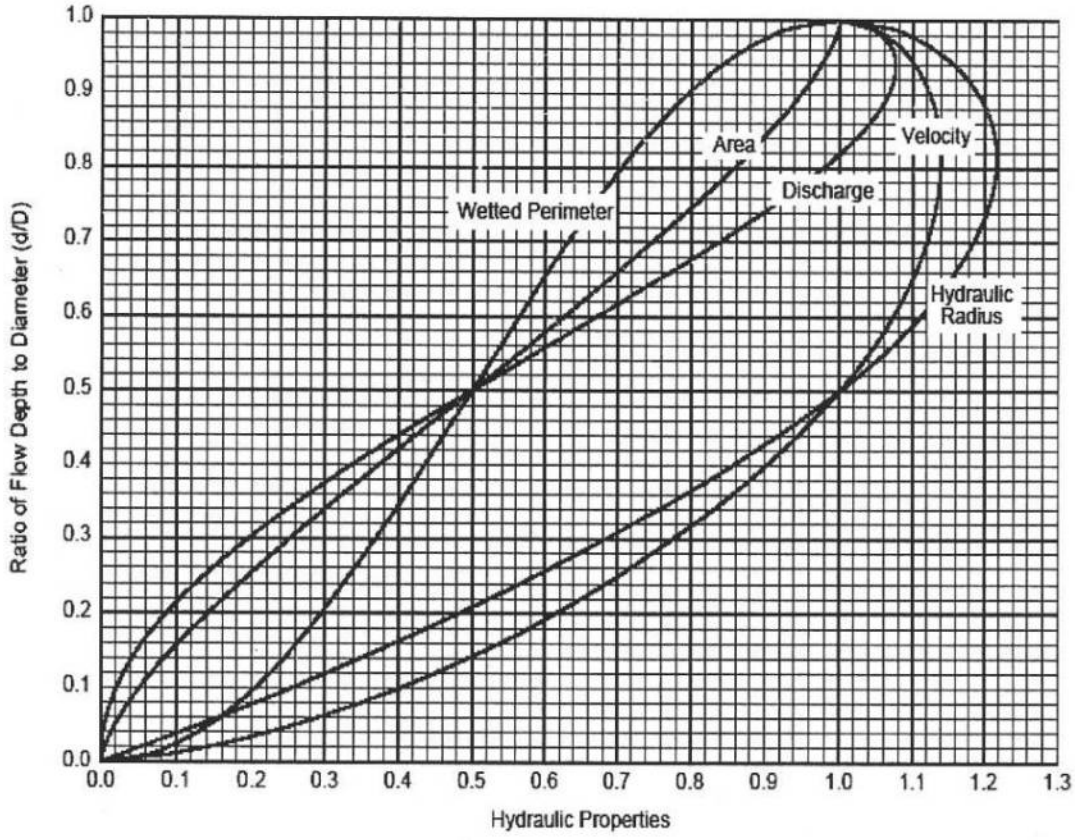


Figure 3: Hydraulic elements diagram

Section B

There are seven questions. Answer any 6 questions. **(6x10 = 60 marks)**

6. A clay stratum of thickness 9 m is located at a depth of 6 m below the ground surface (Figure 1). It is overlain by fine sand. The water table is located at a depth of 2 m below the ground surface. For sand, effective unit weight is 9.2 kN/m^3. The moist unit weight of sand located above water table is 16 kN/m^3. For clay layer, saturated unit weight is 18.6 kN/m^3. Compute the effective stress, the total stress and the pore water pressure at the bottom of the clay layer. Also compute the total and effective stresses at the bottom of the clay layer, if water level in the sand is suddenly lowered by 1.5 m.

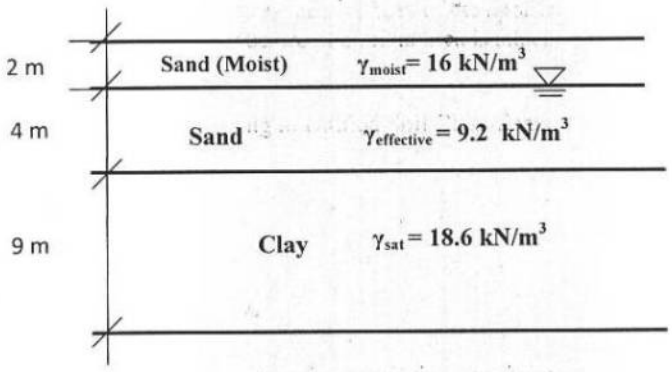


Figure 1

7. A circular area of diameter 3 m is loaded with a uniform pressure of 60 kN/m^2.
(i) Calculate stress in the soil mass at depth 3.5 m below the centre of the loaded area.
(ii) Obtain the exact depth at which stress reduces to 10% of the applied stress.
[Influence chart for vertical stress under centre of circular area is attached.]

8. (a) Classify the following soil according to Unified Soil Classification System. The properties of a subgrade soil (A) are found as follows:

Percent finer than 0.075 mm = 77%
Percent finer than 0.425 mm = 82%
Percent finer than 0.6 mm = 93%
Liquid limit = 63% & Plastic limit = 38%

(b) Compute the two important coefficients for classifying the following subgrade soil (B). Data are given below:
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 = 32%

9. Find the magnitude and location of the active force (per unit width) on the retaining wall, shown in Figure 2, for the Rankine state.

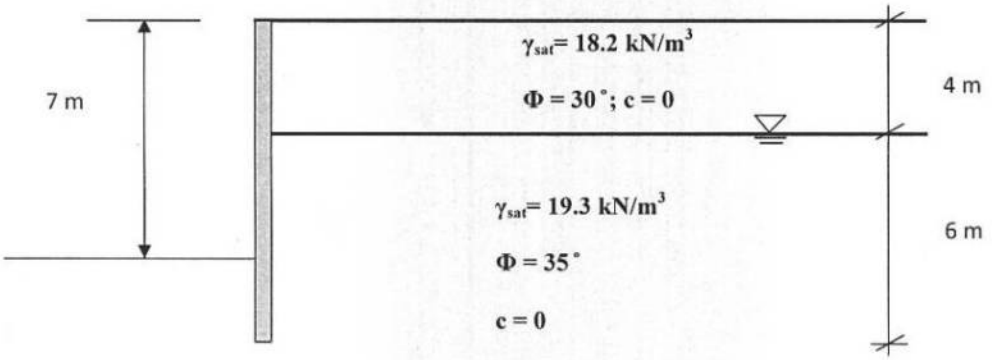


Figure 2

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

Trial No.	1	2	3	4	5
Bulk Density (g/cm^3)	2.06	2.13	2.15	2.16	2.14
Water content (%)	12.85	14.28	15.65	16.86	17.89

Find the maximum dry density and optimum moisture content.

11. A 2 m thick layer of compressible soil (normally consolidated) with an average initial void ratio of 1.02 is subjected to a total overburden pressure of 150 kN/m^2. Laboratory consolidation tests show that the equation for the e-logpσ'curve is

$$e = e_0 - 0.125\, log_{10}\frac{\sigma_0 + \Delta\sigma}{\sigma_0}$$

A large structure at the ground surface increases the pressure in the compressible layer by 70 kN/m^2. The coefficient of permeability of the soil was 25*10^{-6} mm/s.

(i) Determine the compression index, the coefficient of volume compressibility and the coefficient of consolidation.

(ii) Calculate the settlement of the layer due to the increased load.

12. Figure 3 shows a flow net for a steady-state groundwater condition that exists for a sheet pile cofferdam. (i) Calculate pressure head at point 'A'. (ii) Determine the hydraulic conductivity of the ground if the flow rate per unit length of the cofferdam is 2*10^{-4} m^3/s/m.

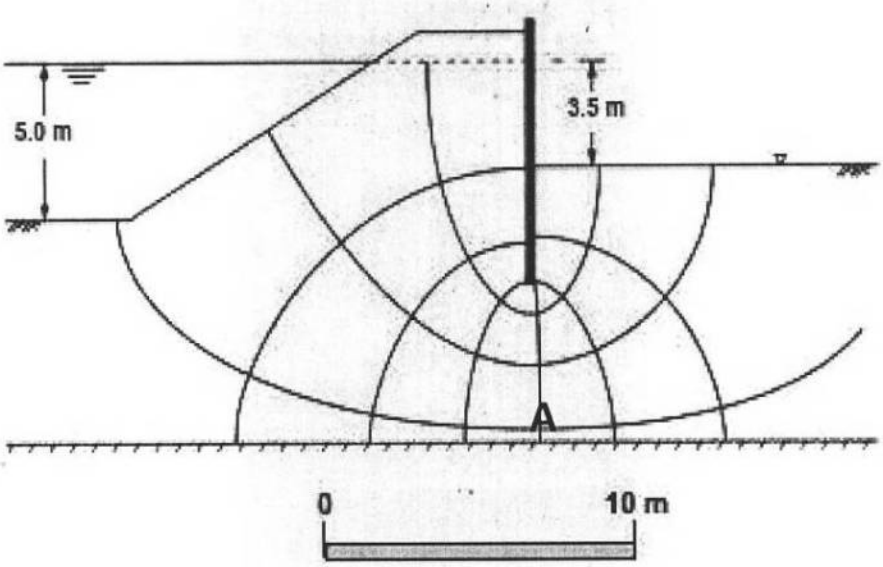
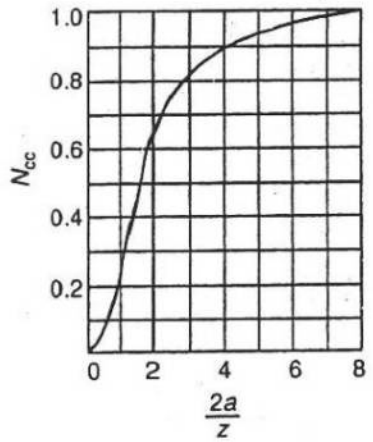


Figure 3



Influence chart for vertical stress under centre of circular area

carries a maximum of 1250 vph at night-time. Design the lighting system considering Tungsten source with mounting height of 45 ft and a maintenance factor of 0.78. Draw the lighting layout.

Section B
(Answer any three questions)

5. a) What is meant by sight distance, stopping sight distance and braking distance? 9
b) A crest vertical curve is to be designed to join a +4% grade with a -4% grade at a section of a two-lane highway. The design speed of the highway is 55 mph. Determine the minimum length of the curve. 10
c) List important functions of shoulder. 6

6. a) A horizontal curve having a radius of 900 ft forms part of a two-lane highway that has a posted speed limit of 35 mph. If the highway is flat at this section determine the min distance the large billboard can be placed from the centerline of the inside lane of the curve without reducing required SSD. Assume PR time 2.5 sec and friction factor 0.34. 16
If sufficient clear distance is not available, what alternative measure/ measures you can take to place the billboard in the same area.
b) Shortly describe any **three (3)** of the following: 9
i) Glare recovery, ii) Cone of vision,
iii) Skid Resistance, iv) Park and ride system

7. a) Illustrate the function of transportation in Economic and Social development of a country. 10
b) What are the problems of urban transportation in Bangladesh? 5
c) Briefly describe the factors affecting the development of Transportation System in a country. 10

8. a) Draw a simple circular curve and show length of curve, long chord, backward tangent, apex distance, deflection angle and mid-ordinate. 12
b) Two straight sections of a road intersect at an angle of 150^0. If the radius of simple circular curve is 500m, find 8
i) the apex distance
ii) the tangent distance
iii) length of long chord and
iv) versed sine
c) What are the main components that influence highway geometric design? 5

TABLES & FIGURES for Question 4 (d)

TABLE 1 RECOMMENDED AVERAGE ILLUMINATION (LUMENS/FT^2)

Pedestrian traffic[1]	Vehicular traffic[2] (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

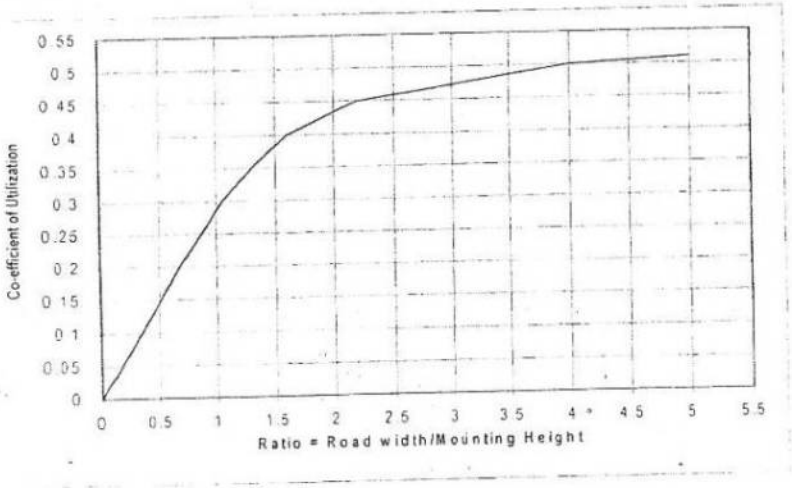
TABLE 3 LIGHTING SOURCE CHARACTERISTICS

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

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

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%).

4(a). Define: (i) Rigid boundary channel, (ii) Free board and (iii) Regime channel (6)

4(b). Using the Lacey method, design a stable alluvial channel when d = 5.0mm and Q = 20 m^3/s. (8)

4(c).A lined channel (n = 0.025) is to be laid on a slope of 1 in 1000. The side slope of the channel is to be maintained at 2.0H:1.0V. Determine the depth of flow in a triangular section with rounded corner to carry a discharge of 44m^3/swhen the maximum permissible velocity is 2.0m/s. (11)

Section B

Marks in this Section: 75

There are **Four (4)** questions in this section. Answer any **Three (3).**

5(a).Write short note on the following terms: (2x3=6)

i. Critical slope
ii. Composite roughness
iii. Conveyance.

5(b). Deduce the expression for normal depth in a triangular channel using Chezy formula. (7)

5(c).For a trapezoidal channel with b = 7 m, z = 2, n = 0.03 and S_0 = 0.002, compute normal depth and velocity if Q = 20 m^3/s. (12)

6(a). Prove that the hydraulic exponent for uniform flow computation for a circular channel is given by the following equation where conveyance is computed by Manning's equation. (12)

$$N = \frac{16y}{3d_0}\left(\frac{5Sin\frac{\omega}{2}}{(\omega - Sin\omega)} - \frac{1}{\omega \times Sin\frac{\omega}{2}}\right)$$

6(b). A rectangular channel has a bottom width of 6 m, α = 1.12, and n = 0.02. Determine the critical slope for y_n = 1 m. (8)

6(c). Write down the steps for computation of flood discharge by slope-area method. (5)

7(a). Explain why H1 and A1 profiles are physically not possible. (6)

7(b). Explain the behavior of flow profile when $y \rightarrow 0$. (5)

7(c). A rectangular channel 10 m wide and having $\alpha = 1.12$ and $n = 0.025$ has three reaches arranged serially. The bottom slopes of these reaches are 0.0035, 0.006 and 0.0085, respectively. For a discharge of 30 m^3/s in the channel, sketch the resulting flow profiles. (9)

7(d). What data or information is generally needed for computing a flow profile? (5)

8(a). Draw the possible flow profiles in the following serial arrangement of channels:

(i) Mild-Critical-Steep.

(ii) Mild-Steep-Milder Steep. (2x5=10)

8(b). A trapezoidal channel with $b = 6$ m, $z = 2$, and $S_0 = 0.002$ carries a discharge of 40 m^3/s. A dam constructed across the channel raises the water level to a depth of 5 m immediately upstream of it. How far upstream or downstream from the dam will the depth be 4.90 m? Apply Direct Step Method. Assume $\alpha = 1.12$, $n = 0.025$. (15)

Isohyetal intervals (cm)	(15-12)	(12-9)	(9-6)	(6-3)	(3-1)
Inter Isohyetal area (km^2)	92	128	120	175	85

Estimate the average depth of precipitation over the catchment.

(c) Draw the typical infiltration curve showing all the elements. (5)

3. (a) Sketch the schematic diagram of energy budget method of estimating evaporation. (5)

(b) Discuss the factors that affect the process of evaporation. (10)

(c) Rain gauge station S was inoperative for a part of the month since the rain gauge was broken. At that month the rainfall recorded in the three surrounding stations P, Q and R were 9.7, 7.8 and 6.7 cm. If the average annual rainfalls for the stations P, Q, R, and S are 180, 155, 95 and 80 cm respectively. Estimate the rainfall at station S. (10)

4. (a) How to determine the precipitable water in a saturated air column? (8)

(b) Describe the Horton's infiltration equation. (5)

(c) Estimate the daily potential evapotranspiration from the following data using Penman's formulae: (12)

(i) Slope of the saturation vs temperature at the mean air temperature =1.4 mm/°C
(ii) Net radiation = 5 mm of water per day
(iii) Relative humidity = 80%
(iv) Saturated vapour pressure e_w = 5.34 mm of Hg
(v) Wind Velocity at 4 m height = 90 km/day
(vi) Psychrometric constant = 0.49 mm of Hg.

SECTION B

There are **Four (4)** questions and answer any **Three (3)** questions

5. (a) With the help of hydrograph describe the salient features of
(i) Perennial, (ii) Intermittent, and (iii) Ephemeral streams (5)

(b) The ordinates of a 6-h unit hydrograph are as given below: (10)

Time (hr)	0	3	6	9	12	15	18	21	24	30
Ordinate of 6-hr Unit Hydrograph (cumec)	0	25	50	85	125	160	185	172.5	160	110

If two storms, each of 6-hr duration and having rainfall excess values of 3 cm and 4 cm respectively, then calculate the resulting Direct Runoff Hydrograph. The 4-cm ER rain follows the 3-cm rain.

(c) Rainfall of magnitude 6 cm and 4 cm occurring on two consecutive 4-hr duration on a catchment of area 192 km^2 produced the following hydrograph of flow at the outlet of the catchment. Estimate the rainfall excess and Ø-index. (10)

Time from start of rainfall (hr)	Observed flow (m^3/s)
0	10
6	35
12	135
18	190
24	165
30	110
36	70
42	40
48	28
54	22
60	17
66	13
72	10

6. (a) Describe different methods of base flow separation. (5)

(b) The ordinates of a 2-hr Unit Hydrograph (UH) are given below. Determine the ordinates of an S-curve hydrograph and using this determine the ordinates of a 4-hr unit hydrograph. (10)

Time (hr)	2-hr UH ordinates (cumec)
0	0
2	25
4	100
6	160
8	190
10	170
12	110
14	70
16	30
18	20
20	6
22	0

(c) A basin has 400 km^2 of area, Basin length along the main stream = 35 km and distance from gauging station along the main stream opposite to the centroid =10 km. Regional constant C_t= 1.5 and C_p= 0.7. For this basin develop 3-hr synthetic unit hydrograph using Snyder's method. (10)

7. (a) Derive the expression and different steps for reservoir routing. What data are required for reservoir routing? (5)

(b) Describe different methods of depth measurement. (5)

(c) The inflow and outflow hydrographs for a reach of river are given below. Determine the best values of the Muskingum coefficient 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) Using 30 years data and Gumble's method the flood magnitudes, for return periods of 100 and 50 years for a river are found to be 1200 and 1060 cumec respectively. (15)

(i) Determine the mean and standard deviation of the data used

(ii) Estimate the magnitude of a flood with a return period of 500 years

(iii) What are the 80% confidence limits for this estimate in (ii)?

(b) The following data were collected for a 24 m width stream at a gauging station. A current meter with a calibration equation V= (0.32 N + 0.032) m/s, where N= revolutions per second was used to measure the velocity at 0.6 depth. Using mid-section method, calculate the discharge in the stream. (10)

Distance from left bank (m)	Depth, d (m)	Current meter reading at 0.6d (m) below water surface	
		Rev	Sec
0	0	0	180
2	0.5	80	120
4	1.10	83	120
6	1.95	131	120
9	2.25	139	120
12	1.85	121	120
15	1.75	114	120
18	1.65	109	120
20	1.5	92	120
22	1.25	85	120
23	0.75	70	150
24	0	0	0

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									

REDUCED STANDARD DEVIATION S_n IN GUMBEL'S EXTREME VALUE DISTRIBUTION

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									

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

Work package	Budgeted Value		Percentage Complete	Estimated Cost	Actual Cost	Cost Overrun /Under-run
	Time	Cost				
A	4	4000	100%		4500	
B	5	3500	100%		2500	
C	6	4500	100%		4000	
D	3	2500	100%		3000	
E	3	1000	30%		1000	
F	7	15000	40%		7800	
G	2	1500	100%		1200	
H	5	8000	25%		1500	

6. A factory purchased 3 years ago for $65,000 is harder to maintain than expected. It can be sold now for $15,000 or kept for a maximum of 3 more years, in which case its operating cost will be $20,000 each year, with a salvage value of $9,000 two years from now. A suitable challenger will have a first cost of $60,000 with an annual operating cost of $5000 per year and a salvage value of $15,000 after 5 years. Interest rate is 10%.
Determine the values of P, A, n, and S for the defender and challenger. What is the decision? (8)

7. (a) What do you understand by six-sigma? Describe general goals of six-sigma. (3)
(b) What is LTM? When LTM is preferred? (2)
(c) What is meant by inventory? Write down the objectives of material management. (3)

8. A software development firm has estimated the following time for its activities.

Activity	Precedence	Optimistic Time	Most likely Time	Pessimistic Time	Expected Time	Variance
A	-	5	7	9		
B	-	4	10	16		
C	A, B	6	7	11		
D	B	4	6	8		
E	C	4	7	7		
F	C, D	3	5	7		
G	E, F	5	6	7		

Draw the network diagram and find the critical path. How much will be the duration for software development? The company has quoted 32 days for the project to the customer. What is the probability for this project that can be completed in 32 days or less?

(10)

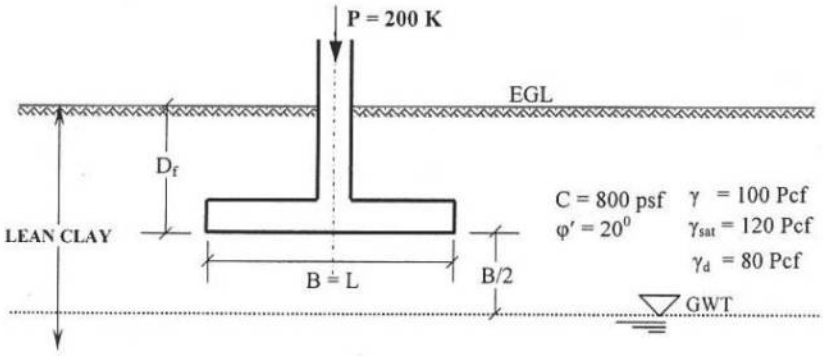
Z Score Table- chart value corresponds to area below z score.

z	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00
–3.4	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
–3.3	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
–3.2	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
–3.1	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010
–3.0	0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013
–2.9	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019
–2.8	0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026
–2.7	0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035
–2.6	0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047
–2.5	0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062
–2.4	0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082
–2.3	0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107
–2.2	0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139
–2.1	0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179
–2.0	0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228
–1.9	0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287
–1.8	0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359
–1.7	0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446
–1.6	0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548
–1.5	0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668
–1.4	0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808
–1.3	0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968
–1.2	0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151
–1.1	0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357
–1.0	0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587
–0.9	0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841
–0.8	0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119
–0.7	0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420
–0.6	0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743
–0.5	0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085
–0.4	0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446
–0.3	0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821
–0.2	0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207
–0.1	0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602
–0.0	0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000

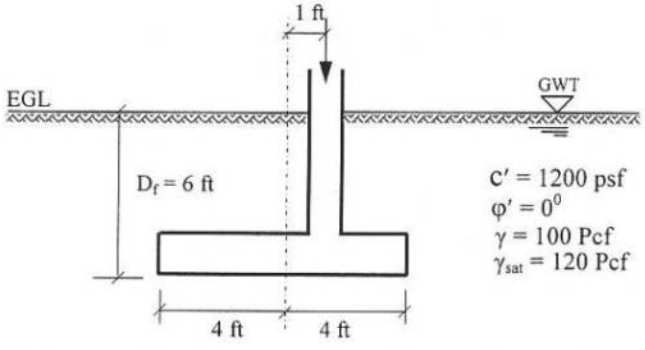
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Interest Rate		10.00%							10.00%
n	F/P	P/F	A/F	A/P	F/A	P/A	A/G	P/G	n
1	1.100	0.9091	1.0000	1.1000	1.000	0.909	0.000	0.000	1
2	1.210	0.8264	0.4762	0.5762	2.100	1.736	0.476	0.826	2
3	1.331	0.7513	0.3021	0.4021	3.310	2.487	0.937	2.329	3
4	1.464	0.6830	0.2155	0.3155	4.641	3.170	1.381	4.378	4
5	1.611	0.6209	0.1638	0.2638	6.105	3.791	1.810	6.862	5
6	1.772	0.5645	0.1296	0.2296	7.716	4.355	2.224	9.684	6
7	1.949	0.5132	0.1054	0.2054	9.487	4.868	2.622	12.763	7
8	2.144	0.4665	0.0874	0.1874	11.436	5.335	3.004	16.029	8
9	2.358	0.4241	0.0736	0.1736	13.579	5.759	3.372	19.421	9
10	2.594	0.3855	0.0627	0.1627	15.937	6.145	3.725	22.891	10
11	2.853	0.3505	0.0540	0.1540	18.531	6.495	4.064	26.396	11
12	3.138	0.3186	0.0468	0.1468	21.384	6.814	4.388	29.901	12
13	3.452	0.2897	0.0408	0.1408	24.523	7.103	4.699	33.377	13
14	3.797	0.2633	0.0357	0.1357	27.975	7.367	4.996	36.800	14
15	4.177	0.2394	0.0315	0.1315	31.772	7.606	5.279	40.152	15
16	4.595	0.2176	0.0278	0.1278	35.950	7.824	5.549	43.416	16
17	5.054	0.1978	0.0247	0.1247	40.545	8.022	5.807	46.582	17
18	5.560	0.1799	0.0219	0.1219	45.599	8.201	6.053	49.640	18
19	6.116	0.1635	0.0195	0.1195	51.159	8.365	6.286	52.583	19
20	6.727	0.1486	0.0175	0.1175	57.275	8.514	6.508	55.407	20
21	7.400	0.1351	0.0156	0.1156	64.002	8.649	6.719	58.110	21
22	8.140	0.1228	0.0140	0.1140	71.403	8.772	6.919	60.689	22
23	8.954	0.1117	0.0126	0.1126	79.543	8.883	7.108	63.146	23
24	9.850	0.1015	0.0113	0.1113	88.497	8.985	7.288	65.481	24
25	10.835	0.0923	0.0102	0.1102	98.347	9.077	7.458	67.696	25
26	11.918	0.0839	0.0092	0.1092	109.182	9.161	7.619	69.794	26
27	13.110	0.0763	0.0083	0.1083	121.100	9.237	7.770	71.777	27
28	14.421	0.0693	0.0075	0.1075	134.210	9.307	7.914	73.650	28
29	15.863	0.0630	0.0067	0.1067	148.631	9.370	8.049	75.415	29
30	17.449	0.0573	0.0061	0.1061	164.494	9.427	8.176	77.077	30
31	19.194	0.0521	0.0055	0.1055	181.943	9.479	8.296	78.640	31
32	21.114	0.0474	0.0050	0.1050	201.138	9.526	8.409	80.108	32
33	23.225	0.0431	0.0045	0.1045	222.252	9.569	8.515	81.486	33
34	25.548	0.0391	0.0041	0.1041	245.477	9.609	8.615	82.777	34
35	28.102	0.0356	0.0037	0.1037	271.024	9.644	8.709	83.987	35
36	30.913	0.0323	0.0033	0.1033	299.127	9.677	8.796	85.119	36
40	45.259	0.0221	0.0023	0.1023	442.593	9.779	9.096	88.953	40
48	97.017	0.0103	0.0010	0.1010	960.17	9.897	9.500	94.02	48
50	117.391	0.0085	0.0009	0.1009	1163.91	9.915	9.570	94.89	50

3. (a) Using General Bearing Capacity Equation (GBCE), design the size of the square footing for the conditions as shown below. Use a factor of safety of 2.5 and $B = 2\ D_f$. 11

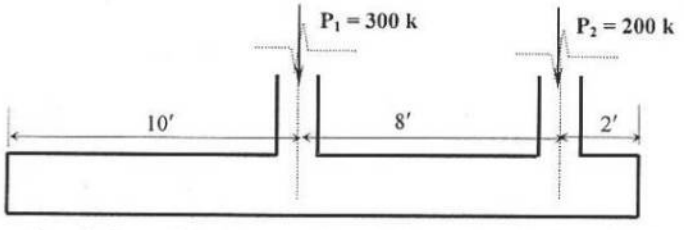


(b) An eccentrically loaded rectangular footing is shown below. Determine the allowable load that the foundation can carry. Use Meyerhof's effective area method. Use FS = 2.5. Use L=1.5B. 9

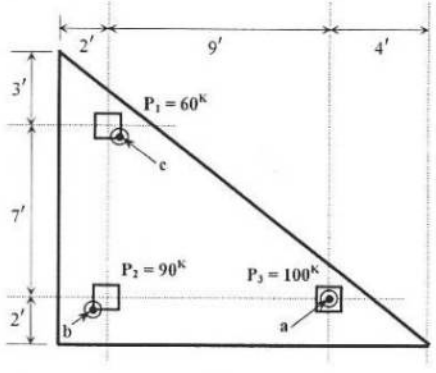


4. (a) Write down the factors considered in general bearing capacity equation which were not considered in Terzaghi's bearing capacity equation. 3

(b) Determine the sizes of a trapezoidal foundation for the conditions shown below (q_a = 1.25 tsf) 7

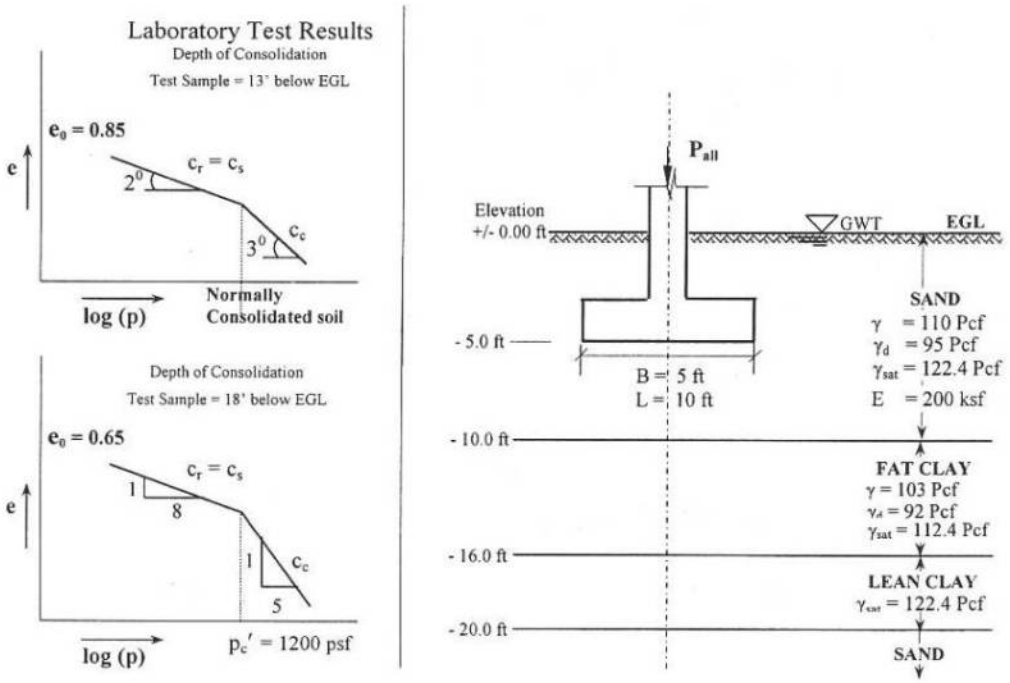


(c) The plan of a mat foundation with column loads and dimensions is shown in the figure below. Calculate the soil pressures at points a, b and c and at the geometric centroid of the foundation (All the columns are of 12 by 12 inches in size). 10

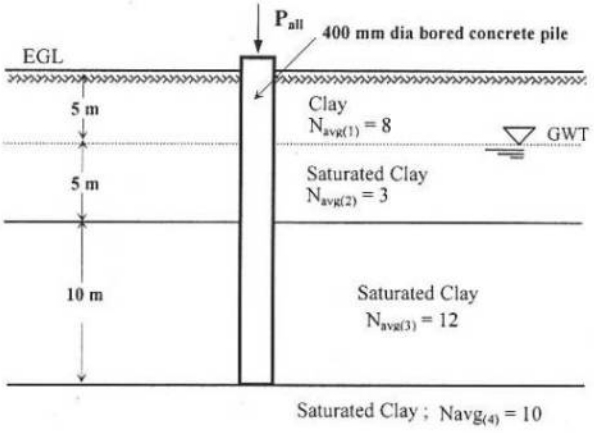


5. (a) Depict and write short notes on general and local shear failure patterns for shallow foundation. 6

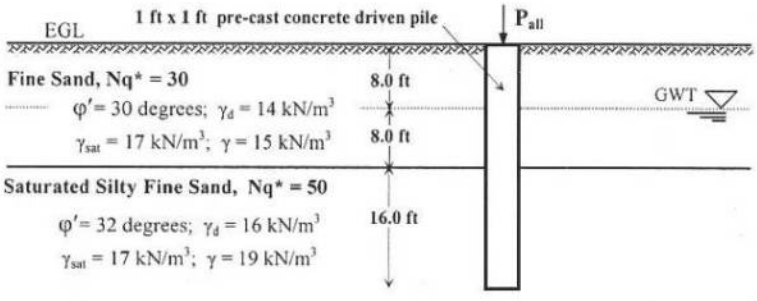
(b) A footing designed as per allowable bearing capacity based on shearing failure is shown in the following figure. Estimate settlements for both sand and clay layers. Use $q_a = p = 2.4$ ksf . 14



6. (a) For the following condition, calculate the allowable capacity of a single pile. Assume reasonable factor of safeties for end bearing and skin resistance. 10



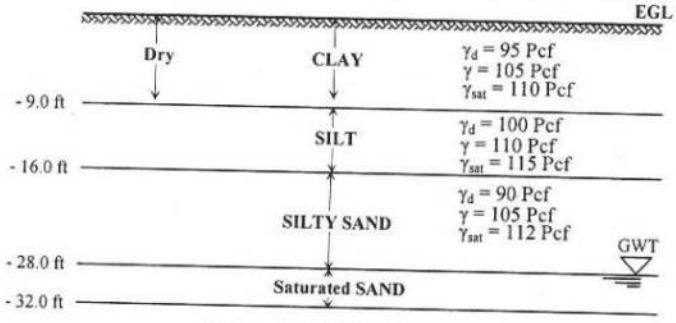
(b) For the following condition, calculate the allowable capacity of a single pile. Assume reasonable factor of safeties for end bearing and skin resistance. 10



7. (a) What do you understand by shallow and deep foundations? Categorize shallow foundations. Draw sketches of different combined footings. Also categorize pile foundations. No description is required. 10

(b) Draw arrangement of group piles for the following sets of piles. 5
(i) Triple row for a wall (ii) 10 piles

(c) For fully compensated condition, if the depth of a mat foundation is 30 ft below EGL, determine the number of stories that could be built considering uniform per floor load as 200 psf. 5



Subsurface Soil Stratigraphy

8. (a) Categorize (with sketch) conventional retaining walls. Write a short note on gravity retaining wall. 8

(b) Determine the factor of safety (stability) against the failure arcs through the slope for the slope as shown below. 12

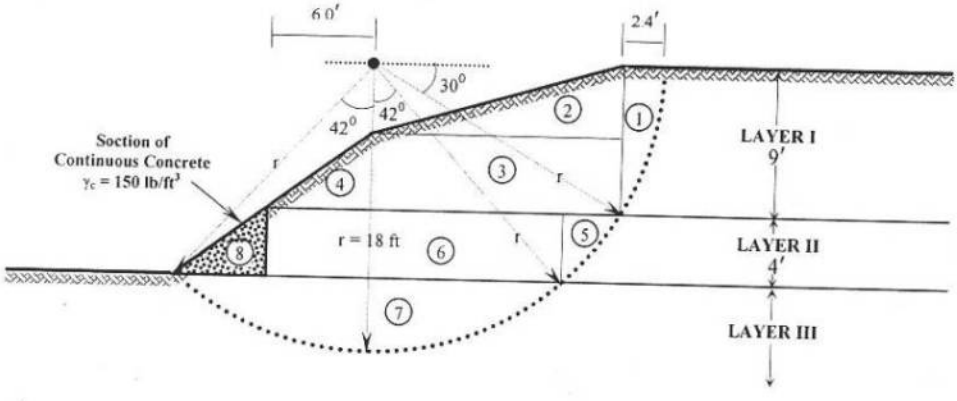
LAYER I:
Sandy Clay
Average SPT Blow Count, N = 6
Unit Weight = 110 pcf

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^2)	Arm (ft)
1	10.8	---
2	31.2	---
3	---	7.8
4	15	---
5	---	13.2
6	---	---
7	---	---

--- to be calculated



University of Asia Pacific
Department of Civil Engineering

APPENDIX

Parameter for 60% Energy Correction For Field SPT

E_m = Hammer Efficiency (Donut + Cathed) = 0.55 to 0.60

C_B = Correction for Borehole Diameter
= 1.0 (For Dia 2.5" – 4.5")
= 1.05 (For Dia of 6")
= 1.15 (For Dia 8")

C_S = Correction for Sampler
= 1.0 Standard Sampler
= 1.2 Sampler Without Liner

C_R = Correction for Rod Length
= 0.75 for L = (3-4) m
= 0.85 for L = (4-6) m
= 0.95 for L = (6-10) m
= 1.0 for L > 10 m

Relevant Empirical Correlations

$CF_1 = \sqrt{\frac{2000}{\sigma_{v0}'}}$ (σ_{v0}' is in psf) $CF_1 = \sqrt{\frac{100}{\sigma_{v0}'}}$ (σ_{v0}' is in kPa)

$C_u = (q_{unc}/2)$

$q_{unc} = 300\ N_f$ (q_{unc} in psf)

$\phi' = 15 + \sqrt{20(N_1)_{60}}$ (ϕ is in degree)

BEARING CAPACITY OF SOIL

(A) TERZAGHI'S ULTIMATE BEARING CAPACITY EQUATIONS

Applicable For Dense/Stiff Soil Considering General Shear Failure

c-part q-part γ-part

$q_u = 1.3\, c' N_c + q_f N_q + 0.4\, \gamma_{bf} B N_\gamma$ (For Square Foundation)

$q_u = 1.3\, c' N_c + q_f N_q + 0.3\, \gamma_{bf} B N_\gamma$ (For Circular Foundation)

$q_u = c' N_c + q_f N_q + 0.5\, \gamma_{bf} B N_\gamma$ (For Strip Foundation)

Table: Terzaghi's Bearing Capacity Factors (General Shear Failure)

φ' (degree)	N_c	N_q	N_γ
0	5.7	1.0	0.0
10	9.61	2.69	0.56
20	17.69	7.44	3.64
30	37.16	22.46	19.13
35	57.75	41.44	45.41

B) TERZAGHI'S MODIFIED ULTIMATE BEARING CAPACITY EQUATIONS

Applicable For Medium Dense/Stiff Soil Considering Local Shear Failure

$q_u = 0.867\, c' N_c' + q_f N_q' + 0.4\, \gamma_{bf} B N_\gamma'$ **(For Square Foundation)**

$q_u = 0.867\, c' N_c' + q_f N_q' + 0.3\, \gamma_{bf} B N_\gamma'$ **(For Circular Foundation)**

$q_u = 0.67\, c' N_c' + q_f N_q' + 0.5\, \gamma_{bf} B N_\gamma'$ **(For Strip Foundation)**

N_c', N_q', N_γ' = Terzaghi's Modified Bearing capacity factors (for local shear failure) that are functions only of the soil friction angle φ'

Table: Terzaghi's Bearing Capacity Factors (Local Shear Failure)

φ' (degree)	N_c'	N_q'	N_γ'
0	5.7	1.0	0.0
10	8.02	1.94	0.24
20	11.85	3.88	1.12
30	18.99	8.31	4.39
35	25.18	12.75	8.35

(C) THE GENERAL BEARING CAPACITY EQUATION

$$q_u = c' N_c F_{cs} F_{cd} F_{ci} + q_f N_q F_{qs} F_{qd} F_{qi} + 0.5\, \gamma_{bf} B N_\gamma F_{\gamma s} F_{\gamma d} F_{\gamma i}$$

F_{cs}, F_{qs}, $F_{\gamma s}$ = Shape Factors
F_{cd}, F_{qd}, $F_{\gamma d}$ = Depth Factors
F_{ci}, F_{qi}, $F_{\gamma i}$ = Inclination Factors

Table: General Bearing Capacity Factors

ϕ'	N_c	N_q	N_γ
0	5.14	1.00	0.00
10	8.35	2.47	1.22
20	14.83	6.40	5.39
26	22.25	11.85	12.54
28	25.80	14.72	16.72
30	30.14	18.40	22.40
32	35.49	23.18	30.22
34	42.16	29.44	41.06

Shape Factors

$F_{cs} = 1 + (B/L)(N_q/N_c)$
$F_{qs} = 1 + (B/L) \tan \phi'$
$F_{\gamma s} = 1 - 0.4\,(B/L)$
Where L = Length of the foundation (L>B)

Depth Factors

For $D_f/B \le 1$

$F_{cd} = 1 + 0.4\,(D_f/B)$
$F_{qd} = 1 + 2 \tan \phi' (1 - \sin \phi')^2 (D_f/B)$
$F_{\gamma d} = 1$

For $D_f/B > 1$

$F_{cd} = 1 + 0.4 \tan^{-1}(D_f/B)$
$F_{qd} = 1 + 2 \tan \phi' (1 - \sin \phi')^2 \tan^{-1}(D_f/B)$
$F_{\gamma d} = 1$
The factor $\tan^{-1}(D_f/B)$ is in radians.

Inclination Factors

$F_{ci} = F_{qi} = (1 - \beta^0/90^0)^2$
$F_{\gamma i} = (1 - \beta/\phi')^2$
β = Inclination of the applied load on the foundation with respect to the vertical

6. (a) The total traffic on a two lane two way for the overall design life was found to be $4x10^6$ ESAL in both direction. Design the minimum thickness of flexible pavement (i.e. thickness of different layers) according to AASHTO flexible pavement design method considering the following conditions. (18)

Given:
Sub grade soil CBR value is 1
Reliability is 90%
Overall standard deviation is 0.45
Design serviceability loss is 1.5
Available material:

- Hot mix asphalt surface concrete ($a_1 = 0.4$)
- Crushed stone base course ($a_2 = 0.14$, $m_2 = 0.4$ and $E_2 = 30$ ksi)
- Crushed stone sub base ($a_3 = 0.1$, $m_3 = 0.9$ and $E_3 = 14.5$ ksi)

Note: Use attached figure.

(b) Write short note on AASHO road test. What is drainage modifying factor? (5+2)

7. (a) Check the adequacy of the thickness of a lane of cement concrete rigid pavement in a rural interstate highway which can be used to carry the following expected loading of heavy vehicle over the design period of 20 years. Combined k of the subgrade and 4 in. untreated subbase was taken to be 130 lb/in^3. The modulus of rupture of the concrete is 650 lb/in^2. Assume doweled joints and no concrete shoulder. Consider 9.0 in as the only trial thickness. (LSF =1.0) (22)
Note: Use attached figures and tables.

Axle load, kips		Expected repetitions
Single axles	30	7,000
	28	12,000
	26	28,000
	24	40,000
	22	50,000
Tandem axles	52	25,000
	48	40,000
	44	50,000

(b) What are the design criteria of PCA design method? (3)

8. (a) Draw the qualitative curves found from the Marshall method of design. What is VFA? If the ADT and ADTT is 10000 and 15% respectively, find out the total number of the trucks for a 4 lane rural interstate highway with projection factor of 1.6 for 20 years. Assume value if required. (8+1+3)

(b) Write down the basic assumed conditions behind Asphalt Institute Method. What are the uses of Asphalt? Describe the design factors for the design of concrete pavement by the PCA method. (5+2+6)

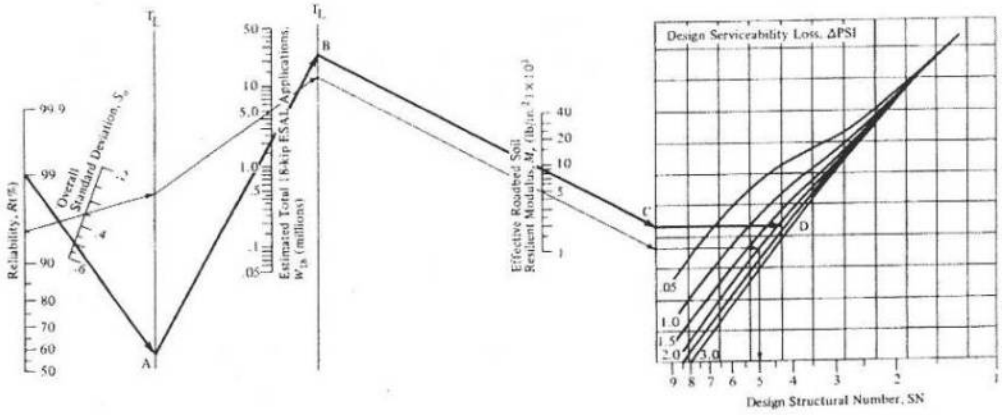


Table 6a. Equivalent Stress — No Concrete Shoulder (Single Axle/Tandem Axle)

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 7a. 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	2.32/2.49	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

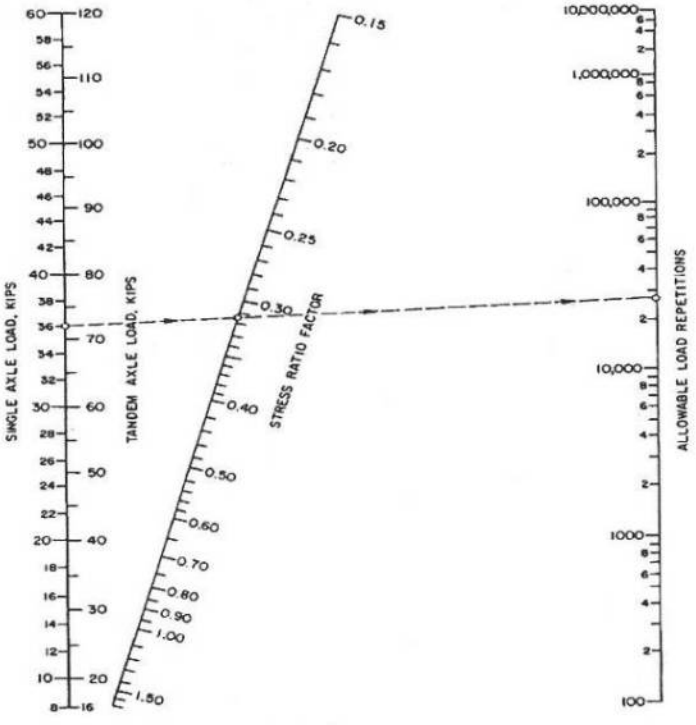


Fig. 3. Fatigue analysis—allowable load repetitions based on stress ratio factor (with and without concrete shoulder).

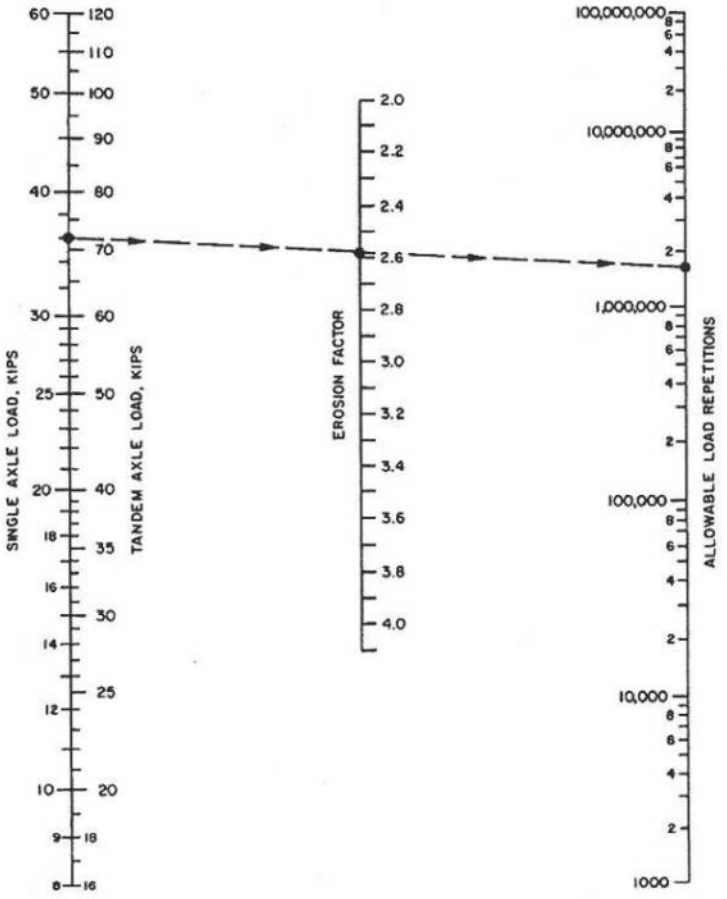


Fig. 6a. Erosion analysis—allowable load repetitions based on erosion factor (without concrete shoulder).

3. a) Define crop period and base period. Derive the relationship between duty and delta for a given base period. 2+4

b) A stream of 130 liters per second was diverted from a canal and 100 liters per second were delivered to the field. An area of 1.6 hectares was irrigated in 8 hours. The effective depth of root zone was 1.7 m. The runoff loss in the field was 420 m^3. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 20 cm per meter depth of soil. Irrigation was started at a moisture extraction level of 50% of the available moisture. 12

Find out the following:

- water conveyance efficiency
- water application efficiency
- water storage efficiency
- water distribution efficiency

4. a) Draw the schematic diagram of soil-water-plant relationship. 3

b) Graphically demonstrate the following (in one figure): 5

- Capillary water
- Hygroscopic water
- Optimum moisture content
- Readily available moisture
- Permanent wilting point
- Field capacity

c) After how many days will you supply water to soil in order to ensure sufficient irrigation of the given crop, if, 10

- Field capacity of the soil = 28%
- Permanent wilting point = 13%
- Dry density of soil = 1.3 gm/cc
- Effective depth of root zone = 70 cm
- Daily consumptive use of water for the given crop = 12 mm
- Readily available moisture is 80% of the available moisture.

5. a) Explain free board and berms. What are the purposes of berms? 4

b) Define diversion head works. Draw the layout of diversion head works. 4

c) Draw the layout of an irrigation canal network. 2

d) The cultivable command area of a watercourse is 1200 hectares. Intensities of sugarcane and wheat crops are 20% and 40% respectively. The duties for the crops at the head of the watercourse are 730 hectares/cumec and 1800 hectares/cumec respectively. 8

Find out the following:

- the discharge required at the head of the watercourse
- determine the design discharge at the outlet, assuming a time factor equal to 0.8.

6. a) Define weir and barrage with neat sketch. 2.5
   b) What is groyne? Explain different types of groyne with neat sketch. 3.5
   c) Design an irrigation channel with the following data (two trials are required): 12
   - Full supply discharge = 6 m^3/sec
   - Rugosity coefficient (n) = 0.0225
   - Critical velocity ratio (C.V.R) (m) = 1
   - Bed slope = 1 in 5000

   Assume other reasonable data for the design.

SECTION B
MARKS: 28

There are THREE (3) questions. Answer question no. 02 (COMPULSORY) and any ONE (1) from the rest. (Assume any missing data.)

1. a) Draw the average monthly discharge hydrographs for Ganges River (at Hardinge Bridge) and Brahmaputra River (at Bahadurabad) for the period 1956-1979. 5
   b) Based on the hydrographs for the Ganges and Brahmaputra, explain the flood-prone season for Ganges and Brahmaputra rivers basins. 3
   c) Write six reasons why transboundary cooperation is needed for increasing food production and mitigating and minimizing floods hazards along the Ganges and Brahmaputra rivers basins inside Bangladesh. 4

2. a) What is Integrated Water Resources Management? Describe Dublin principles (1992) of water resources management. 4
   b) Explain internationally accepted water law principles dealing with the management of international water resources shared by two or more countries. 6
   c) For effective and peaceful management of TEESTA river basin, shared by Bangladesh and India, which three water law principles are most important in your opinion? Justify why these three principles could be beneficial for both Bangladesh and India for reducing water conflict, increasing irrigation and mitigating floods hazards along TEESTA river basin. 6

3. a) Graphically show the different components of *unified city flood management*. 3
   b) Describe how air lift pump works with neat sketch. 3
   c) A centrifugal pump is required to lift water at the rate of 150 liters/sec. Calculate the brake horse power of the engine from the following data: 6
   - Suction head = 5 m
   - Delivery head = 1 m
   - Coefficient of friction = 0.01
   - Efficiency of pump = 75%
   - Diameter of pipe = 15 cm

The University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B. Sc. Engineering (Civil)

Course Title: Chemistry | Course Code: CHEM 111
Time: 3 Hours | Full Marks: 150

Section-A

There are FOUR questions in this section. Answer any **THREE.**

1. a) What is internal energy (E)? Discuss the internal energy profiles for the progress of chemical reactions. 6
Prove mathematically that $\Delta Q = mc\Delta T$ (symbols have their usual meaning) 7

   b) What is enthalpy (H)? How is it related with internal energy (E)? 6
The heat of combustion of carbon mono oxide at constant volume at 17°C is – 283.3 KJ. Calculate its heat of combustion at constant pressure 6
[Given that, $CO\,(g) + \frac{1}{2}\,O_2\,(g) \rightarrow CO_2\,(g)$]

2. a) What is associated liquid? Explain various bonding in the associated structure of water. 6
Discuss the 'Structure –Property' relationship of water molecule. 7

   b) Why CH_4 and AgCl are insoluble in water? 6
How water chemically interacts with non-metals and metal carbides? 6

3. a) What is 'acid rain'? Discuss the possible chemical phenomenon for the formation of acid rain. 6
Describe the various chemical steps for the formation and depletion of ozone (O_3) in the atmosphere. 7

   b) Briefly describe the common impurities that are present in natural water. 6
Discuss coagulation process in removing the fine impurities from water. 6

4. Write notes on: $12.5 \times 2 = 25$
   i) Heavy water
   ii) Break point chlorination

Section-B

There are FOUR questions in this section. Answer any **THREE.**

5. a) Distinguish between 'true solution', 'suspension' and 'colloid'. 6
Illustrate a 'colloidal system'. Classify colloids based on DP and DM. 7

	b)	Define 'Hydrosol', 'Lyophilic' and 'Lyophobic' colloids with examples.	6
		Describe 'Bredig's Are' method for the preparation of gold hydrosol.	6
6.	a)	State and explain 'wet corrosion'.	6
		Discuss the mechanism of wet corrosion that takes place in a dry cell.	7
	b)	Describe 'atmospheric' and 'under water' corrosions.	12
7.	a)	Distinguish between 'monomer', 'oligomer' and 'polymer'.	6
		Briefly discuss 'thermoplastic' and 'thermosetting' polymers.	7
	b)	Discuss the chemical synthesis of melamine and epoxy resin.	12
8.		Write notes on:	$12.5 \times 2 = 25$
		i) Dry corrosion	
		ii) Brownian movement of colloids	

University of Asia Pacific

Department of Civil Engineering

Final Examination Fall 2013

Program: B.Sc Engineering (Civil)

Course Title: Basic Electrical Engineering Course No. ECE 201 Credit Hours: 3.00

Time: 3.00 Hours Full Marks: 150

[There are **Eight** questions. Answer any **Six**. Figures in the right margin indicate marks]

1. a. Describe the hysteresis loop of a ferromagnetic material. Explain it with a B-H curve. [12]

   b. Determine the current I required to establish a flux of $1.5 \times 10^{-4} Wb$ in the section of the core shown in figure 1(b) [13]

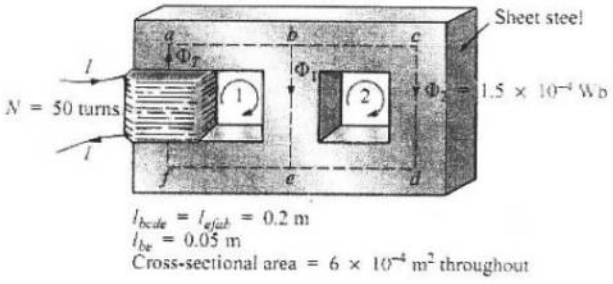


Figure 1(b)

2. a. Derive the voltage-current relationship for the capacitor and from this derive the equivalent capacitance for the parallel connection capacitors. [13]

   b. Determine V_c and i_L and the energy stored in the capacitor and inductor in the circuit of shown in Figure 2(b) under dc conditions. [12]

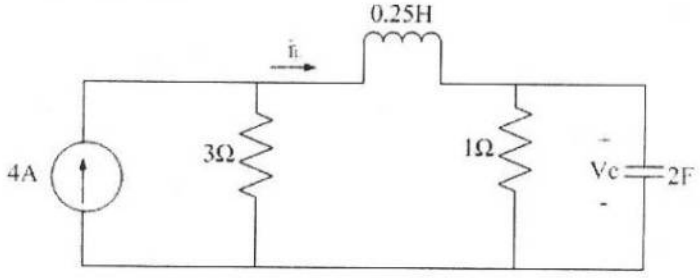


Figure 2(b)

3. a. Find the phase angle between $i_1 = -4\sin(377t + 25°)$ and $i_2 = 5\cos(377t - 40°)$. Does i_1 lead or lag i_2? [10]

   b. Determine $V_o(t)$ in the circuit shown in figure 3(b) [15]

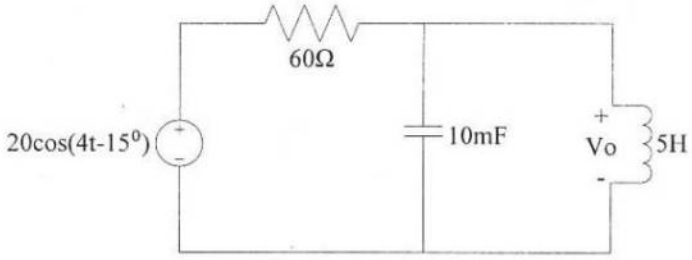


Figure 3(b)

4. a. If $v(t) = 120\cos(377t + 45°)\,V$ and $i(t) = 10\cos(377t - 10°)\,A$. Find the instantaneous power and the average power absorbed by the passive linear network. [12]

   b. A series connected load draws a current $i(t) = 4\cos(100\pi t + 10°)\,A$ when the applied voltage is $v(t) = 120\cos(100\pi t - 20°)\,V$. Find the apparent power and the power factor of the load. Determine the element values that form the series-connected load. [13]

5. a. State Maximum Power Transfer Theorem and prove it. And also show that the expression of maximum power transferred to the load is $P_{max} = \frac{V_{Th}^2}{4R_{th}}$ [15]

   b. Find the Norton equivalent circuit for the circuit shown in Figure 5(b) [10]

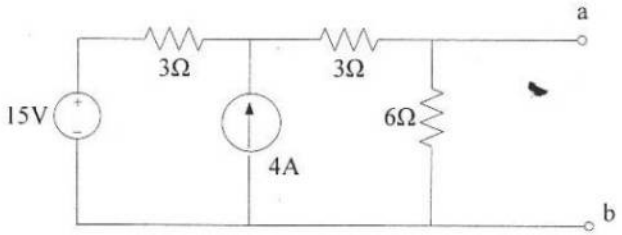


Figure 5(b)

6. a. In the circuit shown below, find v, i and the power absorbed by the 4Ω resistor. [10]

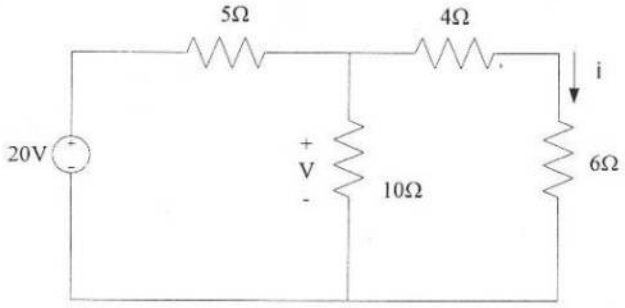


Figure 6(a)

   b. Use source transformation to find V_o in Figure 6(b) [15]

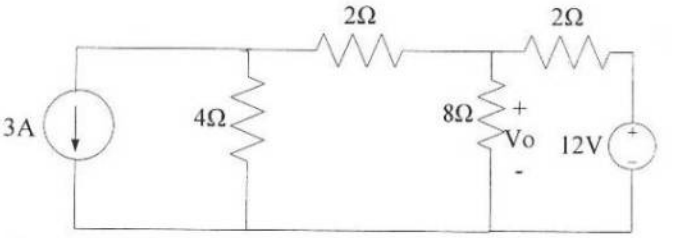


Figure 6(b)

7. a. Determine the voltages at the nodes of circuit shown in figure 7(a) [13]

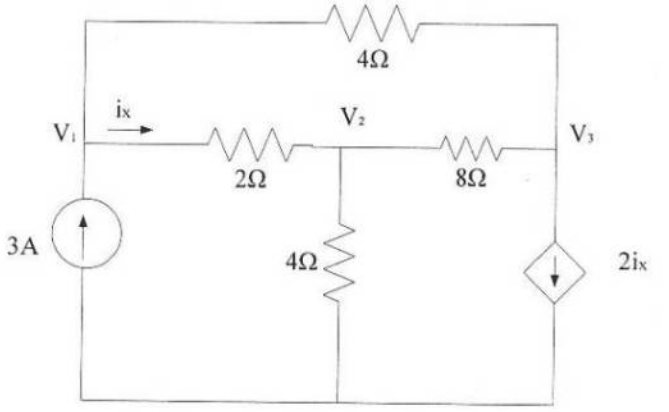


Figure 7(a)

b. Find R_{ab} for the circuit in Figure 7(b) [12]

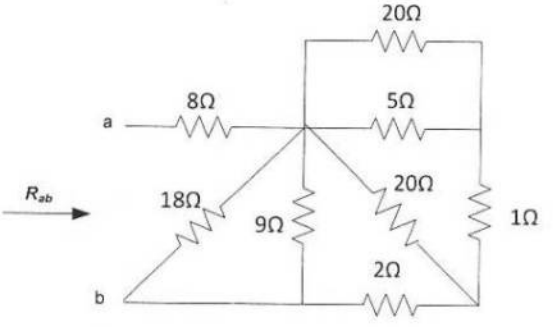


Figure 7(b)

8. a. For the circuit in figure 8(a), find the branch currents i_1, i_2 *and* i_3 using mesh analysis.

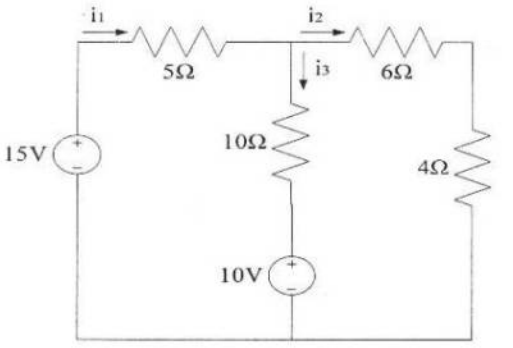


Figure 8(a)

b. Determine the voltages V_1 and V_2 and the current I generated by the voltage source E_1 shown in figure 8(b).

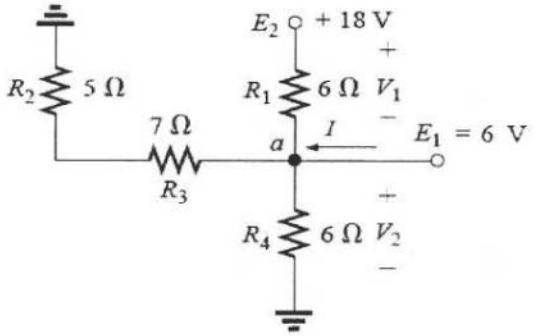
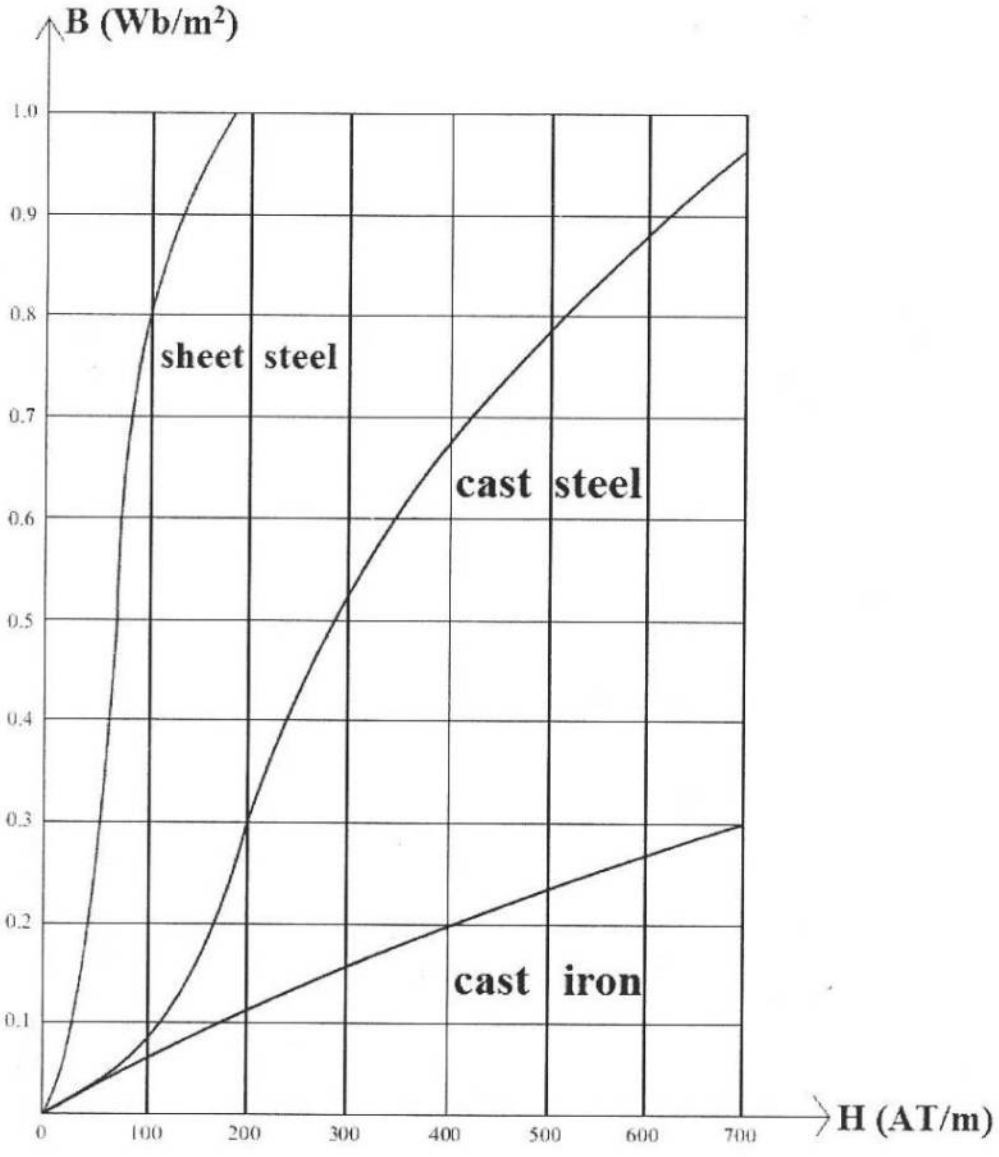


Figure 8(b)



Assume a reasonable value for the parameter as required in solving Q#1 using the figure/chart.

University of Asia Pacific
Department of Civil Engineering
Semester Final Examination, Fall-2013
Program: B.SC Engineering (Civil)

Course Title: Principle of Economics | Course Code: ECN 201

Time: 2 Hours | Full Marks: 50

Answer any **five** from the following questions:

1. (a) What are the features of monopoly ? Why monopoly is inefficient? (7)

   (b) In case of a monopolist: P= 200-3Q, TC= 4Q+4

   Find out the profit maximizing price and quantity for this monopolist. (3)

2. (a) What is GDP? What are the methods of calculating GDP? Explain. (8)

   (b) Explain the problem of "Double counting". (2)

3. (a) Calculate nominal GDP, Real GDP, GDP Deflator : Here, Base Year = **2001** (6)

	Price of Orange	Quantity of Orange	Price of Apple	Quantity of Apple
2001	150	15	145	10
2006	165	20	150	16

   i. Estimate the Nominal GDP for 2001 and 2006. What is the Real GDP in 2006?
   ii. Find the GDP deflator for 2006.

   (b) Show the differences between GDP Deflator and CPI. (4)

4. (a) Suppose price of a consumer basket of goods in year 2000=260 and in 2010=195

Find the CPI in 2010. What is the inflation rate for 2010? [Base Year= 2000] (5)

(b) Describe the causes of inflation. (5)

5. Explain different types of unemployment. (10)

6. Define: Monetary policy and Fiscal policy. What are the objectives of these policies? Show the differences between them. (10)

University of Asia Pacific

Department of Civil Engineering

Semester Final Examination (Fall 2013)

Program: B. Sc Engineering

Year: 1st Semester: 1st

Course Code: HSS 101 Time: 3.00 Hours

Course Title: English Language I Full Marks: 50

*Marks are indicated in the right margin.

Section – A

***Read* the passage *carefully* and then answer the *corresponding questions*.**

While I was walking along the road the other day I happened to notice a small brown leather purse lying on the pavement. I picked it up and opened it to see if I could find out the owner's name. There was nothing inside it except some small change and a rather old photograph-a picture of a woman and a young girl about twelve years old, who looked like the woman's daughter. I put the photograph back and took the purse to the police station, where I handed it to the sergeant in charge. Before I left, the sergeant made a note of my name and address in case the owner of the purse wanted to write and thank me.

That evening I went to have dinner with an uncle and aunt of mine. They had also invited another person, a young woman, so that there would be four people at table. The young woman's face was familiar, but I could not remember where I had seen it. I was quite sure that we had not met before. In the course of conversation, however, the young woman happened to remark that she had lost her purse that afternoon. I at once remembered where I had seen her face. She was the young girl in the photograph, although she was now much older. Of course she was very surprised when I was able to describe her purse to her.

Then I explained that I had recognized her face from the photograph I had found in the purse. My uncle insisted on going round to the police station immediately to claim the purse. As the police sergeant handed it over, he said that it was a remarkable coincidence that I had found not only the purse but also the person who had lost it.

1. Choose the best answer: **5×1= 5**

a. The purse which the writer found-

(i) was empty

(ii) had some money in it

(iii) had a few coins and a photograph in it

(iv) had an old photograph in it

b. The writer recognised the young woman because-

(i) he had met her somewhere before

(ii) she was the woman in the photograph

(iii) she often had dinner with his uncle and aunt

(iv) she looked rather like the young girl in the photo

University of Asia Pacific
Department of CE
Final Examination: Fall 2013
Program: B.Sc Engineering (Civil)

Course Title: English Language II
Time: 3.00 Hours

Course Code: HSS 103
Full Marks: 50

1. Read the following passage and answer the questions that follow:

A snow leopard roars in the high mountains of Asia. A black rhinoceros gallops across the plains of Africa. A grizzly bear hunts for fish in a North American river. A mother blue whale and her calf glide through the deep waters of the ocean.All of these animals share the Earth with us. They fascinate us with their beauty, their grace, and their speed. We love observing their behavior, and learning more about their habits. But just loving them is not enough. All of these animals are endangered. Many of them have died, and without special care, they may someday disappear from the Earth.Why is it important to care for animals like these? One reason is to protect the balance of life on Earth. Another reason is the beauty of the animals themselves. Each species of animal is special. Once it is gone, it is gone forever.Africa was once filled with an abundance of wild animals. But that is changing fast. One of these animals, the black rhinoceros, lives on the plains of Africa. It has very poor eyesight and a very bad temper! Even though the black rhino is powerful, and can be dangerous, its strength can't always help it to escape hunters. Some people think that the rhino's horn has magical powers, and many hunters kill rhinos for their valuable horns. This has caused the black rhino to be placed on the endangered species list.The elephant seems to represent all that is strong and wild in Africa. It once had no natural enemies, but is now endangered—killed for its ivory tusks.The fastest land animal, the cheetah, also lives in Africa. It, too, is becoming extinct as people take over more and more of the land that is the cheetah's natural habitat.Imagine Africa without the powerful rhino, the gentle, intelligent elephant, or the lightning quick cheetah. Once they are gone, they are gone forever.Wherever people are careless about the land, there are endangered species.

Grizzly bears like to wander great distances. Each bear needs up to 1,500 square miles of territory to call its homeland. Today, because forests have been cleared to make room for people, the grizzly's habitat is shrinking and the grizzly is disappearing. It joins other endangered North American animals, such as the red wolf and the American crocodile.

In South America, destruction of the rain forest threatens many animals. Unusual mammals, such as the howler monkey and the three-toed sloth, are endangered. Beautiful birds like the great green macaw and the golden parakeet are also becoming extinct. They're losing their homes in the rain forest, and thousands die when they are caught and shipped off to be sold as exotic pets.The giant panda of Asia is a fascinating and unique animal. Yet there are only about 1,000 still living in the wild. The giant panda's diet consists mainly of the bamboo plant, so when the bamboo forests die, so does the panda. Unfortunately, it is people who cause many of the problems that animals face. We alter and pollute their habitats. We hunt them for skins, tusks, furs, and horns. We destroy animals that get in the way of farming or building. And we remove them from their natural habitats and take them home as pets. What can you do to help endangered animals? Learn as much as you can about them. The more you know, the more you can help. Make an effort to support zoos and wildlife groups. Many zoos breed endangered animals, helping to ensure that they will continue to live on. Contribute to groups, such as the National Wildlife Federation and the Sierra Club, that work hard to protect animals. You can also be a smart shopper and never buy a pet that has been raised in the wilderness.The world is made up of many living things, and each thing is dependent on the others to survive. If we allow even one species on Earth to become extinct, it has an impact on other living things and changes our world. When we mention any endangered wild animals, let's hope that we never again have to say, "Gone forever."

Now, answer the following questions: **01 x 07 = 07**

a) Why is it important to care for the wild animals?
b) What are the valuable animals of Africa?
c) Why are the rhinoceroses and elephants killed?
d) Why is grizzly bear's habitat shrinking day by day in North America?
e) What is happening with Asia's most unique animal the giant panda?
f) How do humans cause many of the problems that wild animals face?
g) What can you do to help endangered animals?

2. Rewrite ***any ten*** of the following sentences using appropriate modal verbs: **0.5 x 10 = 05**

a) He will probably pass the interview.

2-1

University of Asia Pacific

Department of Basic Sciences and Humanities

Semester Final Examination, Fall 2013

Program: B. Sc Engineering (Civil)

(2nd Year 1st Semester)

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. "The nuclear family is sometimes called the two-generation family, whereas the extended family is called a three-or-four-generation family." – Discuss the different types of family using your own experience of family life. Make a list of the advantages and disadvantages of living in each type of family. 10+10

2. Define social survey. Carry out an imaginary small-scale social research using the various sources, research methods and following the stages of a survey. 5+15

3. Describe and explain non-participant and participant observation in sociological research. Explain their various strengths and limitations. 12+8

4. Describe the main features of a democracy. How democracy differs from totalitarianism and dictatorship? 5+15

5. How is culture socially transmitted? Explain the non-material elements of culture. 5+15

SECTION B

There are **THREE** questions in this section. Answer **ANY TWO** (2x10)

6. Explain the difference between quantitative and qualitative data.
7. Discuss with example the difference between ethnocentrism and counter culture.
8. What is the overall physical environment like in the over-urbanized cities?

University of Asia Pacific
Department of Basic Sciences and Humanities
Semester Final Examination, Fall 2013
Programme: B.Sc. Engineering (Civil)
2nd year 1st semester

Course Title: Bangladesh Studies: History **Course Code: HSS 211(b)**
Credit: 2.00

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. Do you think that social difference between Hindus and Muslims and anti British movement worked as a reason behind the *partition of Bengal (1905)*? Show the partition.
2. What was the background of *Lahore Resolution*? Was it Pakistan Resolution?
3. Describe the first phase of *Language Movement*.
4. What was *Permanent settlement*? Was it good for the *rayats*?
5. Do you think that Raja Rammohon Roy was a modern person? Explain on behalf of your answer.

SECTION B

There are **THREE** topics in this section. Write short notes on **ANY TWO** (2 x 10)

1. Rising of Bara Bhuiyas and their main centre
2. Shayesta Khan's conquest of Chittagong
3. Six Point programme

c. According to the context ***familiar*** means-

(i) common (ii) known

(iii) famous (iv) domestic

d. Where did they go to get the purse back?

(i) Owner's house (ii) Park

(iii) Police Station (iv) Writer's house

e. In the context, what can be the another way to say ***claim***-

(i) pretend (ii) identify

(iii) ask for (iv) take

Section – B

2. Fill in *any three* (3) of the blanks with appropriate parts of speech. **3×2=6**

a. Joy _____ (clear) spoke to Sithi about his _____ (horror) experience.

b. These are some _____ (fresh) picked raspberries, look how _____ (softly) they are.

c. In order to _____ (strength) one's mind, one must have _____ (courage) heart.

d. The _____ (different) between you and me is that I am _____ (energy) and you are not.

e. The _____ (origin) price of this phone is very _____ (height).

3. Add either prefix or suffix with any five (5) of the following words and make a sentence with each of the new words. **5 x 1 = 5**

Dis-, -ion, -ive, Extra-, -ly Pre-, For-, -ance, Im-, -ical

Method, Act, Order, Partial, Give, Terrestrial, Express, Poor, Clear, Mature

4. Fill in any four (4) of the blanks with appropriate homophones conforming to their respective IPA transcriptions. **4 x 1 = 4**

i. The principal told us that we are not _____ (/əˈlaʊd/) to sing the song _____ (/əˈlaʊd/).

ii. Dip was boasting that he _____ (/eɪt/) almost _____ (/eɪt/) pieces of pizza.

iii. How many times did I say to _____ (/raɪt/) the letter in the _____ (/raɪt /) way.

iv. Nasif _____ (/rəʊd/) a horse and went to the market by Brooklyn _____(/rəʊd/).

v. I have never _____ (/si:n/) such a beautiful _____ (/si:n/) in my entire life.

vi. Grandfather has been feeling _____ (/wi:k/) since last _____ (/wi:k/).

5. Write two (2) sentences with any four (4) of the following words and their homographs. **4 x 1 = 4**

Interest, Post, File, Poor, Over, Chest

6. The following excerpt has some misspelled words. Trace them out and write them correctly. **10 x 0.5 = 5**

Persuasion is the art of convincing someone to agree with your point of veiw. According to the anceint Greek philosopher Aristotle, there are three basic tools of persuasion: ethos, pathos, and logos. Ethos is a speaker's way of convincing the audience that she is a credible sorce. An audience will consider a speaker credible if she seems trastwurthy, reliable, and sincere. This can be done in many ways. For example, a speaker can develop ethos by explaning how much experince or education she has in the field. After all, you would be more likely to listen to advise about how to take care of your teeth from a dentist than a fierefightar. A speaker can also creat ethos by convincing the audience that she is a good person who has their best interests at hart. If an audience cannot trust you, you will not be able to persuade them.

Section – C

Answer any three (3) of the following questions. Each question carries seven (7) marks.

7. Compare and contrast between public university and private university. (250 words)

8. Write a paragraph describing a 'Cricket Match' that you have witnessed recently. (250 words)

9. Write a letter to your friend describing him/her about the cultural fair you have enjoyed recently. (250 words)

10. Translate the following passage into English.

জয় আজ ক্লাসে আসতে দেরি করে ফেলেছে। সে ঠিক সময়ে বাড়ি থেকে বের হয়েছিল। পথে অতিরিক্ত যানজটের কারনেই তার দেরি হল। ততক্ষনে ক্লাস শুরু হয়ে গিয়েছে। তবুও সে দরজায় দাঁড়িয়ে ম্যাডাম কে জিজ্ঞেস করলো, "ম্যাম, আসতে পারি?" এত দেরি দেখে ম্যাম কিছুটা রাগ করলেন। আজ অনেক গুরুত্বপূর্ণ একটা ক্লাস ছিল। ম্যাম বললেন, "না, বাহিরে দাঁড়িয়ে থাক।" জয় তাই করলো। কিছুক্ষণ দাঁড়িয়ে থেকে জয় আবার ভিতরে আসতে চাইলো। ম্যাম এবার জিজ্ঞেস করলেন, "তোমার বাসা কোথায়?" উত্তরে জয় বলল, "ম্যাম কাছেই। বেশি দূরে নয়"। এই কথা শুনে ম্যাম আরো রেগে গেলেন।

b) Everyone has the obligation to respect their elders.
c) You are inviting your friend for a lunch.
d) You don't have the necessity to keep a seat for me.
e) Zia is able to run a marathon.
f) I have the necessity to buy a vehicle of my own.
g) Perhaps I will study Astrophysics in my higher studies.
h) You are seeking permission to drive the car.
i) My brother is able to convince people just by talking to them for a few minutes.
j) You are suggested to do more practice if you want to make it into the first team.
k) Mamun was in a habit of rising late when he was at college.

3. Join ***any ten*** of the following pairs of sentences with appropriate conjunctions or relative pronouns. Do not repeat the same joining word: **0.5 x 10 = 05**

a) Ben told me he is coming on Friday. He may come on Sunday as well.
b) It was a holiday. All the shops and markets were open.
c) The fight was going out of hand. We had to leave.
d) I will not allow you to leave. You have to tell me where you are going.
e) Diana brought a blue bag with her. She was wearing matching blue shoes.
f) That was my Father's card. I lost it yesterday on my way home.
g) The movie was very scary. We enjoyed it very much.
h) The bikers were tired. They urged to move on.
i) I rang the doorbell thrice. You opened the door.
j) Joya is the girl I was telling you about. She lives in Chittagong.
k) I will show you how it is done. You cannot do it on your own.

4. Write single sentence definition of ***any five*** of the following: **01 x 05 = 05**

a) Courage (negation) b) Postpone (synonym) c) Calculator (function)
d) Fireman (function) e) Camel (class) f) Museum (description)

5. Write an application to your Head of Department seeking permission to organize a debate competition at your own department. **05**

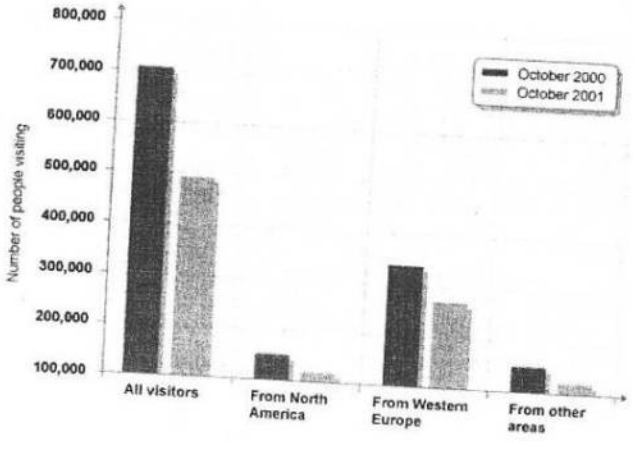
6. UAP will take part in the 'International Science Fair – 2014'. As the convener of UAP Science Club, write a memorandum to this effect. **05**

7. The Inter Department Indoor Sports Competition of UAP has been held recently. 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*** of the following (word limit 130) **08**

a) The Day You Will Never Forget b) Traffic Jam in Dhaka City

9. The bar chart shows information about the number of visitors that visit A National Park in the month of October from different parts of the world. Describe and analyze the information available in the chart in your own words. 05



University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: B.Sc. Engineering (Civil)

Course Title: Principles of Management | Course Code: IMG301
Time: 2 hour | Full Marks: 50

(Answer Question No. 3 & 8 and any four)

1.(a) Write down the 10 methods to motivate employees in an organization. (3)
(b) Describe some (at least 4) popular reward systems for motivating performance of an employee in an organization. (3)

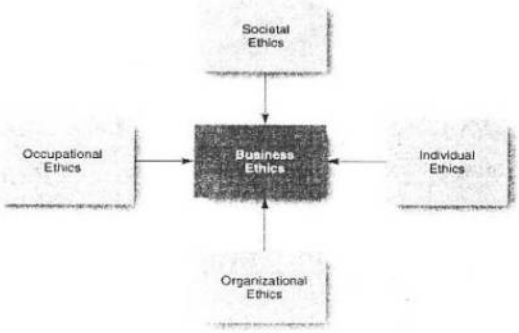
2. (a) What is meant by power? Describe the concept of 'Political Power'. (2)
(b) What do you understand by authority? What are the three kinds of most influential authorities that Max Weber has stated? Give brief description of those. (4)

3. Write short notes on: (2x6 = 12)
(a) Mission Statement
(b) Strategic Goal
(c) Tactical Goal
(d) Operational Goal
(e) Difference between Vision and Mission
(f) Difference between Dream and Goal

4. (a) Write the differences between Manager and Leader in a tabular form. (3)
(b) When do we prefer democratic leadership style? What is its limitation? (3)

5. (a) Why organizational control important? (3)
(b) Describe the demerits of three organizational controls in a tabular form. (3)

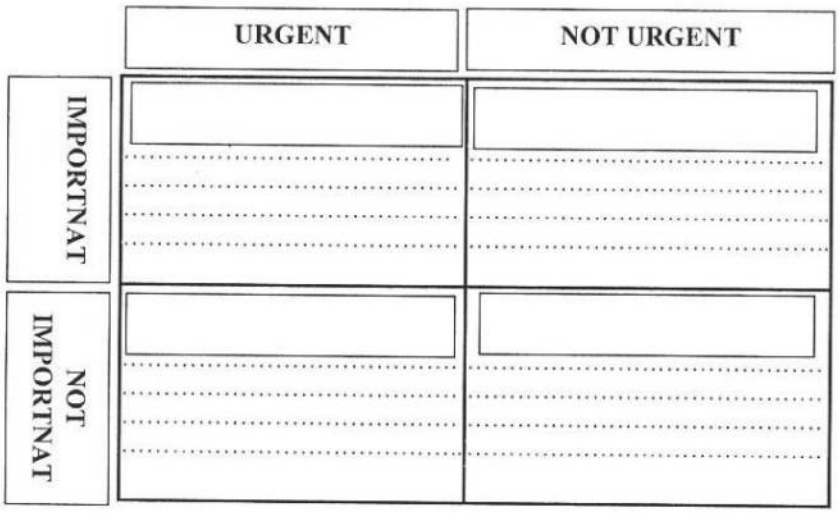
6.(a) Write down the common misconducts in a organization. (3)
(b) Briefly describe the determinants of ethics from the following figure. (3)



7. (a) Describe Maslow's hierarchy of need theory. (4)
(b) Briefly write down Free Rein' leadership style. (2)

8. (a) What do you understand by Time Management? What is its purpose? (6)

(b) From the Task List (Priority Matrix), Draw the figure with the legends of each block and give brief description of activities for that block. (8)



University of Asia Pacific

Department of Basic Sciences and Humanities

Semester Final Examination Fall-2013

Program: B. Sc Engineering (Civil, 1st Year/1nd Semester)

Course Title: Mathematics I | Course Code: MTH 101 | Credits: 3.00
Time: 3 hours | Full Marks: 150

[N.B. The figures in the right margin indicate marks. There are two sections in this question paper, namely **SECTION A** and **SECTION B**. Answer from both sections according to the instructions mentioned in each section.]

SECTION A

(There are **FOUR** questions. Answer any **THREE**.)

1. Consider the equation

   $(*)$ $$y = x^2 + 3x + 2$$

   (a) Which conic section is represented by $(*)$? 5

   (b) Find the equations of the tangent and normal to $(*)$ at the point $(-1, 0)$. 5+5

   (c) Find the radius and centre of curvature of $(*)$ at the point $(-1, 0)$. 5+5

2. Carefully state and prove the fundamental theorem of calculus. 25

3. (a) Find the area below the curve $y = x, x \in [1, 2]$ using the method of summation, and check your answer by integrating the function explicitly. 10+5

   (b) Evaluate $\int_0^{\pi/2} x \sin x \, dx$. 10

4. Show that a circle of radius R encloses an area πR^2 and has circumference $2\pi R$. 15+10

TURN OVER

University of Asia Pacific
Department of Basic Sciences & Humanities
Final Examination, Fall - 2013
Program: B.Sc. Engineering (Civil, 1st year/ 2nd semester)

Course Title: Mathematics II
Time: 3 hours

Course Code: MTH 103
Full Marks: 150

*[N.B. - The figures in the 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**

1. (a) Show that if the direction of axes being changed and the position of the origin remains unchanged then the required transformations are given by the following equations: 15

$$x' = l_1x + m_1y + n_1z$$
$$y' = l_2x + m_2y + n_2z$$
$$z' = l_3x + m_3y + n_3z$$

(b) OA, OB, OC are three mutually perpendicular lines through the origin with direction cosines l_1, m_1, n_1; l_2, m_2, n_2; l_3, m_3, n_3 and if $OA = OB = OC = a$, then show that the equation of the plane ABC is 10

$$(l_1 + l_2 + l_3)x + (m_1 + m_2 + m_3)y + (n_1 + n_2 + n_3)z = a$$

2. (a) Define quadric surfaces. Show that the equation $3x^2 + y^2 + 2z^2 + 3x + 3y - 4z = 0$ represents an ellipsoid. Find its centre and lengths of semi-axes. 10

(b) Find the locus of the perpendiculars from the origin to tangent planes of the surface 15

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$

which cut off from its axes intercepts, the sum of whose reciprocals is equal to a constant $\frac{1}{k}$.

3. (a) Find the equation of the locus of a point, the difference of whose distances from $(-4,3,1)$ and $(4,3,1)$ is 6. 10

(b) Find the equations to the tangent planes to $2x^2 - 6y^2 + 3z^2 = 5$, which passes through the line $x + 9y - 3z = 0$ and $3x + 3y + 6z - 5 = 0$. 15

4. (a) Given three non-coplanar vectors $\underline{a}$, $\underline{b}$ and $\underline{c}$. Find an expression for any vector $\underline{r}$ in three dimensional space. Also discuss the geometrical interpretation of scalar product of two vectors. 15

(b) Find the acute angle between the surfaces $xy^2z = 3x + z^2$ and $3x^2 - y^2 + 2z = 1$ at the point $(1, -2, 1)$. 10

University of Asia Pacific
Department of Basic Sciences & Humanities
Final Examination, Fall - 2013
Program: B.Sc. Engineering (Civil, 2nd year/ 1st semester)

Course Title: Mathematics III | Course Code: MTH 201
Time: 3 hours | Full Marks: 150

*[N.B. - The figures in the 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**

1. (a) Define Matrix representation of linear mapping. 5

   (b) Let $G: \mathbb{R}^3 \longrightarrow \mathbb{R}^2$ be a linear mapping defined by $G(x,y,z) = (3x + 2y - 4z, x - 5y + 3z)$. Then find the matrix representation of G with respect to the following bases of $\mathbb{R}^3$ and $\mathbb{R}^2$: $f = \{f_1 = (1,1,1), f_2 = (1,1,0), f_3 = (1,0,0)\}$ and $g = \{g_1 = (1,3), g_2 = (2,5)\}$ and also verify that $[G]_f^g[v]_f = [G(v)]_g \ \forall\, v \in \mathbb{R}^3$. 20

2. (a) Define Transition matrix. What are the differences between a linear operator and a linear mapping? 5

   (b) Let $\{f_1 = (1,2), f_2 = (2,3)\}$ and $\{g_1 = (1,3), g_2 = (1,4)\}$ be two bases of $\mathbb{R}^2$. Then find the transition matrix P and Q from $\{f_1, f_2\}$ to $\{g_1, g_2\}$ and from $\{g_1, g_2\}$ to $\{f_1, f_2\}$ respectively. Also verify that $P = Q^{-1}$. 15

   (c) Let $A = \begin{bmatrix} 1 & -2 \\ 4 & 5 \end{bmatrix}$ and $f(t) = t^2 - 6t + 13$. Show that A is a root of $f(t)$. 5

3. (a) What do you mean by the Characteristic Polynomial of a matrix? 5

   (b) Let $B = \begin{pmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{pmatrix}$. Then find 20

   (i) The Characteristic matrix;
   (ii) The Characteristic equation;
   (iii) The Eigen values and the corresponding Eigen vectors of B. Also find an invertible matrix P such that $P^{-1}BP$ is diagonal.

4. (a) In what conditions a linear map $F: V \longrightarrow U$ is said to be singular or nonsingular? 5

   (b) Let $T: \mathbb{R}^2 \longrightarrow \mathbb{R}^3$ be defined by $T(x,y) = (x + y, x - 2y, 3x + y)$. 10

   (i) Show that T is nonsingular;
   (ii) Find a formula for T^{-1}.

   (c) Find the Eigen values of $C = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 4 & -17 & 8 \end{pmatrix}$. 10

University of Asia Pacific
Department of Basic Sciences & Humanities
Semester Final Examination, Fall-2013
Program: B.Sc. Engineering (Civil, 2nd year/2nd semester)

Course Title: Mathematics IV | Course Code: MTH 203
Time: 3 hrs | 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) (i) Write down the general solution for conjugate complex roots. (2+5)

   (ii) Find the general solution of $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 25y = 0$.

   (b) Obtain the general solution of $x^2\frac{d^2y}{dx^2} + \frac{dy}{dx} + 4y = 2xlnx$. (18)

2. (a) Using Fourier integral, show that $e^{-ax} = \frac{2a}{\pi}\int_0^\infty \frac{cos\lambda x}{\lambda^2+a^2}d\lambda, \quad a > 0, \quad x \geq 0$. (10)

   (b) Prove that $e^{-x}cosx = \frac{2}{\pi}\int_0^\infty \frac{(u^2+2)cosux}{u^4+4}du$ (15)

3. (a) Define finite Fourier sine transform of $F(x)$. (3)

   (b) Find the finite Fourier sine transform of $f(x) = x^3$. (15)

   (c) Prove that $F_s(sinjx) = \begin{cases} 0 & if\ j \neq s\ and\ j, s\ are\ integers \\ \frac{\pi}{2} & if\ j = s \end{cases}$ (7)

4. (a) (i) Define finite Fourier cosine transform of $F(x)$. (3+7)

   (ii) Find $F_C(sinvx), v$ is a positive integer.

   (b) Obtain the finite Fourier cosine transform of $f(x) = \frac{\pi}{3} - x + \frac{x^2}{2\pi}$ (15)

SECTION B

(There are **FOUR** questions. Answer any **THREE**.)

5. (a) Evaluate the improper integral $\int_{-\infty}^{0} (1+x)e^{x}\,dx$. 15

   (b) Using the substitution $u = 1-x^2$, or otherwise, evaluate $\int_{0}^{\cdot} \frac{x}{\sqrt{1-x^2}}\,dx$. 10

6. (a) Split $\frac{2x+4}{x^3-2x^2}$ into partial fractions. 10

   (b) Evaluate $\int_{1}^{3} \frac{2x+4}{x^3-2x^2}\,dx$. 15

7. Let $I_n = \int x^n e^{-x}\,dx$.

   (a) What is I_0? 3

   (b) Integrating by parts, or otherwise, show that 8

   $$I_n = -x^n e^{-x} + nI_{n-1}$$

   (c) Evaluate $\int_{0}^{1} x^4 e^{-x}\,dx$. 14

8. (a) Define the Gamma function $\Gamma(n)$. For which n is it defined? 3

   (b) Show that $\Gamma(n+1) = n\Gamma(n)$. Hence show that, if $n > 0$ is an integer, then $\Gamma(n+1) = n!$ 8+4

   (c) Using the substitution $u = 2x$, or otherwise, show that $\int_{0}^{\infty} x^{n-1}e^{-2x}\,dx = \frac{\Gamma(n)}{2^n}$. 10

SECTION B

There are **FOUR** questions. Answer any **THREE**

5. (a) Define line integral and surface integral of a vector function. 10

(b) If $\vec{F} = 4xz\hat{\imath} - y^2\hat{\jmath} + yz\hat{k}$, evaluate $\iint_S \vec{F}.\hat{n}\, dS$ where S is the surface of the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. 15

6. (a) Show that $\vec{P}.(\vec{Q} \times \vec{R})$ is in absolute value equal to the volume of a parallelepiped with sides $\vec{P}$, $\vec{Q}$ and $\vec{R}$. 10

(b) If $\vec{A} = (3x^2 + 6y)\hat{\imath} - 14yz\hat{\jmath} + 20xz^2\hat{k}$, evaluate $\int_C \vec{A}.d\vec{r}$ 15

from $(0,0,0)$ *to* $(1,1,1)$ along the following paths in C:

(i) $x = t, y = t^2, z = t^3$

(ii) the straight lines from $(0,0,0)$ to $(1,0,0)$, then to $(1,1,0)$ and then to $(1,1,1)$.

7. (a) Prove the law of sines for plane triangles using the concept of vectors. 10

(b) State the Green's theorem in plane. Verify Green's theorem in the plane for 15

$\int_C (xy + y^2)dx + x^2 dy$ where C is the closed curve of the region bounded by $y = x$ and $y = x^2$.

8. (a) Define the gradient of a scalar function and the divergence of a vector function in space. 5

(b) Prove the following: 20

(i) $\nabla\varphi = \frac{\underline{r}}{r^2}$ if $\varphi = \ln|\underline{r}|$

(ii) $\nabla\varphi = -\frac{\underline{r}}{r^3}$ if $\varphi = \frac{1}{r}$

(iii) $\nabla \mathrm{r}^n = nr^{n-2}\underline{r}$

(iv) $\nabla.\left(\frac{\underline{r}}{r^3}\right) = 0$

The End

SECTION B

There are **FOUR** questions. Answer any **THREE**

5. (a) What is meant by central tendency of data? Write down its characteristics. 5

   (b) What are the usual measures of central tendency? Which of them do you like most and why? 5

   (c) For the frequency table given below $\bar{x} = 3.68$. Find the two missing frequencies. 15

Value of x:	0	1	2	3	4	5	6	7	Total
Frequency:	2	-	11	23	29	-	12	3	100

6. (a) Find out the Quartile Deviation and the Coefficient of Quartile Deviation from the following frequency distribution table: 15

Variable	Frequency
0-5	2
5-10	5
10-15	7
15-20	13
20-25	21
25-30	16
30-35	8
35-40	3

   (b) Define the (i) Geometric Mean (ii) Harmonic Mean. 10
   Three families A, B, C have equal total monthly expenditure. The per capita expenditures of these families are Tk. 700, Tk.850 and Tk. 1090 respectively. Calculate the per capita expenditures of these 3 families together.

7. (a) Define Mean Deviation and Standard Deviation. Derive the working formula to calculate the Standard Deviation. 10

   (b) Calculate the Mean and the Standard Deviation for the following table giving the age distribution of 542 members. 15

Age in years	20-30	30-40	40-50	50-60	60-70	70-80	80-90
No. of members	3	61	132	153	140	51	2

   Also find out the coefficient of variation.

8. (a) What is Conditional Probability? A Fair coin is tossed until a head appears or until it has been tossed 4 times. Given that a head did not appear on either of the first two times, find the probability that 15
      (i) The coin was tossed 4 times;
      (ii) The coin was tossed just 3 times.

   (b) Suppose that the amount of Cake(in hundred pounds) X that a certain bakery is able to sell in a day is found to be a numerical valued random phenomena with a probability function specified by the probability density function $f(x)$ given by 10

$$f(x) = \begin{cases} Ax, \text{ for } 0 \le x \le 5 \\ A(10-x), \text{ for } 5 \le x \le 10 \\ 0, \text{ otherwise.} \end{cases}$$

      (i) Find the value of A such that $f(x)$ is a probability density function.
      (ii) What is the probability that the cake will be sold tomorrow is between 250 to 750 pounds?

The End

SECTION B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define Laplace transform of $F(t)$. (5)

   (b) Determine the Laplace transform of (i)$tsinpt$ and (ii)$tcosqt$. (6+6)

   (c) State and prove the second shifting theorem. (8)

6. (a) Write down the theorem of multiplication by powers of t for Laplace transform. (3)

   (b) Use the theorem of (a), prove that $\int_0^\infty t^3 e^{-t} sintd\,t = 0$. (12)

   (c) Find the Laplace transform of $\int_0^t \frac{1-e^{-2x}}{x} d\,x$. (10)

7. (a) Find $\mathcal{L}^{-1}\{\frac{1+2s}{(s^2+1)(s^2+s+1)}\}$. (use partial fraction) (13)

   (b) Evaluate $\mathcal{L}^{-1}\{\frac{1}{s(s+1)^3}\}$. (Use convolution theorem) (12)

8. (a) Prove that $\mathcal{L}(F''(t)\} = s^2 f(s) - sF(0) - F'(0)$ (10)

   (b) Apply Laplace transform to solve (15)

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = e^{-t} sint$$

given that $y(0) = 0, \frac{dy}{dt} = 1\ when\ t = 0$

University of Asia Pacific
Department of Basic Sciences and Humanities
Final Examination Fall - 2013
Program: B.Sc Engineering (Civil)

Course Title: Physics I | Course Code: PHY-101 | Credit: 3.00
Time: 3.00 Hours | Full Marks: 150

*[N.B- The figures in the right margin indicate 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 and is 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) Prove that the differential equation of a progressive wave is given by $\frac{d^2y}{dt^2}=v^2\frac{d^2y}{dx^2}$, where the symbols have their usual meanings. **15**

   (b) Derive that for a particle executing simple harmonic motion, the acceleration at any instant can be written as $a=-\omega^2 y$, where the symbols have their usual meanings. **10**

3. (a) Prove that the equation of Laplace's correction to Newton's formula for velocity of sound in gas can be written as $V=\sqrt{\frac{\gamma P}{\rho}}$, 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 an expression for the Doppler effect in sound when observer is at rest and source is 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: **10**
   (i) before the trains cross each other
   (ii) after the trains have crossed each other
   Consider the velocity of sound as 340 m/s.

[Turn over

SECTION B

There are **FOUR** questions. Answer any **THREE** Marks

5. (a) Prove that the moment of inertia of a solid sphere is $\frac{2}{5}MR^2$, where the symbols have their usual meanings. Draw the necessary figures. **15**

   (b) Deduce that the radius of gyration of a rotating body can be written as $K = \sqrt{\frac{r_1^2+r_2^2+r_3^2+\ldots+r_n^2}{n}}$, where the symbols have their usual meanings. **10**

6. (a) Derive that the moment of inertia of a uniform circular disk is $\frac{1}{2}MR^2$, where the symbols have their usual meanings. Draw the necessary figures. **15**

   (b) Show that the kinetic energy of a rotating body is given by the relation $\frac{1}{2}I\omega^2$, where the symbols have their usual meanings. **10**

7. (a) Considering that a ring hoops about its axis, derive an expression for the moment of inertia of the ring. Draw the necessary figures. **15**

   (b) Prove that the perpendicular axes theorem for a plane lamina is expressed by the relation **10**

   $$I_Z = I_Y + I_X$$

   where the symbols have their usual meanings.

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. Consider that the axis of rotation passes through its centre and draw the necessary figures. **15**

   (b) Obtain the following expressions: **10**

   (i) Angular momentum $L = I\omega$

   (ii) Torque $\tau = I\alpha$

   where the symbols have their usual meanings.