28.09.2013

L-2/T-2/CE **Date : 28/09/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **HUM 217** (Engineering Economics)

Full Marks: 140 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Explain the short-run equilibrium of a firm under perfect competition. **(10)**

(b) The total cost function of a firm is $C = Q^3 - 10Q^2 + 17Q + 66$. Calculate the amount of output that maximizes profit when P = 5. What is the maximum amount of profit? **(10)**

(c) What are the conditions of profit maximization? **($3\frac{1}{3}$)**

2. (a) Define and explain fixed cost and variable cost. **(10)**

(b) From the following function, find the average cost (AC), average variable cost (AVD), marginal cost (MC), average fixed cost (AFC) functions. Find the slope of the AC and MC curves. Calculate the amount of output when MC and AVC will be minimum. **(10)**

$$C = 0.04Q^3 - 0.9Q^2 + 10Q + 10$$

(c) Graphically show the relationship among various short-run average cost curves. **($3\frac{1}{3}$)**

3. (a) When does a firm emerge as a monopolist? **(5)**

(b) Prove that $MR = P\left(1 - \frac{1}{e}\right)$ in case of a monopolist. **(10)**

(c) Show that the slope of marginal revenue is double than the slope of the demand curve in case of a monopolist. **($8\frac{1}{3}$)**

4. (a) What are the main causes of localization of industries? **(5)**

(b) What are the advantages of division of labour? Explain them. **(10)**

(c) From the following functions, calculate the amount of labour and capital that maximizes output. What is the maximum amount of output? **($8\frac{1}{3}$)**

$Q = 300\ L^{0.7}K^{0.6}$

$1500 = 35\ L + 45\ K$

Here Q = Quantity or output

L = Labour

K = Capital

Contd P/2

HUM 217

SECTION – B

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

5. (a) Explain the concepts of microeconomics and macroeconomics. Briefly discuss the relative importance of microeconomics and macroeconomics in the formation of national economic policies of a country. **(7)**

   (b) Mathematically derive the cardinal theory of consumer equilibrium. **(8)**

   (c) Why does demand curve slope downward to the right? **(3⅓)**

   (d) Briefly discuss the relationship between economics and engineering education. **(5)**

6. (a) Define and explain the concept of demand function. **(3⅓)**

   (b) Explain graphically the 'change in demand' and 'change in quantity demanded' with reference to the change in prices of substitute and complementary commodities. **(10)**

   (c) Illustrate the factors that affect the demand for a commodity in general. **(10)**

7. (a) Define market equilibrium. Explain how the price of a commodity in the market is determined. **(9)**

   (b) Discuss how the state of technology affects the supply of a commodity. **(5⅓)**

   (c) (i) Calculate the equilibrium price and quantity from the following demand and supply functions and graphically show the result. **(9)**

   $$QD_x = 4000 - 400P_x$$

   $$QS_x = -500 + 500P_x$$

   (ii) If a per unit tax of Tk. 0.90 is imposed, how will it affect the equilibrium price and quantity?

   (iii) If Government provides a subsidy of Tk. 2 per unit, what will happen to the equilibrium price and quantity?

8. (a) Define price elasticity of demand, write down its formula and explain. **(8⅓)**

   (b) From the following table calculate the price elasticity of demand when you move from point B to point C. **(5)**

Point	Price	Quantity
A	1200	25
B	1500	20
C	1800	18

   (c) Define substitution effect and income effect of a price change. Describe how would you split up these two effects. Present and explain all necessary diagrams. **(10)**

L-2/T-2/CE Date : 05/10/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CE 207** (Applied Mathematics for Engineers)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Symbols carry their usual meaning. Make use of tables as necessary.

1. (a) If $X_1, X_2, ..., X_n$ are independent Poisson random variables with each having the same parameter λ, determine the maximum likelihood estimator of λ (Derive an expression). **(12)**

(b) The number of claims handled by an insurance company on 15 randomly chosen days in a year are known to be 3, 5, 6, 2, 4, 2, 1, 3, 5, 4, 3, 4, 3, 5, 4. Use this data to determine the proportion of days that will have more than 3 claims. What is the probability that there will be exactly 3 claims in three consecutive days? **(14)**

(c) Describe briefly how quality control is achieved in the manufacturing industry. Discuss how upper and lower control limits are established. **(9)**

2. (a) A producer specifies that the mean life time of a certain type of battery is at least 240 hrs. A sample of 18 such batteries yielded the lifetime data: 237, 242, 232, 242, 248, 230, 244, 243, 254, 262, 234, 220, 225, 236, 232, 218, 228, 240. **(15)**

Assume that the life of the batteries is approximately normally distributed, does the data indicate that the specifications are not being met. Perform the t-test.

(b) A certain component is critical to the operation of an electrical system and must be replaced upon failure. If the mean lifetime of this component is 100 hrs and its standard deviation is 30 hrs, what is the probability that 20 components will last for at least 2000 hrs. How many components are needed for continuous operation with a probability of 0.95. **(14)**

(c) What do you mean by standard residuals? Discuss with diagram how plot of residuals can be helpful in assessing validity of the linear regression model. **(6)**

3. (a) The daily probability of the event (E) that a major earthquake will occur is given as 0.00001. Let C_1 & C_2 represent two mutually independent precursor events which may occur immediately before an earthquake. Assuming the following probabilities $P[C_1 \mid E] = 0.15$, $P[C_2 \mid E] = 0.12$, $P[C_1 \mid E^C] = P[C_2 \mid E^C] = 0.01$, and applying Baye's Theorem, determine the conditional probability for an earthquake to occur, if both precursor events C_1 & C_2 occur. **(12)**

Contd P/2

(b) What is an indicator random variable? Derive the expression for its variance [Var(I)]. **(6)**

(c) Due to a certain type of explosive, the force exerted on a single storey frame (Fig. 1a) is shown in Fig. 1b. The governing equation of motion of the system is **(17)**

$$m\ddot{u} + 2ku = P(t)$$

where u is the displacement of mass. Determine the position of the mass after '2a' secs.

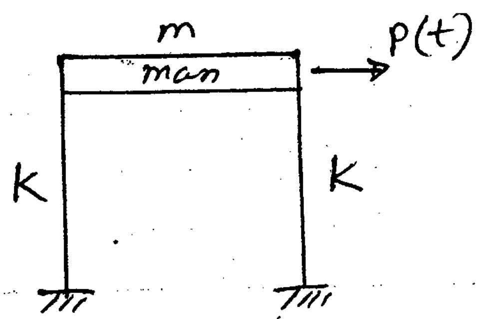

Fig. 1a.

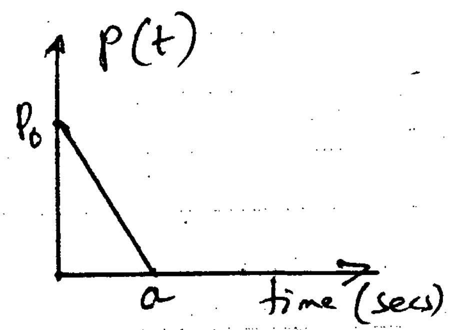

Fig. 1b

4. (a) Plot the function: $f(x) = mx\{H(0) - H(x-a)\}$ where m is a constant, x is the independent variable and H stands for Heavyside Step Function. Determine the Fourier Transform of the function. **(12)**

(b) Suppose a non-prismatic structure is subjected to an exponentially decaying axial force, shown in Fig. 2. The governing equation is: **(23)**

$$-\frac{d}{dx}\left\{E(a+bx)\frac{du}{dx}\right\} = Ce^{-dx}H(0)$$

where a, b, c, d are constants. E is modulus of elasticity and u is the axial deformation. H is the Heavyside Step Function. Solve the equation for u.

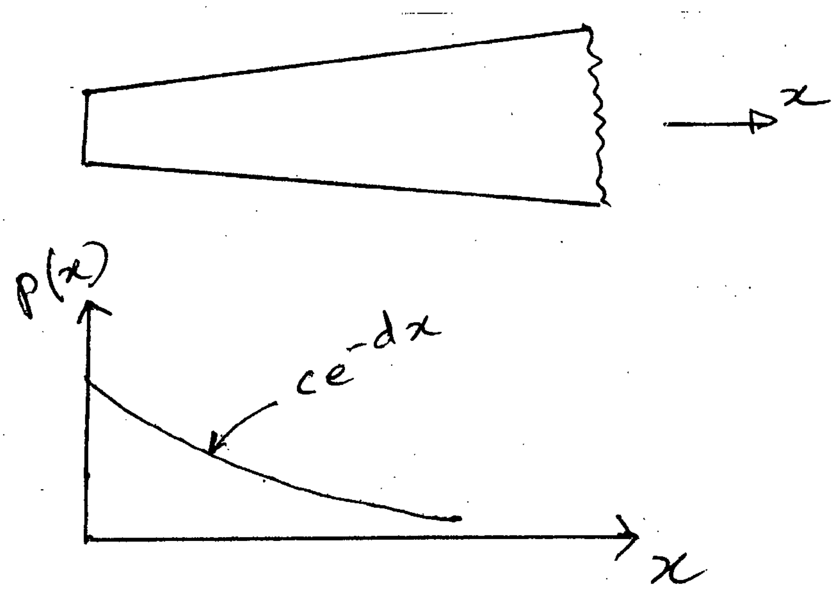

Fig. 2

SECTION – B

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

Symbols carry their common meanings. Assume reasonable values for missing data, if any.

5. (a) Distinguish between dependent variable and independent variable. **(7)**

(b) An airplane flies at a velocity, v. Explain the phenomena and identify the systems affecting the flight. In this course, write down the equations in differential form for the attained velocity overcoming the wind drag. **(20)**

(c) Define with examples: (i) Explicit solution (ii) Singular solution. **(8)**

6. (a) Experiments show that a radioactive substance decomposes at a rate proportional to the amount present. Starting with a given amount of substance, say, 2 gm, at a certain time, say, t = 0, what can be said about the amount available at a later time? Outline a procedure to measure the flow in a estuary with such a substance when dilution factor is known. **(20)**

(b) Classify the following functions as even/odd/neither and also as periodic/non-periodic. If a function is periodic, mention its period. (i) $x = a$, (ii) $y = b$, (iii) $y = mx$, (iv) $y = mx + c$, (v) $y = a\sin bx$, (vi) $y = a\cos bx$, (vii) $y = a\sin b(x \pm \phi)$, (viii) $y = ae^{-bx}$, (ix) $y = ae^{-b|x|}$, (x) $y = H(x+a) - H(x-a)$. **(15)**

7. (a) Express the following periodic half sine pulse (Figure 3) by a Fourier series. **(17)**

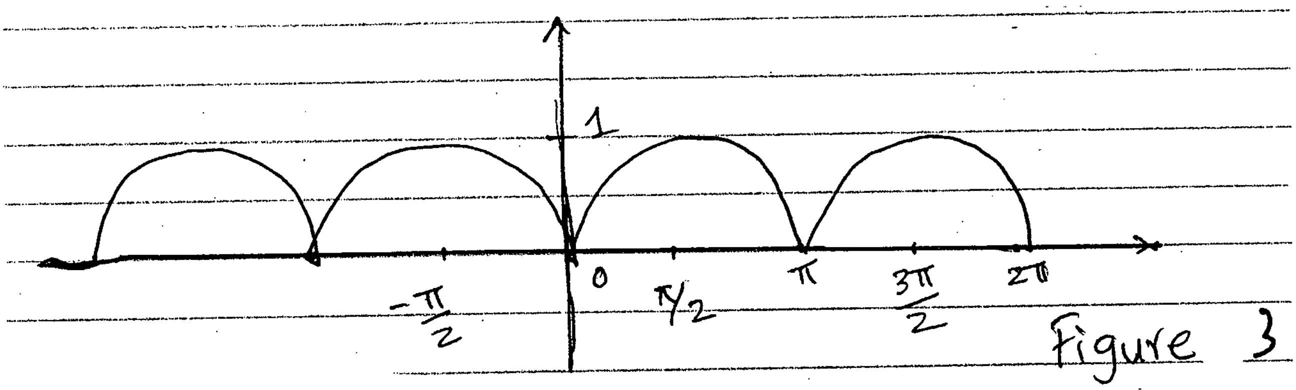

Figure 3

(b) A gas pipe line of flexural rigidity EI is overlain with soil. The soil is, however, not uniformly distributed. Distribution and the force due to the overburden soil is shown in Figure 4. Underneath the pipeline the soil is compacted. Stiffness of underneath soil is k. Determine the vertical deformation of the pipeline due to overlying loose soil. Governing equation is given by: **(18)**

$$EIu^{IV} + ku = p(x)$$

Contd P/4

CE 207

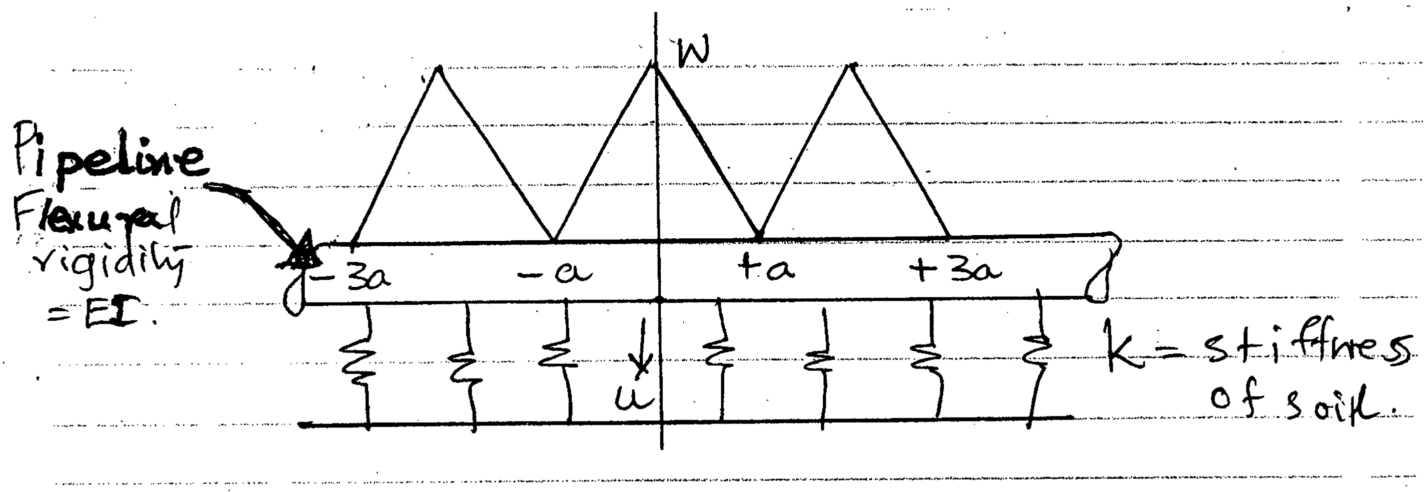

Figure 4

8. (a) What are the cases when you will consider "Power Series Method" in solving a differential equation? **(8)**

(b) What are the operations that are permissible on a power series to solve a differential equation? **(5)**

(c) Write down (i) Legendre Equation (ii) Legendre Polynomial. Use general notations. **(6)**

(d) Legendre polynomials are orthogonal. Explain. **(10)**

(e) Bessel's equation is a special form of Frobenius equation. Explain with an example. **(6)**

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STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997

PERCENTAGE POINTS OF THE T DISTRIBUTION

Tail Probabilities									
One Tail		0.10	0.05	0.025	0.01	0.005	0.001	0.0005	
Two Tails		0.20	0.10	0.05	0.02	0.01	0.002	0.001	
D	1	3.078	6.314	12.71	31.82	63.66	318.3	637	1
E	2	1.886	2.920	4.303	6.965	9.925	22.330	31.6	2
G	3	1.638	2.353	3.182	4.541	5.841	10.210	12.92	3
R	4	1.533	2.132	2.776	3.747	4.604	7.173	8.610	4
E	5	1.476	2.015	2.571	3.365	4.032	5.893	6.869	5
E	6	1.440	1.943	2.447	3.143	3.707	5.208	5.959	6
S	7	1.415	1.895	2.365	2.998	3.499	4.785	5.408	7
	8	1.397	1.860	2.306	2.896	3.355	4.501	5.041	8
O	9	1.383	1.833	2.262	2.821	3.250	4.297	4.781	9
F	10	1.372	1.812	2.228	2.764	3.169	4.144	4.587	10
	11	1.363	1.796	2.201	2.718	3.106	4.025	4.437	11
F	12	1.356	1.782	2.179	2.681	3.055	3.930	4.318	12
R	13	1.350	1.771	2.160	2.650	3.012	3.852	4.221	13
E	14	1.345	1.761	2.145	2.624	2.977	3.787	4.140	14
E	15	1.341	1.753	2.131	2.602	2.947	3.733	4.073	15
D	16	1.337	1.746	2.120	2.583	2.921	3.686	4.015	16
O	17	1.333	1.740	2.110	2.567	2.898	3.646	3.965	17
M	18	1.330	1.734	2.101	2.552	2.878	3.610	3.922	18
	19	1.328	1.729	2.093	2.539	2.861	3.579	3.883	19
	20	1.325	1.725	2.086	2.528	2.845	3.552	3.850	20
	21	1.323	1.721	2.080	2.518	2.831	3.527	3.819	21
	22	1.321	1.717	2.074	2.508	2.819	3.505	3.792	22
	23	1.319	1.714	2.069	2.500	2.807	3.485	3.768	23
	24	1.318	1.711	2.064	2.492	2.797	3.467	3.745	24
	25	1.316	1.708	2.060	2.485	2.787	3.450	3.725	25

Appendix

Table of Fourier Transforms

	$f(x)$	$\hat{f}(\omega) = \int_{-\infty}^{\infty} f(x)e^{-i\omega x}\,dx$
1.	$\dfrac{1}{x^2+a^2}$ $(a>0)$	$\dfrac{\pi}{a}e^{-a\|\omega\|}$
2.	$H(x)e^{-ax}$ $(\mathrm{Re}\,a>0)$	$\dfrac{1}{a+i\omega}$
3.	$H(-x)e^{ax}$ $(\mathrm{Re}\,a>0)$	$\dfrac{1}{a-i\omega}$
4.	$e^{-a\|x\|}$ $(a>0)$	$\dfrac{2a}{\omega^2+a^2}$
5.	e^{-x^2}	$\sqrt{\pi}e^{-\omega^2/4}$
6.	$\dfrac{1}{2a\sqrt{\pi}}e^{-x^2/(2a)^2}$ $(a>0)$	$e^{-a^2\omega^2}$
7.	$\dfrac{1}{\sqrt{\|x\|}}$	$\sqrt{\dfrac{2\pi}{\|\omega\|}}$
8.	$e^{-a\|x\|/\sqrt{2}}\sin\left(\dfrac{a}{\sqrt{2}}\|x\|+\dfrac{\pi}{4}\right)$ $(a>0)$	$\dfrac{2a^3}{\omega^4+a^4}$
9.	$H(x+a)-H(x-a)$	$\dfrac{2\sin\omega a}{\omega}$
10.	$\delta(x-a)$	$e^{-i\omega a}$
11.	$f(ax+b)$ $(a>0)$	$\dfrac{1}{a}e^{ib\omega/a}\hat{f}\left(\dfrac{\omega}{a}\right)$
12.	$\dfrac{1}{a}e^{-ibx/a}f\left(\dfrac{x}{a}\right)$ $(a>0,\ b\ \text{real})$	$\hat{f}(a\omega+b)$
13.	$f(ax)\cos cx$ $(a>0,\ c\ \text{real})$	$\dfrac{1}{2a}\left[\hat{f}\left(\dfrac{\omega-c}{a}\right)+\hat{f}\left(\dfrac{\omega+c}{a}\right)\right]$
14.	$f(ax)\sin cx$ $(a>0,\ c\ \text{real})$	$\dfrac{1}{2ai}\left[\hat{f}\left(\dfrac{\omega-c}{a}\right)-\hat{f}\left(\dfrac{\omega+c}{a}\right)\right]$
15.	$f(x+c)+f(x-c)$ $(c\ \text{real})$	$2\hat{f}(\omega)\cos\omega c$
16.	$f(x+c)-f(x-c)$ $(c\ \text{real})$	$2i\hat{f}(\omega)\sin\omega c$
17.	$x^n f(x)$ $(n=1,2,\ldots)$	$i^n\dfrac{d^n}{d\omega^n}\hat{f}(\omega)$
Linearity of transform and inverse:		
18.	$\alpha f(x)+\beta g(x)$	$\alpha\hat{f}(\omega)+\beta\hat{g}(\omega)$
Transform of derivative:		
19.	$f^{(n)}(x)$	$(i\omega)^n\hat{f}(\omega)$
Transform of integral:		
20.	$f(x)=\int_{-\infty}^{x} g(\xi)\,d\xi$, where $f(x)\to 0$ as $x\to\infty$	$\hat{f}(\omega)=\dfrac{1}{i\omega}\hat{g}(\omega)$
Fourier convolution theorem:		
21.	$(f*g)(x)=\int_{-\infty}^{\infty} f(x-\xi)g(\xi)\,d\xi$	$\hat{f}(\omega)\hat{g}(\omega)$

L-2/T-2/CE **Date : 06/07/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CE 213** (Mechanics of Solids II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value for any missing data.

Symbols bear their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Rivets 20 mm in diameter are used in the connection shown in Fig. 1. If P = 90 kN, what thickness of plate is required so as not to exceed a bearing stress of 160 MPa? Also, determine the maximum and minimum stress in the rivets and identify them. **($16\frac{1}{4}$)**

   (b) By what percentage the maximum stress in the rivet will increase if the rivet at 'D' is found to be inoperative due to poor workmanship. **(10)**

2. (a) At a certain point in a stressed body, the principal stresses are σ_x = 96 MPa and σ_y = –48 MPa. Determine normal (σ) and shearing (τ) stresses on planes which make 120° and –150° angles with the x-axis. Show your result on a sketch of a differential element. [Hint: Solve it analytically]. **(15)**

   (b) Solve the above problem using Mohr's circle of stress. **($11\frac{1}{4}$)**

3. (a) Concrete dam has the shape shown in Fig. 2. Determine the maximum compressive stress (bearing stress) on section p-q if the depth (h) of water behind the dam is 12 metre. Assume density of concrete and water to be 24 kN/m^3 and 10 kN/m^3 respectively. **($16\frac{1}{4}$)**

   (b) Determine the maximum level (h) of water that can be stored behind the dam so that no tension develop at the base of the dam. **(10)**

4. (a) A beam is loaded as shown in Fig. 3. Determine the stresses at the four corners of the rectangular beam section where maximum bending moment occurs. Hence, locate the neutral axis. **(15)**

   (b) A bronze bar of different cross-section is subjected to an axial tensile force as shown in Fig. 4. Compute the axial deformation of the free end 'A' using energy method. Assume E_{br} = 83 GPa. **($11\frac{1}{4}$)**

5. For the restrained steel beam shown in Fig. 5, determine the mid-span deflection. Also, draw shear force and bending moment diagrams for this beam. Given: P = 25 kN, E = 200 GPa and $I_1 = 6.87 \times 10^7$ mm^4. **($26\frac{1}{4}$)**

Contd P/2

CE 213

SECTION – B

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

5. (a) Derive Euler load equation for a column fixed at one end and pinned at the other. **(10 ¼)**

(b) Using AISC ASD column formulas, select a 20′ long pin ended column to carry a concentric load of 120 kips. Given $\sigma_{yp} = 50$ ksi and $c_c = \sqrt{\dfrac{2\pi^2 E}{\sigma_{yp}}}$; $E = 29 \times 10^3$ ksi **(16)**

for $\dfrac{L_e}{r} \geq c_c$; $\sigma_{allow} = \dfrac{12\pi^2 E}{23\left(L_e/r\right)^2}$

for $\dfrac{L_e}{r} < c_c$; $\sigma_{allow} = \dfrac{\left|1 - (L_e/r)^2/(2C_c^2)\right|}{F.S.}\sigma_{yp}$

where $F.S. = \dfrac{5}{3} + \dfrac{3}{8}\dfrac{L_e/r}{c_c} - \dfrac{1}{8}\left(\dfrac{L_e/r}{c_c}\right)^3$

7. (a) Using equation of strain energy density i.e. $u = \int \sigma_x d\in$ derive the expression for elastic strain energy for normal stress. **(10)**

(b) Calculate the strain energy of the beam shown in Fig. 6 for normal stress. **(16 ¼)**

8. (a) Derive equation for maximum energy of distortion theory (Von Mises theory). Given that: (i) total strain energy for three principle stress is given by **(10)**

$$W = \frac{1}{2E}\left(\sigma_1^2 + \sigma_2^2 + \sigma_3^2\right) - \frac{\upsilon}{E}\left(\sigma_1\sigma_2 + \sigma_2\sigma_3 + \sigma_3\sigma_1\right)$$

(ii) Bulk modulus $K = \dfrac{E}{3(1-2\upsilon)}$ and $\in_v = \dfrac{\sigma_m}{K}$.

(b) Find the safe load on the lap connection shown in Fig. 7 if the rivets are of 19 mm diameter and the plates are 8 mm thick. Use allowable stresses of $\tau = 95$ MPa, $\sigma_t = 140$ MPa and $\sigma_p = 220$ MPa. **(16 ¼)**

9. A plate is attached to the frame of a machine by two side fillet welds as shown in Fig. 8. Determine the size of the welds to resist a vertical load of 10 kips. Given that allowable shear stress through the throat of weld is 21 ksi. **(26 ¼)**

10. (a) Derive equation of General Cable theorem. **(10)**

(b) Draw bending moment diagram of the stiffening girder of Fig. 9. **(16 ¼)**

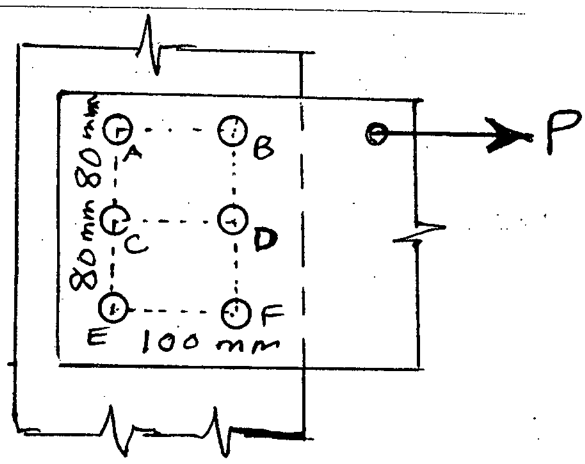


FIG. 1

Q. 1(a).

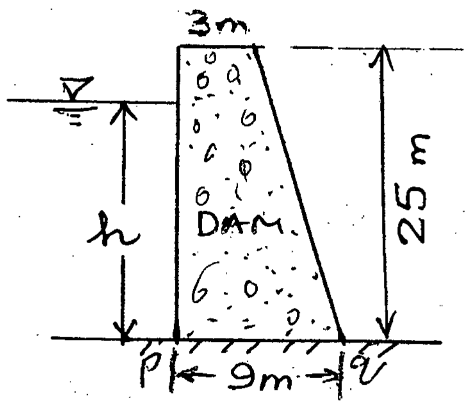
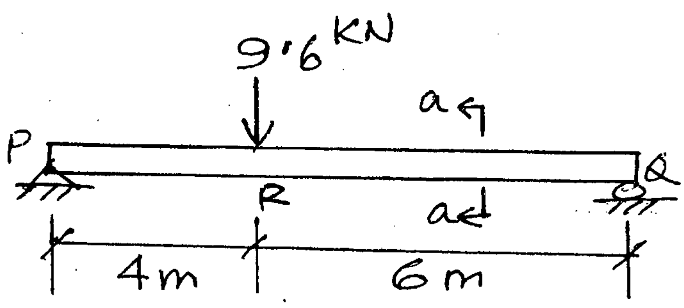


FIG. 2

Q. 3(a)



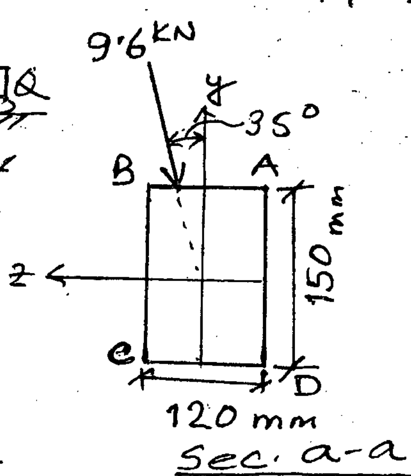


FIG. 3

Q. 4(a)

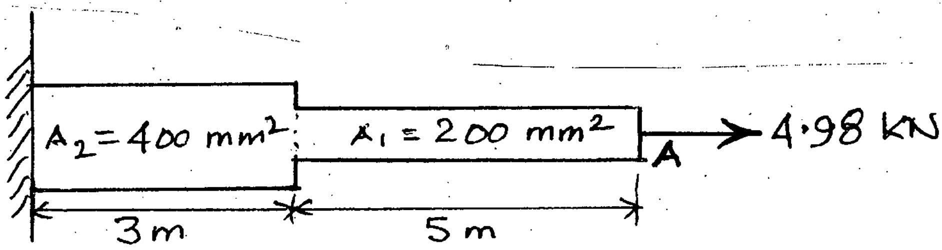


FIG. 4

Q. 4(b)

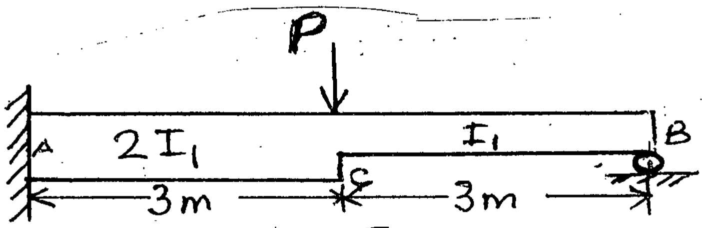


FIG. 5

Q. 5

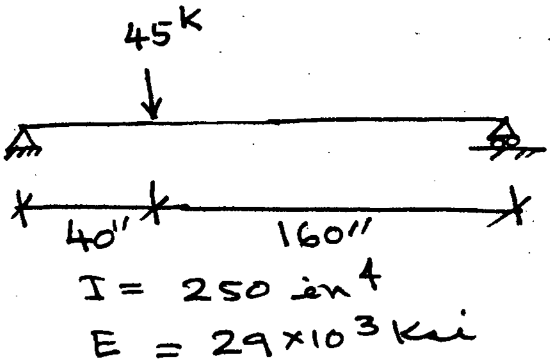


Fig 6 for Q7(b)

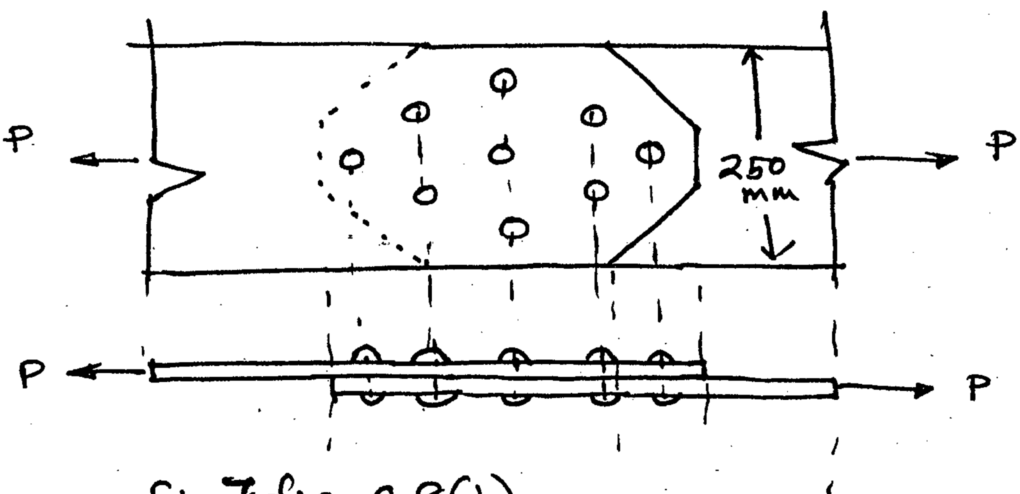


Fig 7 for Q8(b)

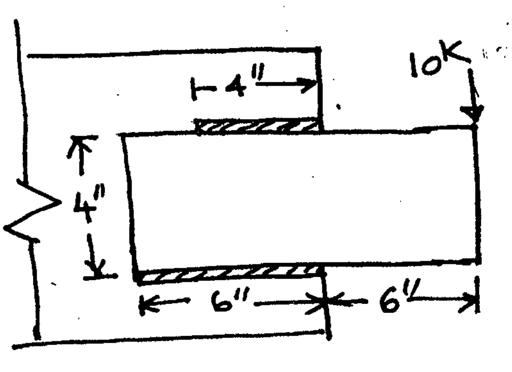


Fig 8 for Q9

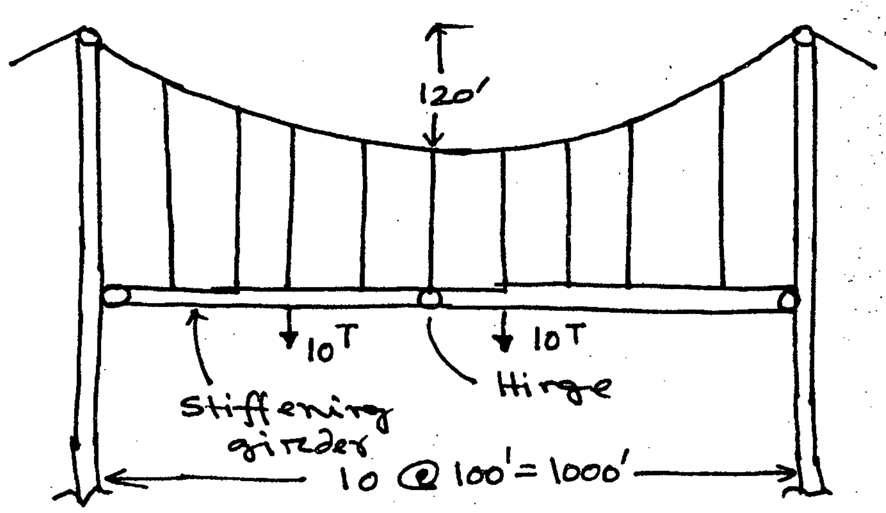


Fig 9 for Q10(b)

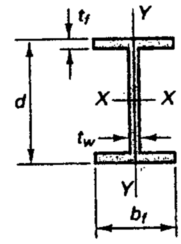


TABLE 4A. AMERICAN STANDARD STEEL W SHAPES DIMENSIONS AND PROPERTIES U.S. CUSTOMARY UNITS (ABRIDGED LIST)

Designation*	Area A	Depth d	Web Thickness t_w	Flange Width b_f	Flange Thickness t_f	Axis X–X I_x	Axis X–X r_x	Axis Y–Y I_y	Axis Y–Y r_y
in × lb/ft	*in²*	*in*	*in*	*in*	*in*	*in⁴*	*in*	*in⁴*	*in*
W36 × 245	72.1	36.08	0.800	16.510	1.350	16100	15.0	1010	3.75
230	67.6	35.90	0.760	16.470	1.260	15000	14.9	940	3.73
150	44.2	35.85	0.625	11.975	0.940	9040	14.3	270	2.47
135	39.7	35.55	0.600	11.950	0.790	7800	14.0	225	2.38
W33 × 201	59.1	33.68	0.715	15.745	1.150	11500	14.0	749	3.56
130	38.3	33.09	0.580	11.510	0.855	6710	13.2	218	2.39
118	34.7	32.86	0.550	11.480	0.740	5900	13.0	187	2.32
W30 × 191	56.1	30.68	0.710	15.040	1.185	9170	12.8	673	3.46
173	50.8	30.44	0.655	14.985	1.065	8200	12.7	598	3.43
W27 × 161	47.4	27.59	0.660	14.020	1.080	6280	11.5	497	3.24
146	42.9	27.38	0.605	13.965	0.975	5630	11.4	443	3.21
94	27.7	26.92	0.490	9.990	0.745	3270	10.9	124	2.12
84	24.8	26.71	0.460	9.960	0.640	2850	10.7	106	2.07
W18 × 60	17.6	18.24	0.415	7.555	0.695	984	7.47	50.1	1.69
50	14.7	17.99	0.355	7.495	0.570	800	7.38	40.1	1.65
46	13.5	18.06	0.360	6.060	0.605	712	7.25	22.5	1.29
35	10.3	17.70	0.300	6.000	0.425	510	7.04	15.3	1.22
W16 × 26	7.68	15.69	0.250	5.500	0.345	301	6.26	9.59	1.12
W14 × 193	56.8	15.48	0.890	15.710	1.440	2400	6.50	931	4.05
159	46.7	14.98	0.745	15.565	1.190	1900	6.38	748	4.00
99	29.1	14.16	0.485	14.565	0.780	1110	6.17	402	3.71
90	26.5	14.02	0.440	14.520	0.710	999	6.14	362	3.70
W12 × 72	21.1	12.25	0.430	12.040	0.670	597	5.31	195	3.04
65	19.1	12.12	0.390	12.000	0.605	533	5.28	174	3.02
50	14.7	12.19	0.370	8.080	0.640	394	5.18	56.3	1.96
45	13.2	12.06	0.335	8.045	0.575	350	5.15	50.0	1.94
40	11.8	11.94	0.295	8.005	0.515	310	5.13	44.1	1.93
W10 × 112	32.9	11.36	0.755	10.415	1.250	716	4.66	236	2.68
60	17.6	10.22	0.420	10.080	0.680	341	4.39	116	2.57
49	14.4	9.98	0.340	10.000	0.560	272	4.35	93.4	2.54
45	13.3	10.10	0.350	8.020	0.620	248	4.33	53.4	2.01
39	11.5	9.92	0.315	7.985	0.530	209	4.27	45.0	1.98
33	9.71	9.73	0.290	7.960	0.435	170	4.19	36.6	1.94
W8 × 67	19.7	9.00	0.570	8.280	0.935	272	3.72	88.6	2.12
58	17.1	8.75	0.510	8.220	0.810	228	3.65	75.1	2.10
40	11.7	8.25	0.360	8.070	0.560	146	3.53	49.1	2.04
31	9.13	8.00	0.285	7.995	0.435	110	3.47	37.1	2.02
28	8.25	8.06	0.285	6.535	0.465	98.0	3.45	21.7	1.62
24	7.08	7.93	0.245	6.495	0.400	82.8	3.42	18.3	1.61
21	6.16	8.28	0.250	5.270	0.400	75.3	3.49	9.77	1.26
18	5.26	8.14	0.230	5.250	0.330	61.9	3.43	7.97	1.23

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

Bonus 15.9.13

L-2/T-2/CE **Date : 22/07/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CE 205** (Numerical Methods)

Full Marks: 140 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Explain Gauss-Elimination Method with required Expressions. **(11⅓)**

   (b) Solve the following system using Crout's Method **(12)**

$$2.51x_1 + 1.48x_2 + 4.53x_3 = 0.05$$
$$1.48x_1 + 0.93x_2 - 1.30x_3 = 1.03$$
$$2.68x_1 + 3.04x_2 - 1.48x_3 = -0.53$$

2. (a) Explain Gauss – Quadrature method and derive the required parameters for n = 3. **(11⅓)**

   (b) The deflection at various points on a normally loaded plate are shown in the table. Calculate the bending moments in the plate at points 1, 6, 11 and 16. **(12)**

Given: $D = \frac{Et^3}{12(1-\nu^2)}$; E = 30 × 10^6 psi

t = 5 inch

ν = 0.15

$$M_x = -D\left[\frac{\partial^2 Z}{\partial x^2} + \nu\frac{\partial^2 Z}{\partial y^2}\right]$$

$$M_y = -D\left[\nu\frac{\partial^2 Z}{\partial x^2} + \frac{\partial^2 Z}{\partial y^2}\right]$$

Point	Deflection (in) × 10^{-4}	Point	Deflection (in) × 10^{-4}
1	2.5	9	3.8
2	1.5	10	4.5
3	4.1	11	4.1
4	5	12	3.6
5	4.2	13	4.2
6	4.7	14	4.5
7	3.7	15	4.0
8	3.2	16	3.9

The spacing between the points is 12 inch in all directions.

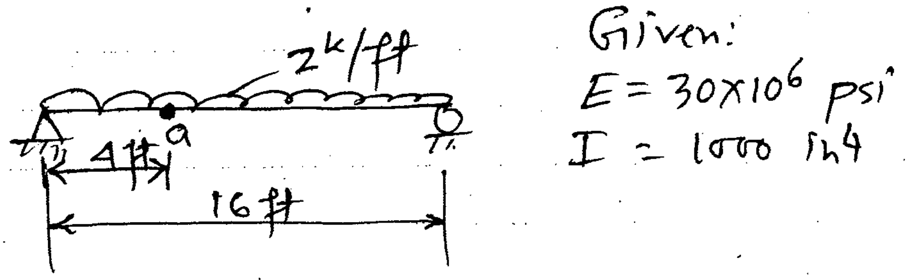
Contd P/2

CE 205

3. (a) Explain Difference Table. **(5)**

(b) Derive the general expression of $I = \int_a^b f(x)dx$ using Trapezoidal Rule. **(5)**

(c) Using Simpson's Method, find the deflection at point 'a'. **($13\frac{1}{3}$)**



4. (a) Derive the final expression of Gregory–Newton Interpolation Formula. **($10\frac{1}{3}$)**

(b) Set a polynomial equation passing through the points provided in the following table and use it to find the interpolated value for x = 1.5. **(13)**

x	1	−2	3	−1
$f(x)$	0	16	−2	1

SECTION – B

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

5. (a) Find the root of the following function: **(17)**

$$f(x) = 2\sin\left(\sqrt{x}\right) - x$$

applying both (i) Fixed point iteration and (ii) Newton–Raphson Method.
Use an initial guess of $x_0 = 0.5$. For each case, perform 6 (six) iterations and calculate the approximate error (ε_a) for each iteration performed. Also check the convergence criteria for the fixed point iteration method.

(b) What is the difference between round–off error and truncation error? How can you estimate the local truncation error in Euler's method? How can this error be minimized? **($6\frac{1}{3}$)**

6. (a) Use nonlinear regression to fit a parabola to the following data: **(14)**

x	0.2	0.5	0.8	1.2	1.7	2	2.3
y	500	700	1000	1200	2200	2650	3750

(b) Use zero to 4th order Taylor series expansion to predict $f(2.5)$ for **($9\frac{1}{3}$)**

$$f(x) = \ln(x)$$

using a base point at x = 1. Compute the true percent relative error (ε_t) for each approximation.

Contd P/3

CE 205

7. (a) Use Euler's method to solve **(12)**

$$\frac{dy}{dx} = -2y + 4e^{-x}$$

$$\frac{dz}{dx} = -\frac{yz^2}{3}$$

over the range $x = 0$ to 1 using a step size of 0.2 with $y(0) = 2$ and $z(0) = 4$.

(b) Solve the following equation for $y(0.2)$ **(7)**

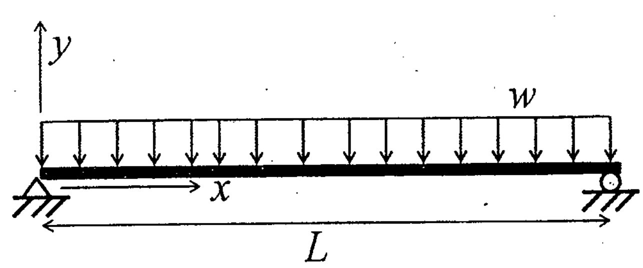
$$10\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + 6x = 0$$

using a step size of 0.2 with y(0) = 1 and y'(0) = 0. Use Heun's method.

(c) What are the limitations of Newton–Raphson method? Explain with diagrams. **(4⅓)**

8. (a) The basic differential equation of the elastic curve for a simply supported, uniformly loaded beam (shown in figure below) is given as **(18)**

$$EI\frac{d^2y}{dx^2} = \frac{wLx}{2} - \frac{wx^2}{2}$$



Where, E = 30,000 ksi, I = 800 in^4, L = 10 ft, w = 1 kip/ft.

Solve for the deflection of the beam using finite difference approach. Use $\Delta x = 2$ ft

(b) Write down the steps of solving the above beam problem using the Shooting Method. **(5⅓)**

21.09.13

L-2/T-2/CE Date : 21/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **WRE 211** (Fluid Mechanics)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume any reasonable value, if missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define: (i) Newtonian fluid (ii) Streamline (iii) Unsteady flow. **(6)**

(b) Derive continuity equation based on Eulerian View of motion. **(6)**

(c) In a flow the velocity vector is given by **(7)**

$$V = 3xi + 4yj - 7zk$$

Determine the equation of the streamline through a point M = (1, 4, 5).

(d) The velocity vector in an incompressible flow is given by **(9)**

$$V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)k$$

(i) Verify whether the continuity equation is satisfied.

(ii) Determine the acceleration vector at point A(2, 2, 2) at t = 2.0.

(e) Water is pumped into the tank shown in Figure 1 at 100 l/s. Both kerosene (rel. den. = 0.8) and oil (rel. den. = 0.9) are driven out. If 30 l/s oil is driven out estimate the volume of kerosene coming out of tank per second. **(7)**

2. (a) Derive Bernoulli's equation for steady, incompressible and frictionless fluid. **(8)**

(b) Figure 2 shows a nozzle at the end of a pipe discharging oil from a tank to the atmosphere. Estimate the discharge from the nozzle when the head H in the tank is 4.0 m. The loss in the pipe can be taken as $20\frac{V^2}{2g}$ where V = velocity in the pipe. The energy loss in the nozzle can be neglected. Also determine the pressure at the base of the nozzle. **(9)**

(c) A turbine is set 40 m below the water level of a reservoir and is fed by a 60 cm diameter pipe (Figure 3). A short pipe of 45 cm diameter discharges the water from the turbine to the atmosphere. If a total frictional loss of 10 m is assumed and the turbine efficiency is 85%, estimate the power output. **(8)**

(d) A pipeline delivering water from a reservoir is shown in Figure 4. A pump adds energy to the flow and 45 l/s of water is discharged to atmosphere at the outlet. Calculate the power delivered by the pump. Assume the head loss in pipe as two times the velocity head at the suction side and 10 times the velocity head in the delivery pipe. Draw a neat sketch showing energy line and hydraulic grade line. **(10)**

Contd P/2

3. (a) Derive the Momentum equation for a reducing pipe bend. **(5)**

   (b) A jet of oil (RD = 0.8) issues from a nozzle of 15 cm diameter with a velocity of 12 m/s. A smooth cone with vertex angle of 90° deflects the jet. The jet is horizontal and the vertex of the cone points towards the jet (Figure 5). Calculate the force required to hold the cone in position. **(9)**

   (c) A 3 cm diameter water jet with a velocity of 36 m/s impinges on a single moving vane in the same direction at a velocity of 16 m/s. If $\beta_2 = 140°$ and friction losses over the vane such that $v_2 = 0.9v_1$. Compute the force exerted by the water on the vane. **(9)**

   (d) A centrifugal pump impeller has $r_1 = 0.25$ m, $r_2 = 0.9$ m, $\beta_1 = 110°$, $\beta_2 = 130°$ and a thickness of 0.15 m parallel to the axis of rotation. If it delivers 3 m^3/s with no tangential velocity component at the entrance, what is the rotational speed? For this condition, calculate: (i) torque, (ii) power of the machine and (iii) energy given to each Newton of water. **(12)**

4. (a) Write down the differences between **(6)**
   (i) uniform and non-uniform flow
   (ii) laminar flow and ~~turbine~~ flow turbulent

   (b) The axial velocity profile in a pipe is given by **(7)**

$$u = u_m \left[1 - \frac{r}{R}\right]^n$$

   where, R = radius of the pipe, u_m = maximum velocity, u = local velocity at a distance r. Calculate the average velocity for n = 2.

   (c) A pump is 2.5 m above the water level in the sump and has a pressure of –22 cm of mercury at the suction side. The suction pipe is of 25 cm diameter and the delivery pipe is a short 30 cm dia pipe ending in a nozzle of 10 cm diameter. If the nozzle is directed vertically upwards at an elevation of 4.0 m above the sump water level (Figure 6), determine (i) the discharge, (ii) power input into the flow by the pump and (iii) the elevation, above the sump water level to which the jet would reach. (Neglect all losses). **(14)**

   (d) A discharge of 0.06 m^3/s flows through a horizontal bend as shown in figure 7. Calculate the force on the bolt in section 1. **(8)**

SECTION – B

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

5. (a) Define absolute pressure, vacuum pressure and gage pressure. How are they interrelated? **(8)**

   (b) Derive the general equation which gives the variation of pressure in a static fluid on a plane area. **(12)**

   (c) The gate shown in Figure 8 is 60 cm wide perpendicular to the sketch. It is pivoted at O. The gate weighs 2224 N. Its center of gravity is 36 cm to the right and 27 cm above O. For what values of water depth X above O will the gate remain closed? Neglect friction at the pivot and neglect thickness of the gate z. **(15)**

Contd P/3

6. (a) Write short notes on (10)
   (i) Compressible and incompressible fluid
   (ii) Simple Manometer and Differential Manometer
   (iii) Center of pressure
   (iv) Viscous sublayer
   (v) Solid and liquid

   (b) What is viscosity of fluid? Derive the equation of viscosity of fluid. In this respect differentiate between Newtonian and non-Newtonian, ideal plastic and elastic solid with examples. Support your answer with proper figures. (8)

   (c) Two reservoirs with a difference in water surface elevation of 8 m are connected by two pipes in series as shown in Figure 9. The equivalent roughness heights are 2.0 mm and 0.3 mm respectively. Find discharge by equivalent velocity head method. Given $\nu = 3 \times 10^{-6}$ m^2/s. Use Moody diagram for friction factor. (17)

7. (a) The flows into and out of a two-loop pipe system are shown in Figure 10. Determine the flow in each pipe. The n = 2 for all pipes and K values for each pipe are given in Figure 10. (15)

   (b) A space of 30 mm width between two large plane surfaces is filled with SAE 30 western lubricating oil at 25 °C ($\mu = 2.1 \times 10^{-1}$ N-s/m^2). What force is required to drag a very thin plate of 0.4 m^2 area between the surfaces at a speed of 0.12 m/s. (10)
   (i) If the plate is equally spaced between the two surfaces.
   (ii) If it is at a distance of 10 mm from one surface?

   (c) Differentiate between (10)
   (i) Ideal and real fluid
   (ii) Hydraulically rough and smooth boundary
   (iii) Dynamic and Kinematic Viscosity
   (iv) Adhesion and Cohesion

8. (a) Derive the expression for friction loss with laminar flow. (10)

   (b) The pipes in the system shown in Figure 11 are all new cast iron (e = 0.25 mm). With a flow of 0.8 m^3/s, find the head loss from B to C. Given $\nu = 1.14 \times 10^{-6}$ m^2/s. (15)

   (c) Name the different types of losses in pipe flow. A pipe 65 m long and 20 cm in diameter is connected to a water tank at one end and flows freely into the atmosphere at the other end. The height of the water level in the tank is 3.2 m above the center of the pipe. The pipe is horizontal with f = 0.04. Determine the discharge through the pipe. (10)
