L-2/T-1/NAME **Date : 17/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 251** (Mechanics of Structure)

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**.

Assume reasonable value for missing data if any.

1. (a) A strip of metal is originally 1.50 m long. It is stretched in three steps: first to a length 1.75 m, then to 2.00 m and finally to 3.00 m. Show that the total true strain is the sum of the true strains in each step, that is, that the strains are additive. Show that, using engineering strains, the strain for each step can not be added to obtain the total strain. **(18)**

   (b) A paper clip is made of wire 1.2 mm in diameter. If the original material from which the wire is made is a rod 15 mm in diameter, calculate the longitudinal and diametrical engineering and true strains that the wire has undergone. **(12)**

   (c) What is ductile material and Brittle material? **(5)**

2. (a) The composite bar as shown in Fig. for Q. No. 2(a) is stress free before the axial loads p_1 and p_2 are applied. Assuming that the walls are rigid, calculate the stress in each material if $P_1 = 150$ kN and $P_2 = 90$ kN. **(18)**

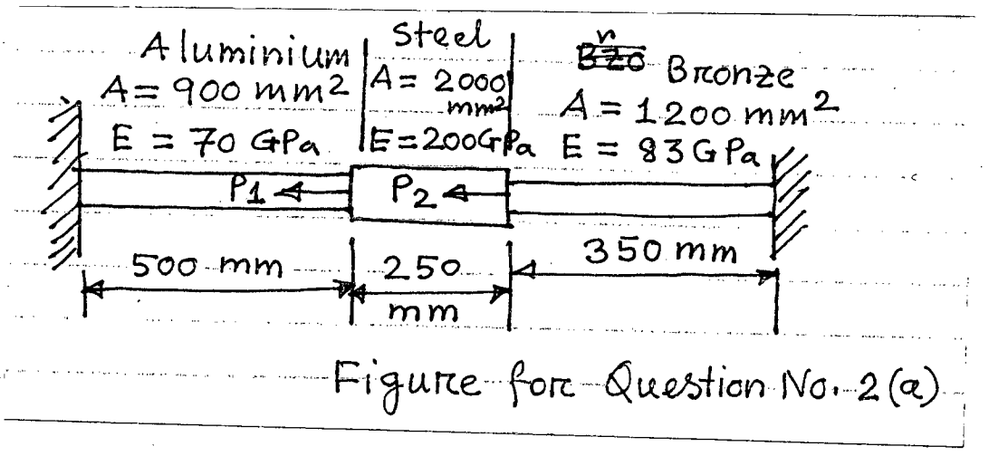

Figure for Question No. 2(a)

   (b) A homogeneous bar ($A = 1$ in.^{2}) is rigidly fixed to D. If $P_1 = 20{,}000$ lb and $P_2 = 10{,}000$ lb, what will the stress be in BC? Consider the gap between A and the wall equals 0.086 inch before the loads are applied. Given, $E = 10 \times 10^6$ psi. **(17)**

Contd P/2

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Contd... Q. No. 2(b)

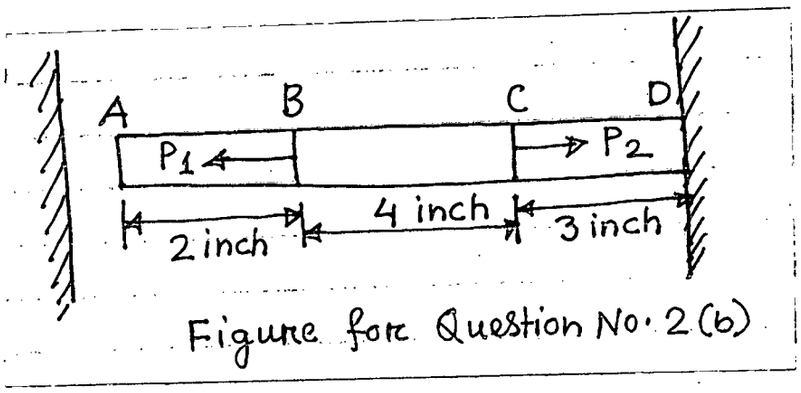

Figure for Question No. 2(b)

3. (a) The simply supported beam as shown in figure for Q. No. 2(b) supports 30 kN concentrated force at B and a 40 kN.m couple at D. Sketch the shear force and bending moment diagrams. Neglect the weight of the beam. **(22)**

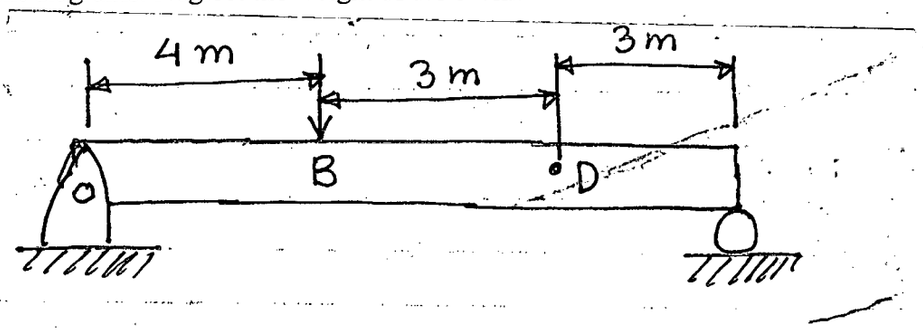

Figure for Question No. 3(a)

(b) Determine the shear force and bending moment at the midpoint of the beam with overhangs as shown in figure for Q. No. 3(b). **(13)**

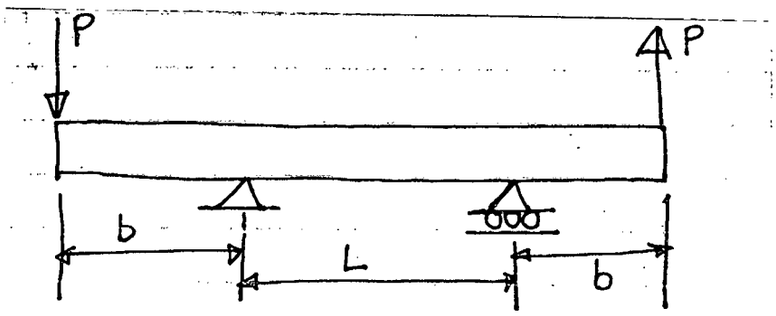

Figure for Question No. 3(b)

4. (a) A beam with cross-section as shown in figure for Q. No. 4(a) is loaded in such a way that the maximum moments are +1.0 P lb-ft and –1.5 P lb-ft, where P is the applied load in pounds. Determine the maximum safe value of P if the working stresses are 4 ksi in tension and 10 ksi in compression. **(13)**

Contd P/3

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Contd... Q. No. 4

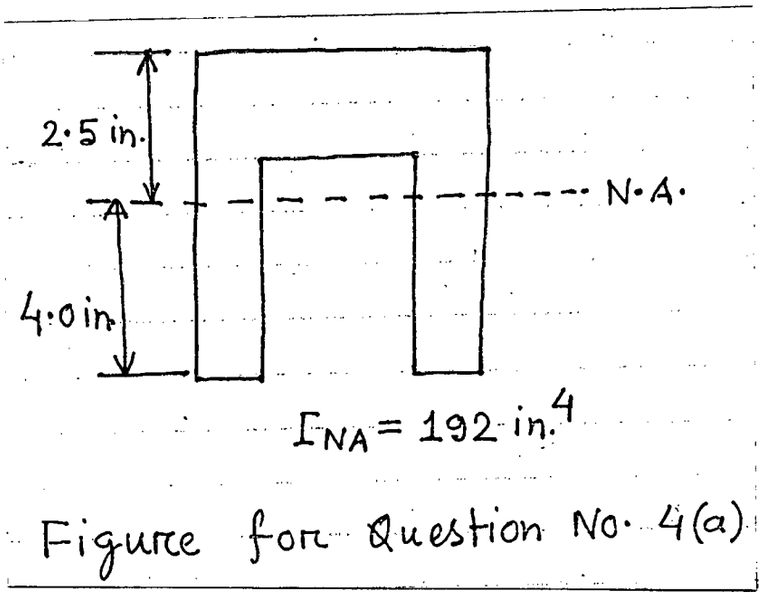

Figure for Question No. 4(a)

(b) Two C230 × 30 structural steel channels are used for a column that is 12 m long. Determine the total compressive load required to buckle the two members if **(22)**

(i) They act independently of each other, use E = 200 GPa.

(ii) They are laced 150 mm back to back as shown in figure for Q. No. 4(b).

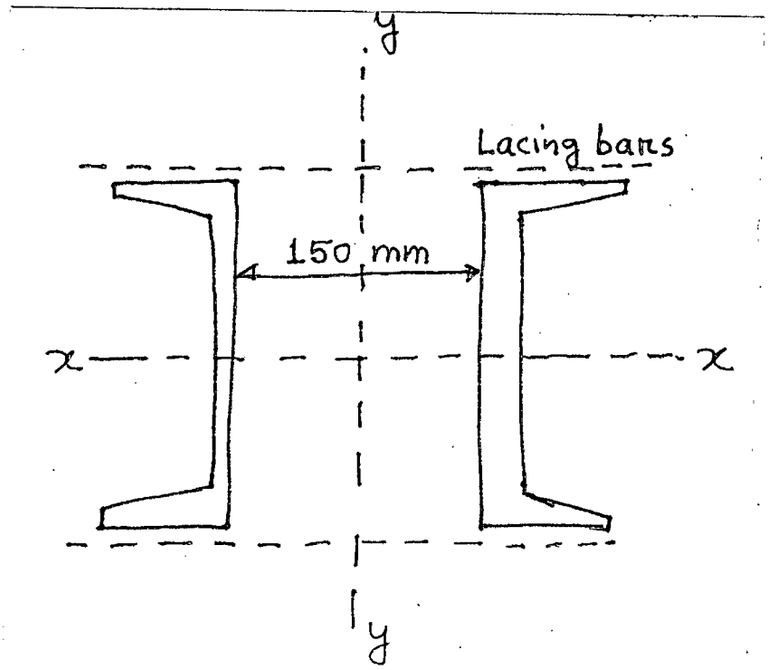

Figure for Question No. 4(b)

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SECTION – B

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

Figures are attached.

5. (a) Compute the force in each member of the loaded cantilever truss shown in Fig. for q. No. 5(a) by the method of joints. **(20)**

   (b) The state of plane stress at a point is represented by the stress element shown in Fig. for Q. No. 5(b). Draw Mohr's circle, determine the principal stresses and maximum shear stress. **(15)**

6. (a) A beam ABC of length 9 m has one support of the left end and the other support at a distance of 6 m from the left end. The beam carries a point load of 16 kN at right end and also carries of uniformly distributed load of 8 kN/m over a length of 3 m as shown in Fig. for Q. No. 6(a). Determine the slope and deflection at point C. **(20)**

   [$E = 2 \times 10^5$ N/mm^2, and $I = 5 \times 10^8$ mm^4]

   (b) The simply supported beam shown in Fig. for Q. No. 6(b) carrying and triangularly distributed load. Find the deflection curve of the beam. **(15)**

7. (a) Determine all the reactions of the loaded beam shown in Fig. for Q. No. 7(a). **(15)**

   (b) A beam has fixed support at A and roller supports at C and E as shown in Fig. for Q. No. 7(b). Internal hinges are placed at B and D. **(20)**

   (i) Determine all the reactions.

   (ii) Draw the shear force diagram for the beam

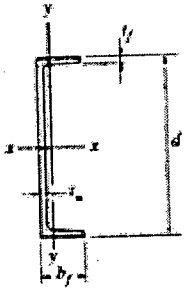
   (iii) Draw the bending moment diagram for the beam.

8. (a) Deduce the torsion formula of a solid circular shaft. Also find the expression of angle of twist made by the torsion. **(20)**

   (b) A shaft composed of segments AC, CD, and DB is fastened to rigid supports and loaded as shown in Fig. for Q. No. 8(b). Determine the maximum shearing stress developed in each segment. **(15)**

   [G_{br} = 35 GPa, G_{al} = 28 GPa and G_{st} = 83 GPa].

Table for Question no. 4(b)



American Standard Channels or C Shapes SI Units

Designation	Area A	Depth d	Web thickness t_w	Flange width b_f	Flange thickness t_f	x–x axis I	x–x axis S	x–x axis r	y–y axis I	y–y axis S	y–y axis r
mm × kg/m	mm^2	mm	mm	mm	mm	$10^6\ mm^4$	$10^3\ mm^3$	mm	$10^6\ mm^4$	$10^3\ mm^3$	mm
C380 × 74	9 480	381.0	18.20	94.4	16.50	168	882	133	4.58	61.8	22.0
C380 × 60	7 610	381.0	13.20	89.4	16.50	145	761	138	3.84	55.1	22.5
C380 × 50	6 430	381.0	10.20	86.4	16.50	131	688	143	3.38	50.9	22.9
C310 × 45	5 690	305.0	13.00	80.5	12.70	67.4	442	109	2.14	33.8	19.4
C310 × 37	4 740	305.0	9.83	77.4	12.70	59.9	393	112	1.86	30.9	19.8
C310 × 31	3 930	305.0	7.16	74.7	12.70	53.7	352	117	1.61	28.3	20.2
C250 × 45	5 690	254.0	17.10	77.0	11.10	42.9	338	86.8	1.61	27.1	17.0
C250 × 37	4 740	254.0	13.40	73.3	11.10	38.0	299	89.5	1.40	24.3	17.2
C250 × 30	3 790	254.0	9.63	69.6	11.10	32.8	258	93.0	1.17	21.6	17.6
C250 × 23	2 900	254.0	6.10	66.0	11.10	28.1	221	98.4	0.949	19.0	18.1
C230 × 30	3 790	229.0	11.40	67.3	10.50	25.3	221	81.7	1.01	19.2	16.3
C230 × 22	2 850	229.0	7.24	63.1	10.50	21.2	185	86.2	0.803	16.7	16.8
C230 × 20	2 540	229.0	5.92	61.8	10.50	19.9	174	88.5	0.733	15.8	17.0
C200 × 28	3 550	203.0	12.40	64.2	9.90	18.3	180	71.8	0.824	16.5	15.2
C200 × 20	2 610	203.0	7.70	59.5	9.90	15.0	148	75.8	0.637	14.0	15.6
C200 × 17	2 180	203.0	5.59	57.4	9.90	13.6	134	79.0	0.549	12.8	15.9
C180 × 22	2 790	178.0	10.60	58.4	9.30	11.3	127	63.6	0.574	12.8	14.3
C180 × 18	2 320	178.0	7.98	55.7	9.30	10.1	113	66.0	0.487	11.5	14.5
C180 × 15	1 850	178.0	5.33	53.1	9.30	8.87	99.7	69.2	0.403	10.2	14.8
C150 × 19	2 470	152.0	11.10	54.8	8.70	7.24	95.3	54.1	0.437	10.5	13.3
C150 × 16	1 990	152.0	7.98	51.7	8.70	6.33	83.3	56.4	0.360	9.22	13.5
C150 × 12	1 550	152.0	5.08	48.8	8.70	5.45	71.7	59.3	0.288	8.04	13.6
C130 × 13	1 700	127.0	8.25	47.9	8.10	3.70	58.3	46.7	0.263	7.35	12.4
C130 × 10	1 270	127.0	4.83	44.5	8.10	3.12	49.1	49.6	0.199	6.18	12.5
C100 × 11	1 370	102.0	8.15	43.7	7.50	1.91	37.5	37.3	0.180	5.62	11.5
C100 × 8	1 030	102.0	4.67	40.2	7.50	1.60	31.4	39.4	0.133	4.65	11.4
C75 × 9	1 140	76.2	9.04	40.5	6.90	0.862	22.6	27.5	0.127	4.39	10.6
C75 × 7	948	76.2	6.55	38.0	6.90	0.770	20.2	28.5	0.103	3.83	10.4
C75 × 6	781	76.2	4.32	35.8	6.90	0.691	18.1	29.8	0.082	3.32	10.2

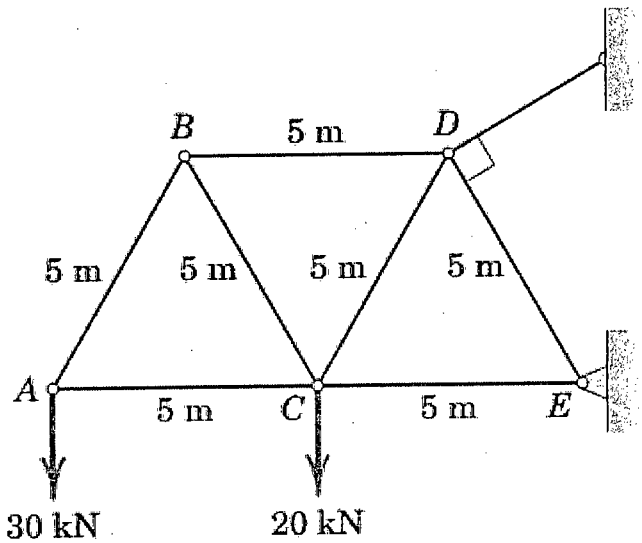


Fig for Question No. 5(a)

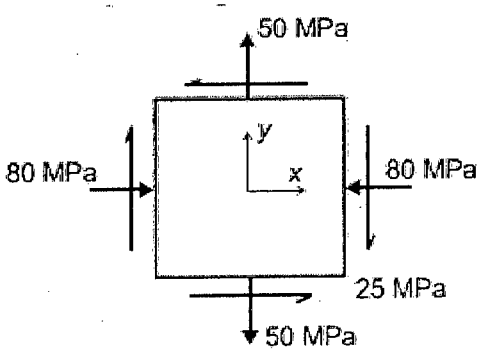


Fig for Question No. 5(b)

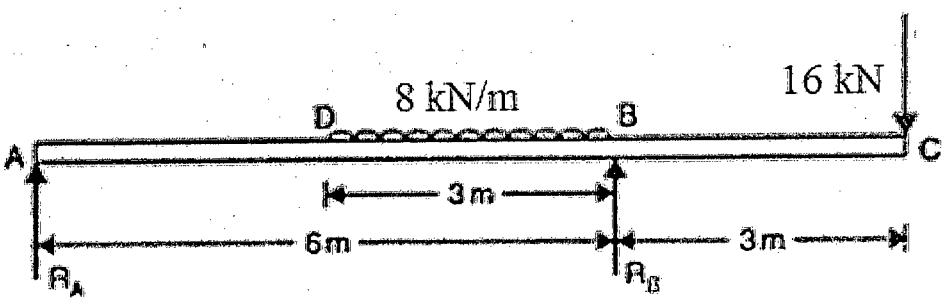


Fig. for Question No. 6(a)

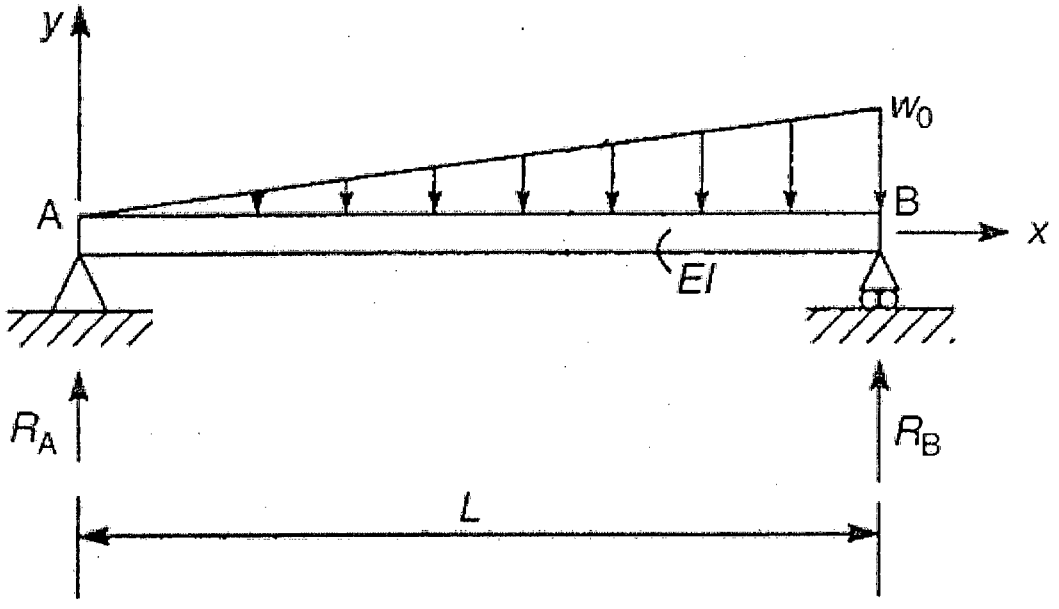


Fig. for Question No. 6(b)

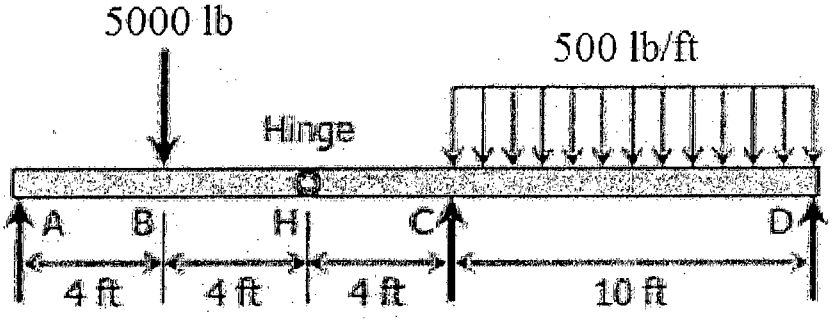


Fig for Question No. 7(a)

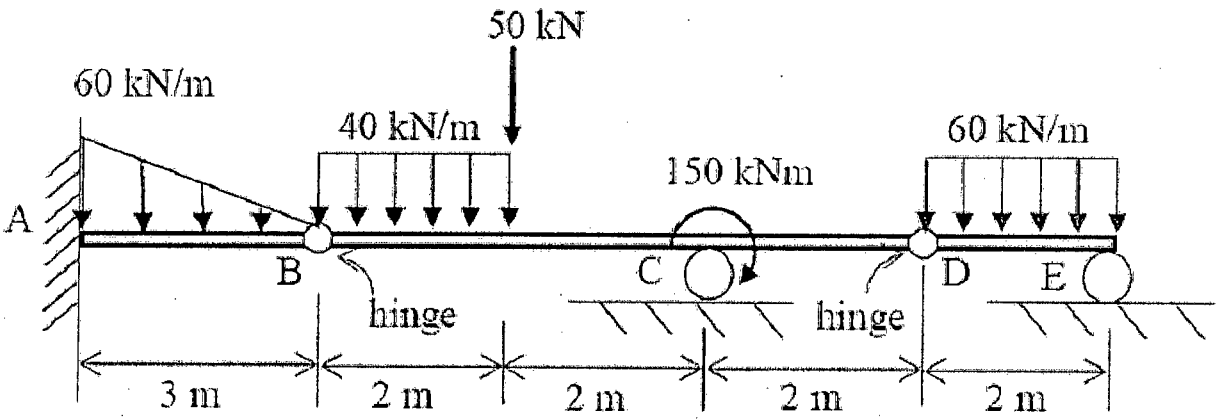


Fig for Question No. 7(b)

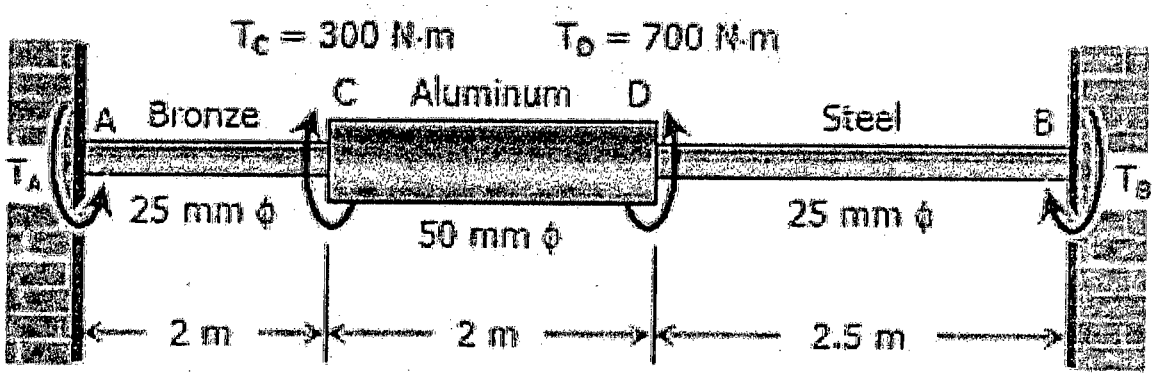


Fig. for Question No. 8(b)

L-2/T-1/NAME **Date : 23/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **MATH 281** (Differential Equations and Vector Analysis)

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 used have their usual meaning.

1. (a) Solve $\left[(x+3)D^2-(2x+7)D+2\right]y=(x+3)^2e^x$ by the method based on the factorization of operator. **(18)**

   (b) Solve: $x^2\dfrac{d^2y}{dx^2}-3x\dfrac{dy}{dx}+4y=x+x^2\ln x$. **(17)**

2. Apply method of Fröbenius to obtain two linearly independent solutions valid near $x = 0$ for the differential equation $x\dfrac{d^2y}{dx^2}+\dfrac{dy}{dx}+xy=0$. **(35)**

3. (a) For any positive integer n, show that $J_n(x)=(-2)^n x^n\dfrac{d^n}{d(x^2)^n}\{J_0(x)\}$. **(12)**

   (b) Prove that $J_n(x)$ and $J_{-n}(x)$ are linearly dependent when n is any integer. **(10)**

   (c) Prove that $\displaystyle\int_0^1\frac{tJ_0(xt)}{\sqrt{1-t^2}}dt=\frac{\sin x}{x}$. **(13)**

4. (a) Show that $P_n(x)$ is the coefficient of z^n in the expansion of $(1-2xz+z^2)^{-\frac{1}{2}}$ in ascending power of z. **(18)**

   (b) Show that $P_n(x)=\dfrac{1}{\pi}\displaystyle\int_0^\pi\left[x\pm\sqrt{x^2-1}\cos\theta\right]^n d\theta$, where n is a positive integer. **(17)**

SECTION – B

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

5. (a) Determine whether the vectors **u** = (1, –1, 2), **v** = (5, 3, –2), **w** = (–7, –9, 10) are linearly independent. If not, then find a relation between them. Also determine whether the terminal points are collinear. **(17)**

   (b) Prove that $\nabla\times(\nabla\times\mathbf{A})=\nabla(\nabla\cdot\mathbf{A})-\nabla^2\mathbf{A}$. **(18)**

Contd P/2

MATH 281

6. (a) If $\mathbf{A} = (3x^2 + 6y)\mathbf{i} - 14yz\mathbf{j} + 20xz^2\mathbf{k}$, evaluate $\int_C \mathbf{A} \cdot d\mathbf{r}$ from (0,0,0) to (1,1,1) along the paths C: (i) straight lines from (0,0,0) to (1,0,0) then to (1,1,0) then to (1,1,1) and (ii) $x = t, y = t^2, z = t^3$ **(20)**

(b) Show that $\mathbf{F} = (2xy + z^3)\mathbf{i} + x^2\mathbf{j} + 3xz^2\mathbf{k}$ is a conservative force field. Find the scalar potential and the work done in moving an object in this field from (1, –2, 1) to (3, 1, 4). **(15)**

7. (a) Evaluate $\iint_S \mathbf{A} \cdot \mathbf{n} dS$, where $\mathbf{A} = 18z\mathbf{i} - 12\mathbf{j} + 3y\,\mathbf{k}$ and S is that part of the plane $2x + 3y + 6z = 12$ which is located in the first octant. **(17)**

(b) State Gauss's Divergence theorem and use it to evaluate $\iint_S \mathbf{F} \cdot \hat{\mathbf{n}}\, dS$ for the vector function $\mathbf{F} = 2x^2y\,\mathbf{i} - y^2\mathbf{j} + 4xz^2\mathbf{k}$ taken over the region in the first octant bounded by $y^2 + z^2 = 9$ and $x = 2$. **(18)**

8. (a) State Stokes' theorem. Hence verify Stokes' theorem for $\mathbf{A} = (2x - y)\mathbf{i} - yz^2\mathbf{j} - y^2z\mathbf{k}$, where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$ and C is its boundary. **(18)**

(b) Use Green's theorem to evaluate **(17)**

$$\oint_C (x^2 + xy)dx + (x^2 + y^2)dy$$

where C is the square formed by the lines $y = \pm 1, \quad x = \pm 1$.

L-2/T-1/NAME **Date : 27/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **HUM 113** (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**.

Symbols indicate their usual meaning.

1. (a) From the following demand function, make a hypothetical demand schedule and plot the curve. **(8 ⅓)**

$$Q = 1000 - 20P + P^2$$

(b) What are the main causes of shifting of the demand curve? Explain them. **(10)**

(c) Why do demand curves generally slope downward? **(5)**

2. (a) How would you measure price elasticity of demand at any point of a straight line demand curve? Explain graphically. **(15)**

(b) From the following table calculate elasticity of demand if you move from point A to C and explain what you understand from the result. **(8 ⅓)**

POINT	P_y	Q_y
A	1500	50
B	1600	60
C	1700	70

3. (a) Explain the properties of an indifference curve. **(10)**

(b) Explain consumer's equilibrium with the help of budget line and indifference curve. **(13 ⅓)**

4. (a) How is price determination in an economy under competition? What will happen to the price and quantity due to change in demand? **(10)**

(b) From the following demand and supply functions, calculate equilibrium price and quantity and show the result in a graph. **(13 ⅓)**

$$P = 0.50\,Q + 150$$
$$P = -0.40\,Q + 300$$

(i) What will happen to the equilibrium price and quantity if government imposes a unit tax of TK 2 per unit?

(ii) Describe the change in equilibrium. Show the equilibrium coordinates on the same graph.

Contd P/2

HUM 113

SECTION – B

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

5. (a) Explain the concept of production function. Discuss the various forms of productivity. **(7)**

   (b) State and prove the application of Euler's theorem in the theory of distribution of production. **(10)**

   (c) What are the internal and external economies of scale of production? Discuss them. **(6⅓)**

6. (a) Critically explain the concept of optimization. **(5)**

   (b) What are the assumptions of perfect competition? Discuss them. **(3⅓)**

   (c) Explain the short run equilibrium of a firm under perfect competition. **(5)**

   (d) Given the following total revenue (TR) and total cost (TC) functions for a firm **(10)**

$$TR = 5900 - 10Q^2$$

$$TC = 2Q^3 - 4Q^2 + 140Q + 845$$

   where Q is the quantity of output.

   (i) Set up the profit function,

   (ii) Find the critical value(s) and

   (iii) Calculate the maximum profit.

7. (a) Distinguish between the concepts of fixed cost and variable cost. Explain graphically. **(3⅓)**

   (b) Explain short run total cost curves and short run per unit cost curves. Present hypothetical average and marginal cost schedules, plot these schedules on graph and show that short run cost curves are 4-shaped. **(8)**

   (c) Discuss any two methods of measuring national income of a country. **(6)**

   (d) Calculate national income from the following information. **(6)**

   GNP = Tk. 1,16,000 crore
   Depreciation = Tk. 10,000 crore
   Indirect tax = Tk. 11,500 crore
   Subsidy is 20% of indirect tax

8. (a) What is meant by inflation? What are the causes of demand pull and cost push inflation? **(5)**

   (b) Compare graphically the effects of demand pull and cost push inflation on the price level and output. **(6)**

   (c) How will you determine macroeconomic equilibrium with the help of aggregate demand and aggregate supply? **(6)**

   (d) How does Production Possibility Frontier of a country indicate efficient resource allocation? Explain. **(6⅓)**

L-2/T-1/NAME **Date : 31/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 219** (Marine Engines and Fuels)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Assume reasonable value for any missing data.

SECTION – A

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

1. (a) What is knocking in diesel engine? In which phase of combustion in diesel engine it may occur and why? How knocking can be prevented? **(20)**

   (b) Draw a schematic diagram to show the phases of diesel combustion process. **(10)**

   (c) Define exhaust smoke. **(5)**

2. John's automobile has a three liter SI V6 engine that operates on a four-stroke cycle at 3600 RPM. The compression ratio is 9.5, the length of the connecting rod is 16.6 cm, and the engine is square (B = S). The engine is connected to a dynamometer which gives a brake output torque reading of 205 N-m at 3600 RPM. At this sped air enters the cylinder at 85 kPa and 60°C, and the mechanical efficiency of the engine is 85%. AFR of the engine is 15, having fuel heating value 44,000 kj/kg and a combustion efficiency of 97%. **(35)**

   Calculate:

   (i) cylinder bore and stroke length.
   (ii) average piston speed.
   (iii) clearance volume of one cylinder.
   (iv) brake power.
   (v) break mean effective pressure.
   (vi) power lost to friction.
   (vii) rate of fuel flow into engine.
   (viii) brake thermal efficiency.
   (ix) volumetric efficiency.
   (x) brake specific fuel consumption.

3. (a) Differentiate the followings: **(25)**

   (i) Trunk piston and Crosshead piston.
   (ii) Dry liner and wet liner.
   (iii) Compression ring and oil ring.
   (iv) Dry sump and wet sump.
   (v) Service rating and peak rating.

   (b) Why AFR in petrol engine is lower than diesel engine? **(10)**

NAME 219

4. (a) A 500 bhp diesel engine has a η_{th} of 40%. It is water cooling which the takes away 25% of the total heat input. If maximum temperature rises of cooling water is 30°F what should be the minimum flow of water in gallon/hr/bhp. **(15)**

   (b) With neat sketch, describe different types of combustion chamber. **(15)**

   (c) Why turbulence is important in combustion chamber of diesel engine? **(5)**

SECTION – B

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

5. (a) Schematically describe different types of nozzles mentioning their construction, advantages and disadvantages. **(20)**

   (b) A 6-cylinder 4-stroke C.I. Engine develops 180 r.p.m. with brake specific fuel consumption of 0.273 kg/kWh. Determine the size of the single hole injector nozzle if the injection pressure is 180 bar and the pressure in the combustion chamber is 50 bar. The period of injection is 30° of crank angle. Specific gravity of fuel = 0.85 and orifice discharge coefficient = 0.9. **(15)**

6. (a) Briefly describe the components of water cooling system. **(18)**

   (b) With neat sketch, discuss different types of lubricating systems. **(17)**

7. (a) Define prime movers. Make a comparison between internal-combustion and other thermal engines. **(13)**

   (b) Describe with figure the hydrodynamic theory of lubrication. **(12)**

   (c) Discuss the factors that cause low oil pressure or discontinue oil supply. **(10)**

8. (a) Explain the basic principles of gas turbine engine. **(9)**

   (b) Discuss the effects of turbine temperature and atmospheric conditions on gas turbine engine. **(10)**

   (c) Describe the operation of turbocharger and supercharger. **(11)**

   (d) What are the main components of magneto ignition system? **(5)**

L-2/T-1/NAME **Date : 06/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **MME 293** (Shipbuilding Materials)

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**.

1. (a) Compare between bend test and tensile test. **(10)**

   (b) Describe the factors that control ductile to brittle transition. **(15)**

   (c) Steady-state creep rate data are given in Table 1 for some alloys taken at 200°C. If it is known that the activation energy for creep is 140,000 J/mol, compute the steady-state creep rate at a temperature of 250°C and a stress level of 48 MPa. **(10)**

2. (a) A copper-silver alloy of composition 85 wt% Ag-15 wt% Cu is slowly heated from a temperature of 700°C (1300°F). Using Figure 1 answer the following: **(25)**

   (i) At what temperature does the first liquid phase form?

   (ii) What is the composition of this liquid phase?

   (iii) At what temperature does complete melting of the alloy occur?

   (iv) What is the composition of the last solid remaining prior to complete melting?

   (v) Again using Figure 1 draw the cooling curve and microstructures at various temperatures during solidification of a 95 wt% Ag- 5wt% Cu alloy.

   (b) How does cored structure produce during non equilibrium cooling? **(10)**

3. (a) Explain the operations of blast furnace with necessary reactions. **(25)**

   (b) "Blast furnace operation can not be carried out without coke or coal". Explain this statement. **(10)**

4. (a) What are stainless steels? Differentiate between ferritic and martensitic stainless steels. **(12)**

   (b) What is crevice corrosion? How does crevice corrosion occur? Mention its remedies. **(12)**

   (c) Describe, with necessary figures how surface cracks and blow holes are detected by the method of dye penetrant inspection. **(11)**

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MME 293

SECTION – B

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

5. (a) What is the purpose of surface hardening? Explain how a hard surface can be produced on a low carbon steel part. **(16)**

   (b) Mention the effect of tempering temperature on hardness, toughness and residual stress of a quenched high carbon steel part. **(9)**

   (c) Why normalized steel has higher hardness as compared to annealed steel of same composition. **(10)**

6. (a) Describe how steel is produced using an acid Bessemer converter. **(20)**

   (b) Differentiate between Bessemer steel making process and LD steel making process. **(15)**

7. (a) How aluminium is produced from aluminium ore. **(10)**

   (b) Mention composition, properties and uses of (i) oxygen-free high-conductivity copper, (ii) cupronickel and (iii) nickel silver. **(18)**

   (c) Write a short note on strengthening mechanism of copper alloys. **(7)**

8. (a) Describe the process of producing pearlitic malleable cast iron showing the microstructural changes that occur during the process. **(18)**

   (b) Nodular cast iron is tougher than gray cast iron— explain. **(7)**

   (c) Compare the properties and structure of hypo-eutectoid steel with that of hyper-eutectoid steel. **(10)**

Table 1 for question 1 (e)

$\dot{\varepsilon}_s$ (h^{-1})	σ (MPa)
2.5×10^{-3}	55
2.4×10^{-2}	69

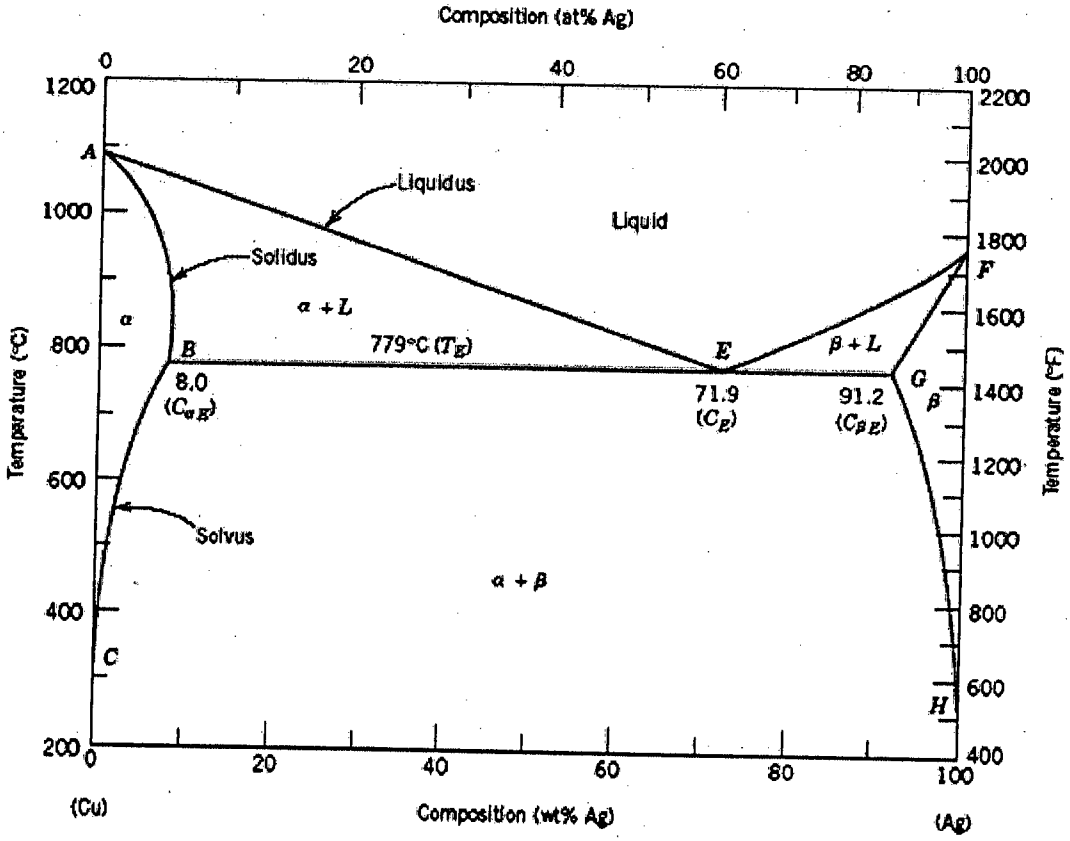

Figure 1 for question 2 (a)