L-2/T-2/ME **Date : 16/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **MATH 263** (Complex Variables, Fourier Series, Harmonic Functions and Partial Differential Equations)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Prove that following inequalities: **(20 2/3)**

$$\text{(i)}\ |z_1 + z_2| \le |z_1| + |z_2| \qquad \text{(ii)}\ |z_1 + z_2| \ge ||z_1| - |z_2||$$

(b) Find the principal argument of $(\sqrt{3} - i)^6$. **(10)**

(c) Find the image of the infinite strip $0 < y < \frac{1}{2c}$, $c > 0$, under the transformation $w = \frac{1}{z}$. Sketch the strip and its image. **(16)**

2. (a) Given $f(z) = x^3 + i(1 - y)^3$. Show that $f'(z)$ exists at $z = i$. **(10)**

(b) Find the polar form of Cauchy-Riemann equations. **(10)**

(c) Solve $\cos z = 2$ by equating the real and imaginary parts in the equation. **(14 2/3)**

(d) Express $\sinh z$ in the complex form $x + iy$ and hence show that $|\sinh z|^2 = |\sin(iz)|^2$. **(12)**

3. (a) Use Cauchy's integral formula to evaluate the integral $\int_C \frac{z}{(9 - z^2)(z + i)} dz$, where C is the circle $|z| = 2$, taken in the positive sense. **(16)**

(b) State Laurent's theorem. Expand $f(z) = \frac{1}{(z+1)(z+3)}$ in a Laurent series valid for **(16)**

(i) $1 < |z| < 3$ and (ii) $0 < |z + 1| < 2$

(c) Evaluate the integral $\int_C \frac{1 + z^2}{(z - 1)^2 (z + 2i)} dz$ by Cauchy's residue theorem, where C is the circle $|z| = 3$ oriented in the positive sense. **(14 2/3)**

4. Evaluate the following integrals using residues and contours:

(i) $\int_{-\infty}^{\infty} \frac{x \sin(\pi x)}{x^2 + 2x + 5} dx$ **(26 2/3)**

(ii) $\int_0^{2\pi} \frac{\sin^2 \theta}{5 - 4\cos\theta} d\theta$ **(20)**

Contd P/2

MATH 263/ME

SECTION – B

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

5. (a) Solve the following partial differential equation

$$(2xy - 1)p + (z - 2x^2)q = 2(x - yz)$$

and find the particular integral which passes through the line $x = 1$, $y = 0$. **(15)**

(b) Find a complete integral of the PDE $z^2(p^2 + q^2) = x^2 + y^2$. **(15)**

(c) Use Charpit's method to find a complete integral and a singular integral (if exists) of the PDE $(p^2 + q^2)y = qz$. **(16 2/3)**

6. Solve the following higher order partial differential equations:

(i) $\left(4D_x^2 - 4D_xD_y + D_y^2\right)z = \log(x + 2y)$ **(15)**

(ii) $\left(D_x^2 - D_xD_y - 2D_x\right)z = \sin(3x + 4y) - e^{2x + y}$ **(15)**

(iii) $\left(x^2D_x^2 - xyD_xD_y - 2y^2D_y^2 + xD_x - 2yD_y\right)z = \log\left(y/x\right)$ **(16 2/3)**

7. (a) Find the Fourier cosine series of the function $f(x) = \sin x$; $0 < x < \pi$ and hence find the sum of the infinite series $\sum_{n=1}^{\infty} \frac{(-1)^n}{4n^2 - 1}$. **(23)**

(b) Find the Fourier integral of the function **(23 2/3)**

$$f(t) = \begin{cases} 1 + t\,; & |t| < 1 \\ 0\,; & |t| > 1 \end{cases}$$

and hence evaluate $\int_0^{\infty} \left(\frac{\sin\omega}{\omega}\right)^2 d\omega$.

8. (a) Use Finite Fourier transform to solve **(23)**

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}\,; \qquad 0 < x < 5, \qquad t > 0$$

where $u_x(0, t) = u_x(5, t) = 0\,;$ $t > 0$

and $u(x, 0) = 2x\,;$ $0 < x < 5$

(b) The surface of a hollow sphere of unit radius is kept at a distribution of potential $v_0(1 + 3\cos\theta)$. Find the potential at any point inside the sphere. **(23 2/3)**

L-2/T-2/ME Date : 20/07/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **HUM 201** (Sociology)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What is meant by social norms? How do social norms help to develop normative behaviour pattern of a social group? **(10)**

   (b) 'Ethnocentrism is the tendency to assume one's own culture as superior to other' – Explain. **(10)**

   (c) Write down the differences between culture and civilization. **(15)**

2. (a) What is meant by socialization? Explain primary socialization and anticipatory socialization and give examples. **(10)**

   (b) Discuss the preconditions of successful learning. **(10)**

   (c) How does socialization shape human behaviour? Write your answer highlighting G.H. Mead's theory of socialization. **(15)**

3. (a) 'Globalization is often used to refer to economic globalization: like integration of national economies into the international economy through trade, foreign direct investment, capital flows, migration, and the spread of technology' – Explain. **(20)**

   (b) Critically discuss the various functions of mass media in our society. **(15)**

4. Write short notes on any three of the following: **(35)**

   (a) Different systems of social stratification.

   (b) Types of social mobility.

   (c) Karl Marx's theory of social differences.

   (d) Social values.

SECTION – B

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

5. (a) Define greenhouse gases. **(5)**

   (b) What are the main sources of global warming? **(15)**

   (c) Write short notes on environmental justice. **(15)**

Contd P/2

HUM 201/ME

6. (a) Write down the important characteristics of capitalism. **(10)**

   (b) What are the factors that have led to the growth of cities? **(10)**

   (c) Describe the social consequences of industrial revolution. **(15)**

7. (a) Illustrate Merton's typology of deviance. Cite examples from your society. **(10)**

   (b) Discuss the factors facilitating juvenile delinquency in Bangladesh. **(10)**

   (c) Critically discuss the modernization theory of development. **(15)**

8. Write short notes on any THREE of the followings: **(35)**

   (a) Demographic transition theory.

   (b) The sources of social change.

   (c) Causes of poverty in Bangladesh.

   (d) Types of family.

L-2/T-2/ME Date : 20/07/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **HUM 203** (Government)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What are the parliamentary and presidential forms of government? Describe the differences between the parliamentary and presidential forms of government. **(15)**

   (b) What is citizenship? Explain the rights and duties of a citizen in a state. **(20)**

2. (a) Discuss the modern classification of government with a diagram. **(15)**

   (b) Briefly review the functions of the three organs (legislature, executive and judiciary) of government. **(20)**

3. (a) Define a political party. Discuss the functions of political parties in a state. **(15)**

   (b) What are the features of sovereignty? Describe different forms of sovereignty. **(20)**

4. Write short notes on any three (03) of the following: **(35)**

   (a) Pressure Group

   (b) Socialism

   (c) Good Governance

   (d) Bureaucracy

SECTION – B

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

5. (a) How do you define nationalism and internationalism? Describe the different elements of nationalism. **(15)**

   (b) What are unitary and federal forms of government? Discuss the differences between unitary and federal forms of government. **(20)**

Contd P/2

HUM 203/ME

6. (a) Define constitution. Describe the major amendments of Bangladesh constitution. **(15)**

   (b) Define foreign policy. Discuss the determinants and main principles of Bangladesh foreign policy. **(20)**

7. (a) Define local government. Critically discuss the constitutional provisions of Bangladesh regarding local government. **(20)**

   (b) Define decentralization. How far is the local government system in Bangladesh decentralized? **(15)**

8. (a) Discuss the rule making process in Bangladesh. **(15)**

   (b) What is meant by electoral college? How does the American political system work? **(20)**

L-2/T-2/ME Date : 26/07/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **ME 261** (Numerical Analysis)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Assume any data if necessary.

1. (a) What do you understand by solving a problem numerically using 'iterative' methods? **(3)**

   (b) Solve the following equation iteratively using 'Regula Falsi' method accurate up to four decimal places within the bracket [1, 3]: **(10)**

   $$\sin x - x + 2 = 0$$

   (c) The n^{th} root of a number 'k' can be obtained by solving the equation, $f(x) = x^n - k = 0$. Use fixed-point iteration method to get the cubic root of 0.75 accurate up to three decimal places. **(12)**

   (d) Briefly discuss the convergence characteristics and the associated convergence criteria for the iterative root-finding methods. **(10)**

2. (a) Solve the following system of equations by the Gaussian Elimination method: **(15)**

   $$x_1 + x_2 - 2x_3 = 3$$
   $$4x_1 - 2x_2 + x_3 = 5$$
   $$3x_1 - x_2 + 3x_3 = 8$$

   Use partial pivoting and keep at least four digits after decimal in your calculations.

   (b) Briefly discuss the algorithm to complete the inverse of a square matrix using Gauss-Jordan elimination method. **(6)**

   (c) (i) Use LU decomposition method to invert Matrix [A] given below **(14)**

   $$[A] = \begin{bmatrix} 4 & 1 & 6 \\ 1 & 3 & 1 \\ 5 & 2 & 5 \end{bmatrix}$$

   (ii) Use the inverse to solve

   $$[A]\{X\} = \{b\}, \text{ where } \{b\} = \begin{Bmatrix} 20 \\ 10 \\ 24 \end{Bmatrix}$$

3. (a) Solve the following system of equations by the Gauss-Seidel method: **(15)**

   $$2x_1 - 7x_2 - 10x_3 = -17$$
   $$5x_1 + x_2 + 3x_3 = 14$$
   $$x_1 + 10x_2 + 9x_3 = 7$$

Contd P/2

ME 261

Contd ... Q. No. 3(a)

Use $x_1^{(0)} = x_2^{(0)} = x_3^{(0)} = 0$ as the initial guesses. Perform 10 iterations maintaining at least four digits after decimal for all the iterations.

(b) Did the iterations in Q.3(a) converge? Explain your answer by mentioning the general criterion for a system of equations to converge in case of the Gauss-Seidel method and the associated prevailing situation in the system of equations above. **(6)**

(c) Solve the following initial value problem **(14)**

$$\frac{dy}{dx} = x^2 + y, \qquad y(0) = 1$$

by the 'Midpoint Interval' method to estimate $y(0.1)$ using $h = 0.05$. Also estimate the percentage error of the numerical result with the exact answer given by the analytical solution as: $y(x) = 3e^x - x^2 - 2x - 2$.

4. (a) Explain the generalized R-K method used for estimating dependent variable of an initial value problem and show mathematically that Euler's method, Heun's method, Midpoint Interval method, etc. are special cases of the generalized R-K method. **(12)**

(b) An object with a *mass*, $m = 10$ *kg* is falling under the influence of earth gravity. The object starts from rest and experiences a retarding force equal to 0.25 of its *velocity*, v, i.e., in differential equation form, **(23)**

$$m\frac{dv}{dt} = mg - 0.25v$$

Find its *velocity*, v after *time*, $t = 4$ *seconds* using the classical 4^{th} order R-K method with a *step size*, $h = 2$ *seconds*. Solve it analytically and determine the percentage error of your numerical estimate. [$g = 9.81$ m/s^2]

SECTION – B

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

5. (a) Define relative error. How do you compute relative error for an approximate number in practice? **(10)**

(b) Mathematically show that relative error accumulation in multiplication and division of two approximate numbers is identical. **(10)**

(c) The function, $y(x) = 2.0 \sin x + 3.00 \ln x + x^2$ is to be evaluate for $x = 1.26$. The constants and the value of x are correct only up to the number of significant digits shown. Find the absolute and percentage errors in y. **(15)**

Contd P/3

ME 261

6. (a) With necessary schematic illustrations, compare and contrast Simpson's $\frac{1}{3}$rd and $\frac{3}{8}$th rules of integration with special reference to the following aspects: **(18)**

   (i) single application formula.

   (ii) multiple application formula.

   (iii) local truncation error.

   (iv) global truncation error.

   (v) application flexibility.

   (b) What is Richardson's extrapolation scheme? Deduce Richardson's extrapolation formulae for Trapizoidal and Simpson's methods of integration. How can you combine the two extrapolation formulae to a single one? **(17)**

7. (a) For symmetrical stress distribution in a circular body, the stress function ϕ is governed by the following DEQ, **(18)**

$$\frac{d^4\phi}{dr^4} + \frac{2}{r}\frac{d^3\phi}{dr^3} - \frac{1}{r^2}\frac{d^2\phi}{dr^2} + \frac{1}{r^3}\frac{d\phi}{dr} = 0$$

   Derive the corresponding central-difference algebraic equation with an error of $O(h^2)$ and show the corresponding finite-difference stencil.

   (b) The electrical voltage drop across an inductor, according to Faraday's law, is given by **(17)**

$$V_L = L\frac{di}{dt}$$

   where, V_L = voltage drop (V)

   L = inductance (Henry)

   i = current (A)

   t = time (sec)

i	0	0.15	0.3	0.55	0.8	1.9
t	0	0.1	0.2	0.3	0.5	0.7

   From the above data set, determine the voltage drops at the following time steps for an inductance of 4 Henry:

   (i) t = 0, (ii) t = 0.15, (iii) t = 0.4, (iv) t = 0.7.

   All the results should conform to the accuracy level of $O(h^2)$.

8. (a) $(x_1, y_1), (x_2, y_2), (x_3, y_3) \ldots\ldots\ldots\ldots\ldots (x_n, y_n)$ **(17)**

   Consider curve fitting of the above data set with a general linear form

$$y = f(x, c_1, c_2, c_3, \ldots\ldots\ldots\ldots\ldots c_m) = \sum_{i=1}^{m} c_i f_i(x)$$

Contd P/4

ME 261

Contd ... Q. No. 8(a)

Show that the matrix formulation of least-squares procedure for the above case is given by

$$\left[[F]^T\,[F]\right]_{m\times m}\{C\}_{m\times 1} = \left\{[F]^T\,\{Y\}\right\}_{m\times 1}$$

where [F] is the coefficient matrix associated with the set of observation equations.

(b) Apply the above matrix formulation to the experimental data points shown in the accompanying figure [Fig. Q. 8(b)] to obtain a least-squares fit having the form **(18)**

$$y = a + bx^2$$

Comment on the quality of the approximation curve you obtained.

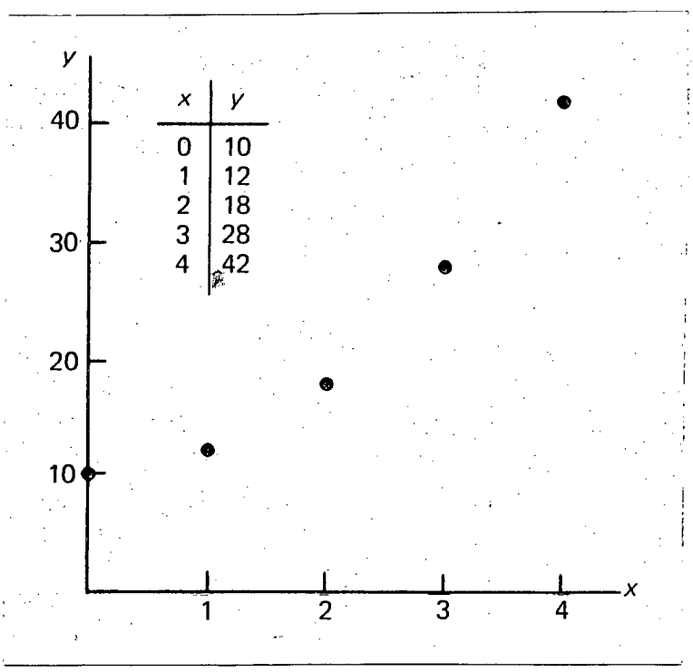

Fig. for Q. 8(b)

L-2/T-2/ME Date : 31/07/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **MME 291** (Metallic materials)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) A specimen of magnesium having a rectangular cross section of dimensions 3.2 mm × 19.1 mm is deformed in tension. Using the load-elongation data of Table 1 complete parts (i) through (vi). **(30)**

   (i) Plot the data as engineering stress versus engineering strain.

   (ii) Compute the modulus of elasticity.

   (iii) The stress at the limit of proportionality.

   (iv) Determine the yield strength at a strain offset of 0.002.

   (v) Determine the ultimate tensile strength of this specimen.

   (vi) Compute the modulus of resilience.

   Table 1 for Q. 1(a): Load – elongation data of tensile testing of magnesium

Load (N)	0	1380	2780	5630	7430	9870	12850	14340	13830	12500	Fracture
Length (mm)	63.50	63.53	63.56	63.62	63.70	64.14	65.41	67.95	69.22	70.49	

   (b) Mention the importance of ductility of a material. **(5)**

2. (a) Rocket motor cases need to be fabricated as thin walled tubes from both low and high alloy steels. Yield strength (YS) and fracture toughness of both these steels are measured in the sheet form of appropriate thickness. Their YS and fracture toughness are listed in Table 2. Calculate the minimum size of the defect permissible for these two materials to fulfill the service conditions. Also make comment on the results. Young's modulus may be taken as 200 GPa in both cases. Note: The design code specifies the safety factor to be 1.5. Assume reasonable value for any missing data. **(15)**

   Table 2 for Q. 2(a): Yield strength and fracture toughness of low and high alloy steels.

	Yield strength (MPa)	Fracture toughness (kJm^{-2})
Low alloy steel	1200	24
High alloy steel	1800	24

Contd P/2

MME 291/ME

Contd ... Q. No. 2(a)

(b) A single crystal of aluminum is oriented for a tensile test such that its slip plane normal makes as angle of 28.1° with the tensile axis. Three possible slip directions make angles of 62.4°, 72.0° and 81.1° with the same tensile axis. A tensile stress of 3 MPa (435 psi) is applied for these cases. **(10)**

(i) Which of these three slip directions is most favored?

(ii) If plastic deformation begins at a tensile stress of 1.95 MPa (280 psi), determine the critical resolved shear stress for aluminum.

(c) Explain the factors that control plane strain fracture toughness. **(10)**

3. (a) Two undeformed specimens of the mild steel are to be plastically deformed by reducing their cross-sectional areas. One has a circular cross section and the other is rectangular; during deformation the circular cross section is to remain circular, and the rectangular is to remain as such. Their original and deformed dimensions are given in Table 3. **(10)**

Which of these specimens will be the hardest after plastic deformation, and why?

Table 3 for Q. 3(a): Original and deformed dimensions of the specimens.

	Circular (diameter, mm)	Rectangular (mm)
Original dimensions	18.0	20 × 50
Deformed dimensions	15.9	13.7 × 55.1

(b) How can aluminum alloys be strengthened? Explain any two mechanisms of strengthening of aluminum alloys. **(12)**

(c) Illustrate the mechanical properties of different phases of Cu-Zn alloy. **(13)**

4. (a) Describe the structural changes that occur during quenching of steel. **(10)**

(b) To improve machinability of a full annealed hypereutectoid steel, which heat treatment process will you follow? Justify your answer with detailed explanation. **(12)**

(c) What is the effect of increasing cooling rate on: **(7)**

(i) temperature of austenite transformation.

(ii) fineness of pearlite.

(iii) amount of proeutectoid constituent.

(d) Is it possible to determine the approximate carbon content of a normalized steel from microscopic study? Explain. **(6)**

Contd P/3

MME 291/ME

SECTION – B

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

5. (a) What are the functions of the three substances charged in a Blast urnace? Discuss how and when Iron picks up C, Mn, Si, S and P during Blast Furnace operation with reactions. **(18)**

   (b) With necessary diagram briefly describe the operating steps of any method, which you think is suitable in detecting surface cracks of a steel component. **(13)**

   (c) In a radiograph what will be the difference in appearance of cracks and high density impurities? **(4)**

6. (a) Acidic refractory (e.g Silica) is usually cheaper and more available than basic refractory (e.g Dolomite/magnesite). Why then do steel making furnace commonly have basic lining? **(10)**

   (b) In terms of the disadvantages of EAF discuss why most steelmakers in Bangladesh op for induction furnace. **(12)**

   (c) Briefly discuss the problem associated with the removal of P and S from steel and describe a solution to this problem. **(8)**

   (d) Give the advantages of LD steelmaking over EAF steelmaking. **(5)**

7. (a) A complex and intricate shaped part is required for an agricultural tractor. The part does not require high strength but needs to be cheap and **castable**.

   (i) Which is a better choice, steel or cast iron? Justify. **(4)**

   (ii) If ductility is also required which two of the cast irons can be used? **(4)**

   (iii) Now suppose the part has some sections which are thick. These sections will **cool slowly** during casting. Bearing this mind, one of the two cast irons from (ii) will be unsuitable if ductility is desired in all sections of the part. Identify which one and the reason behind it. **(7)**

   (iv) Again suppose you need extra strength even if some ductility is sacrificed. What sub-type of the suitable material from (iii) has these properties? **(2)**

   (v) Finally, list the steps you would follow to produce this material. **(5)**

   (b) List the reasons that make Cr a suitable alloying element to obtain corrosion resistant steel. How can you make martensitic and austenitic stainless steels? What are their benefits? **(3+6+4=13)**

8. (a) Define critical cooling rate. **(6)**

   (b) What are the effects of tempering on structure and properties of quenched steel? **(7)**

   (c) Differentiate between cyaniding and carbonitriding. What are the advantages of gas carburizing over pack carburizing? Which compounds are responsible for the properties provided by a nitride case? **(5+5+2=12)**

   (d) For a Fe-C alloy containing 0.45 wt% C at a temperature just below the eutectoid temperature determine the fraction of eutectoid ferrite. In Fe-Fe_3C diagram Fe_3C contains 6.67% C. The solubility of ferrite is about 0.022% C at eutectoid temperature. Eutectoid point is at 0.76% C. **(10)**

L-2/T-2/ME Date : 06/08/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub : **ME 243** (Mechanics of Solids)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume any data if necessary.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) The assembly shown in Figure for Q. No. 1(a) consists of three disks A, B and C that are used to support the load of 140 kN. If the allowable bearing stress and the shear stress are 350 MPa and 125 MPa, respectively, determine the smallest diameter d_1 of the top disk, the diameter d_2 within the support space, and the diameter d_3 of the hole in the bottom disk. **(18)**

   (b) A rigid beam with negligible weight is pinned at one end and attached to two vertical rods as shown in Figure for Q. No. 1(b). The beam was initially horizontal before the load W = 100 kN was applied. Find the vertical movement of the point of the beam where W is applied. **(17)**

2. (a) A steel propeller shaft is to transmit 4.5 MW at 3 Hz without exceeding a shearing stress of 50 MPa or twisting through more than 1° in a length of 26 diameters. If G = 83 GPa, compute the minimum diameter of the shaft required. **(18)**

   (b) The cylinder for a hydraulic press has an inside diameter of 300 mm. Determine the wall thickness required if the cylinder is to withstand an internal pressure of 60 MPa without exceeding a shearing stress of 90 MPa. **(17)**

3. (a) A column with the C-section dimensions as shown in Figure for Q. No. 3(a) is to be used for carrying 15 kN axial load. The column has a length 0.8 m. If the Young's modulus and the yield stress of the material are 200 GPa and 250 MPa, respectively, determine the factor of safety for using this column. Use AISC specifications. **(18)**

   (b) A bill board with 50 kg weight is to be supported by a 6 m long hollow circular cross section column with aluminum material (E = 80 GPa, σ_y = 120 MPa). If the distance of the centroid of the billboard from the column axis is 500 mm and the outer dia of the column cross section is 100 mm, find the minimum thickness required for this column section. **(17)**

4. (a) The state of stress at a point on the surface of a microprocessor component is shown in Figure for Q. No. 4(a). Determine the principal stresses and the maximum shear stress along with their directions. With sketches, show the orientations of the element for the principal stresses and the maximum shear stress. **(18)**

Contd P/2

ME 243

Contd ... Q. No. 4

(b) The steel shaft in Figure for Q. No. 4(b) is loaded as shown. The Young's modulus and the yield stress of the material is 200 GPa and 250 MPa. If a factor of safety 1.6 is to be used based on the yield stress of the material, determine the minimum diameter 'd' required. **(17)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.
Symbols indicate their usual meaning.

5. (a) Draw shear and moment diagrams for the beam shown in Figure for Q. No. 5(a). Give numerical values at all changes of loading positions and at all points of zero shear. **(15)**

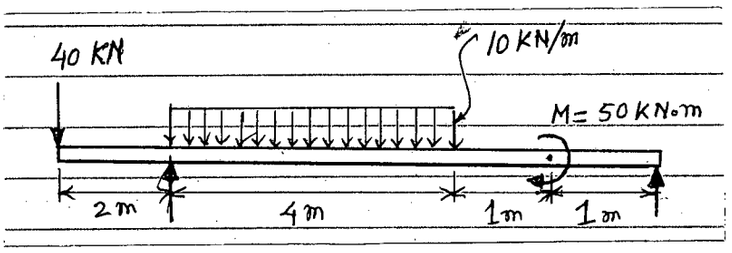

Figure for Q. No. 5(a)

(b) A crane hook has a cross-section that is approximated by the trapezoidal section shown in Figure for Q. No. 5(b). What is the maximum load P that will not exceed a stress of 120 MPa. **(20)**

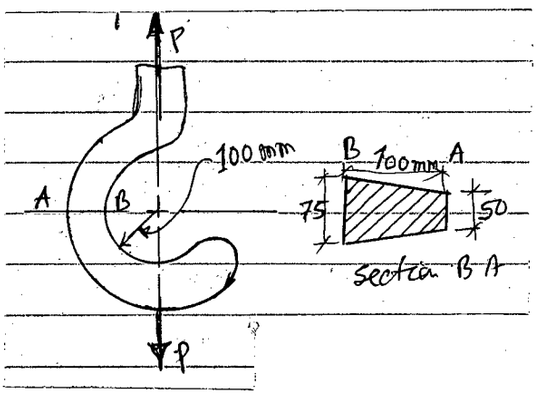

Figure for Q. No. 5(b)

6. (a) Write shear and moment equations for the beam shown in Figure for Q. No. 6(a). Draw shear and moment diagrams specifying values at all change of loading positions. Neglect the mass of the beam. **(17)**

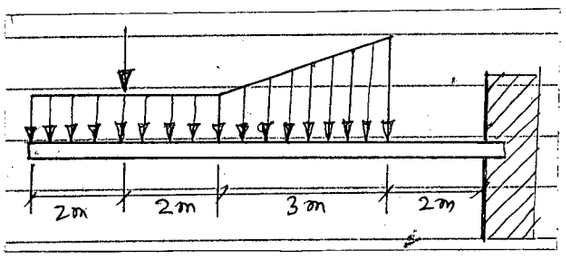

Figure for Q. No. 6(a)

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Contd ... Q. No. 6

(b) In a reinforced concrete beam b = 300 mm, d = 450 mm and n = 8. If a maximum stress of 10 MPa is developed in the concrete when resisting a bending moment of 100 kN.m, what stress is developed in the steel? What area of reinforcing steel is required, if allowable stress in steel is 150 MPa? **(18)**

7. The distributed load as shown in Figure for Q. No. 7, is supported by a wide flange section of the given dimensions. Compute (a) the maximum shearing stress, (b) the shearing stress at the junction of the flange and web and (c) the maximum bending stress developed in the beam. **(35)**

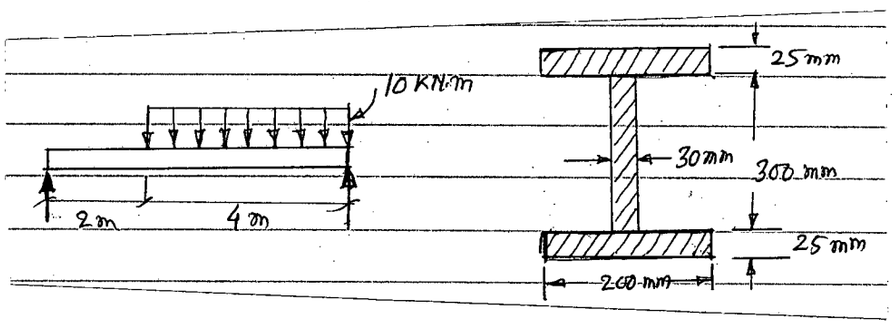

Figure for Q. No. 7

8. (a) For the beam loaded as shown in Figure for Q. No. 8(a), determine the maximum deflection of the beam by double integration method. **(18)**

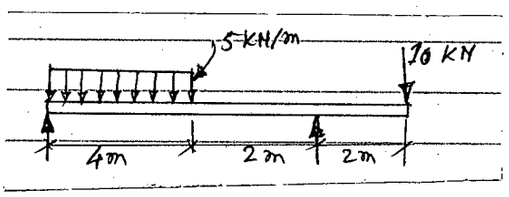

Figure for Q. No. 8(a)

(b) Determine the maximum deflection for the beam loaded as shown in Figure for Q. No. 8(b) by area-moment method. **(17)**

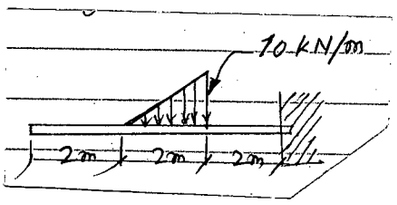

Figure for Q. No. 8(b)

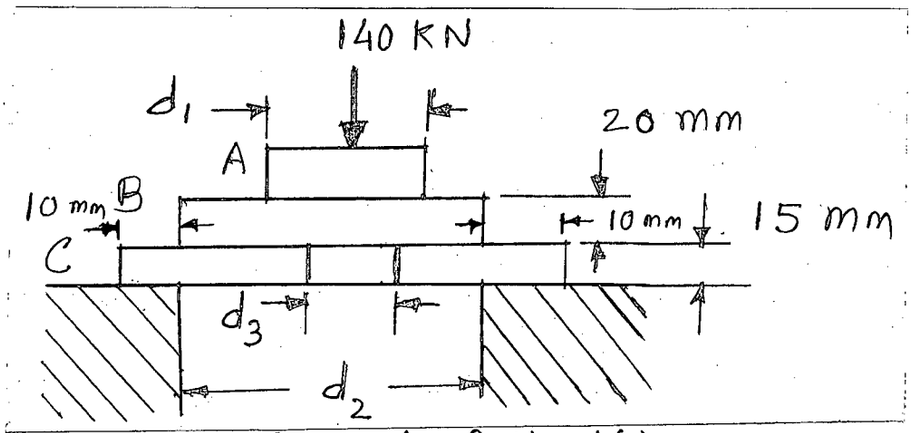

Figure for Q. No. 1(a)

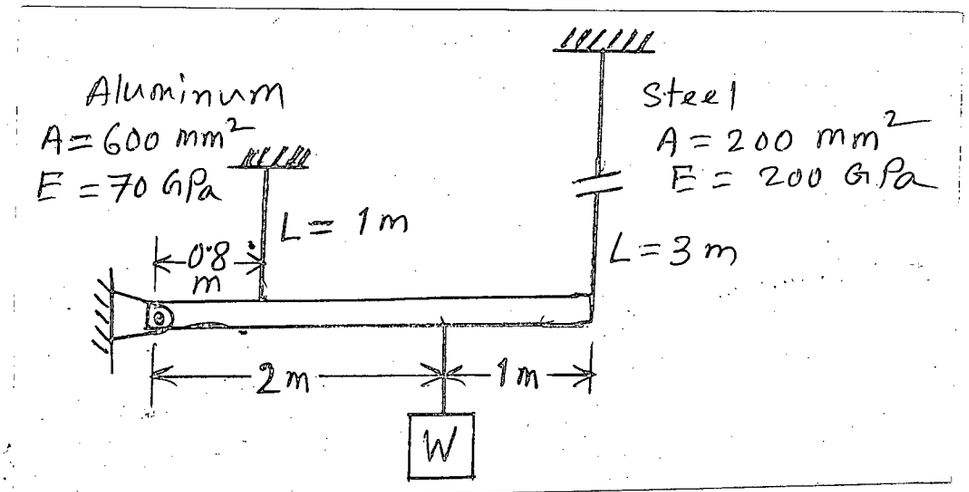

Figure for Q. No. 1(b)

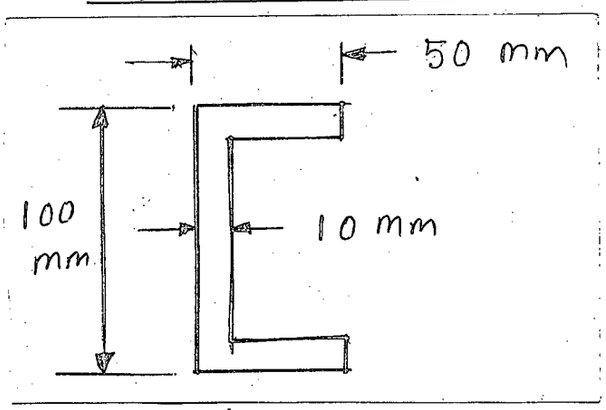

Figure for Q. No. 3(a)

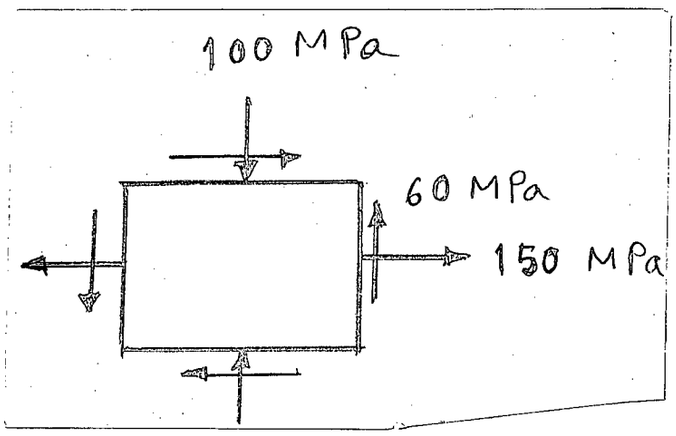

Figure for Q. No. 4(a)

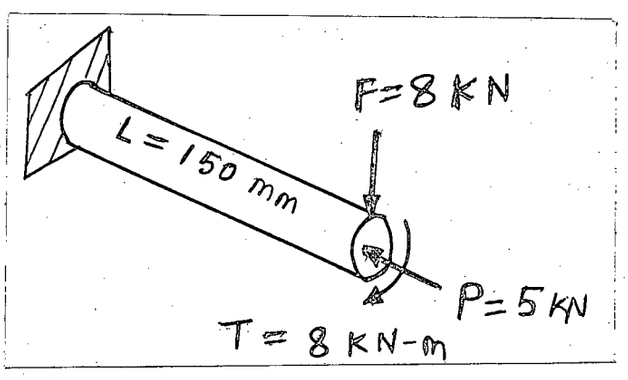

Figure for Q. No. 4(b)