L-2/T-2/ME Date: 16/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-2/T-2 B.Sc. Engineering Examinations **2019-2020**

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

Full Marks: 180 Time: 2 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**

1. (a) In the assembly between two rigid walls shown in Fig. 1(a), the steel bar is rigidly attached to the brass bar with a gap of 0.5 mm between the left wall and the steel bar. When the temperature is 20°C, the bars are stress free. Find the stresses in the bars and the length of each bar when the temperature rises to 120°C in brass and 150°C in steel. The diameters of steel and brass bars are 18 mm and 30 mm, respectively. For steel, E = 200 GPa and $\alpha = 12 \times 10^{-6}/°C$. For brass, E = 95 GPa and $\alpha = 20 \times 10^{-6}/°C$. **(15)**

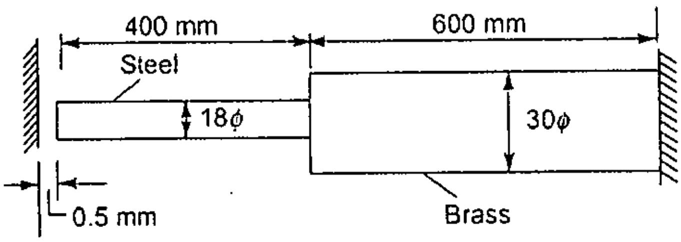


Fig. 1(a)

(b) Assume that the axial load P applied to the lap joint is distributed equally among the three 20-mm-diameter rivets as shown in Fig. 1(b). What is the maximum load P that can be applied if the allowable stresses are 40 MPa for shear in rivets, 90 MPa for bearing between a plate and a rivet, and 120 MPa for tension in the plates? **(15)**

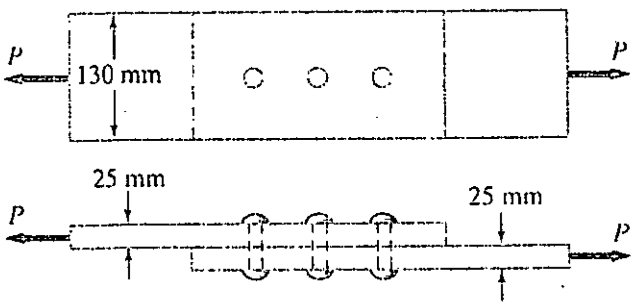


Fig. 1(b)

2. (a) A thick-walled cylinder has inner and outer diameters as 120 mm and 180 mm, respectively. It is subjected to an external pressure of 9 MPa. Find the value of the internal pressure which can be applied if the maximum shear stress in the cylinder is not to exceed 30 MPa. **(15)**

(b) A helical compression spring and the cross-section of its wire are shown in Fig. 2(b). Determine the shear stress at the inner point A, the outer point B, and the center C of the spring wire. Neglect the effect of curvature. **(15)**

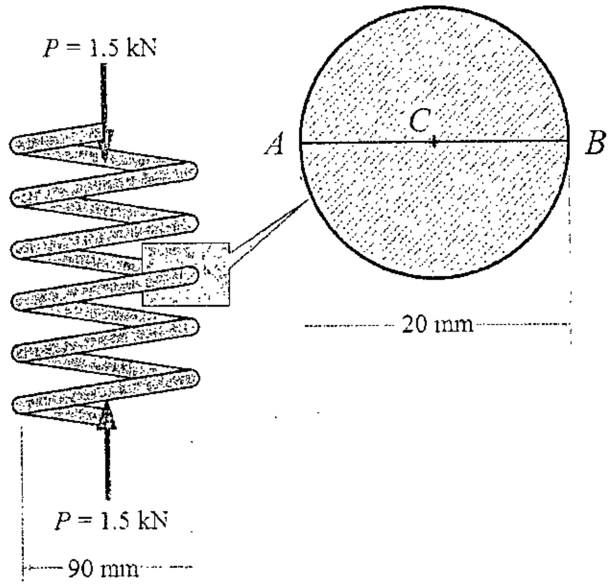


Fig. 2(b)

3. (a) The cross section of the machine part shown in Fig. 3(a) is a square of dimension 5×5 mm. If the maximum stress at section m-n is limited to 150 MPa, determine the largest allowable value of the eccentricity e. **(15)**

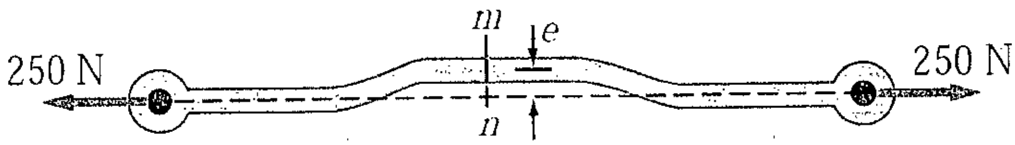


Fig. 3(a)

(b) For the state of pure shear shown in Fig. 3(b), find (i) the principal stresses and (ii) the stress components on planes whose normal are at +60° and +150° with the x axis. Show your answers on a complete sketch of a differential element for each case (i) and (ii). Solve the problem using Mohr's circle. **(15)**

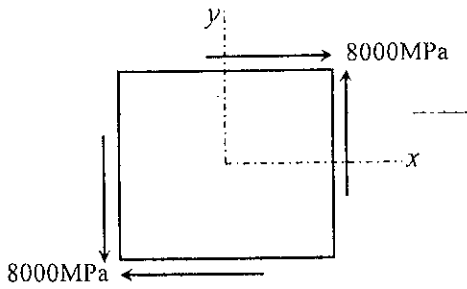


Fig. 3(b)

4. (a) A cantilever beam of length l is subjected to a point load P at the free end as shown in Fig. 4(a). Using Castigliano's theorem, determine the deflection at the midpoint of the beam. Neglect the effect of vertical shear. **(15)**

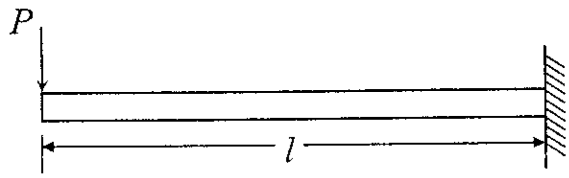


Fig. 4(a)

(b) A mild steel shaft of 100-mm diameter is subjected to a maximum torque of 12 kN.m and a maximum bending moment of 8 kN.m at a particular section. Determine the factor of safety according to maximum shear stress failure theory if the yield strength of mild steel in simple tension is 240 MPa. **(15)**

SECTION-B

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

5. A steel shaft is to be manufactured either as a solid circular bar or as a circular tube. The shaft is required to transmit a torque of 1500 N.m without exceeding an allowable shear stress of 55 MPa nor an allowable rate of twist of 0.83°/m. The shear modulus of elasticity of the steel is 83 GPa. **(30)**

(a) Determine the required diameter of the solid shaft;

(b) Determine the required outer diameter of the hollow shaft if the thickness of the shaft is specified as one-eighth of the outer diameter;

(c) Determine the ratio of diameters and the ratio of weights of the hollow and solid shafts.

6. For the loaded simple beam shown in Fig. 6, **(30)**

(a) use method of sections to derive the shear force and bending moment as functions of x over the entire beam;

(b) draw the shear force and bending moment diagrams;

(c) determine the maximum magnitudes of the shear and moment.

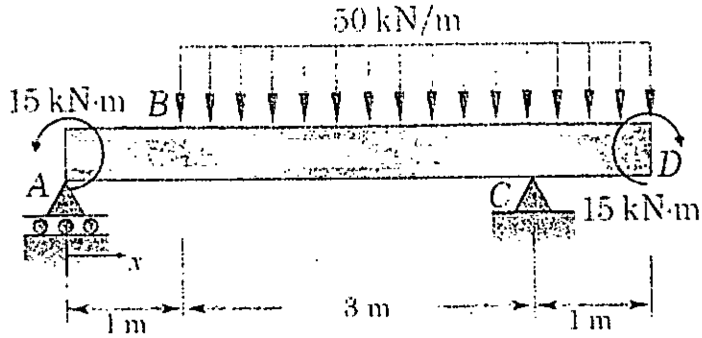


Fig. 6

7. (a) A metal beam with span of 1 m is simply supported at points A and B as shown in Fig. 7(a). The uniform load on the beam is 30 kN/m. The beam has a rectangular cross section having a width of 30 mm and height 100 mm. The beam is adequately supported against sideways buckling. Determine the normal and shear stress at point C. Show these stresses on a sketch of a stress element at point C. **(18)**

Given, M_C = 2.22 kN.m and V_C=8.4 kN, where the signs of these quantities are based upon the standard sign conventions for bending moments and shear forces.

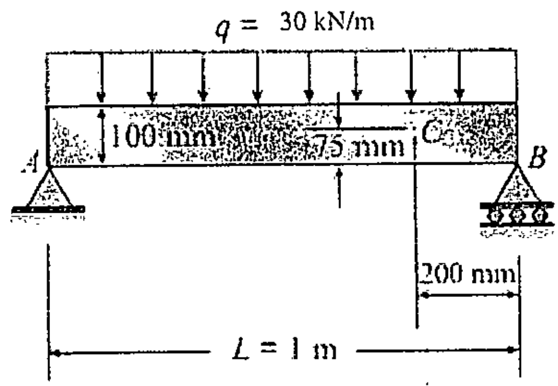


Fig. 7 (a)

(b) Determine the displacement at the end C of the cantilever beam shown in the Fig. 7(b) with EI being constant. **(12)**

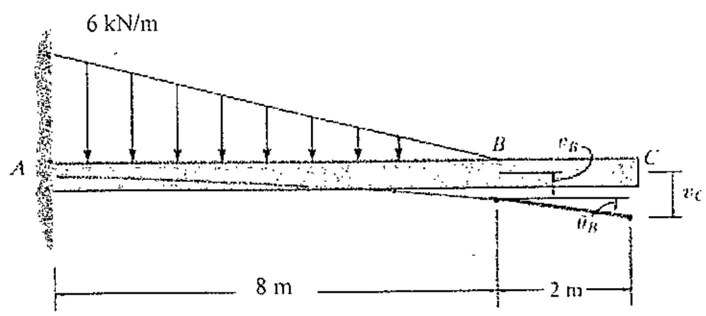


Fig. 7(b)

8. (a) For an industrial laboratory, a pilot unit is to employ a cylindrical steel pressure vessel with an outside diameter of 500 mm and a wall thickness of 10 mm. The vessel is subjected to an internal pressure of 4 MPa. If for this unit 20 bolts are to be used on a 550 mm bolt circle diameter, what is the required bolt diameter at the root of the threads? Set the allowable stress for the bolts at 80 MPa, of which 45 MPa is the initial stress. What circumferential stress is developed in the vessel? Discuss the scenario, if the internal pressure causes the stress in the bolts to be twice the value of the initial stress? **(20)**

(b) The aluminum column is fixed at its bottom and is braced at its top by cables so as to prevent movement at the top along the x axis as shown in Fig. 8(b). If it is assumed to be fixed at its base, determine the largest allowable load P that can be applied. Use a factor of safety for buckling of 2.0. Take E_{al}= 70 GPa, A= 7.5(10^{-3}) m^2, I_x= 61.3(10^{-6}) m^4, I_y= 23.2(10^{-6}) m^4. Discuss the justification of using the Euler's equation for solving this problem. **(10)**

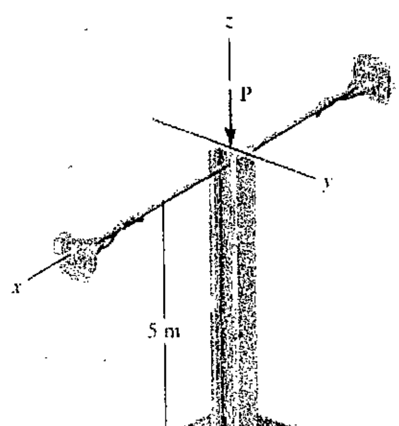


Fig. 8(b)

L-2/T-2/ME Date: 23/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-2/T-2 B.Sc. Engineering Examinations **2019-2020**

Sub: **ME 249** (Engineering Mechanics II)

Full Marks: 180 Time: 2 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**

1. (a) A 80-kg man and a 50-kg woman stand side by side at the same end of a 140-kg boat, ready to dive, each with a 5 m/s velocity relative to the boat as shown in Figure 1(a). Determine the velocity of the boat after the woman dives only. **(15)**

   (b) A 10-kg block *B* starts from rest and slides on the 15-kg wedge *A*, which is supported by a horizontal surface as shown in Figure-1(b). Neglecting friction, determine the velocity of *B* relative to *A* after it has slid 0.5 m down the inclined surface of the wedge. **(15)**

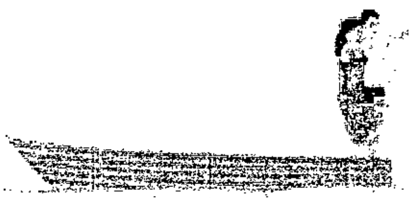


Figure 1(a)

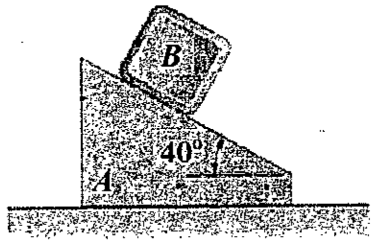


Figure 1(b)

2. The ends of the 10-kg uniform rod *AB* are attached to collars of negligible mass that slide without friction along fixed rods as shown in Figure 2. If the rod is released from rest determine immediately after release (*a*) the angular acceleration of the rod, (*b*) the reaction at *A*, (*c*) the reaction at *B*. Consider the angle $\theta = 15 + \frac{1}{3}X$ where, *X* is the last three significant digits your student ID number in degree. **(30)**

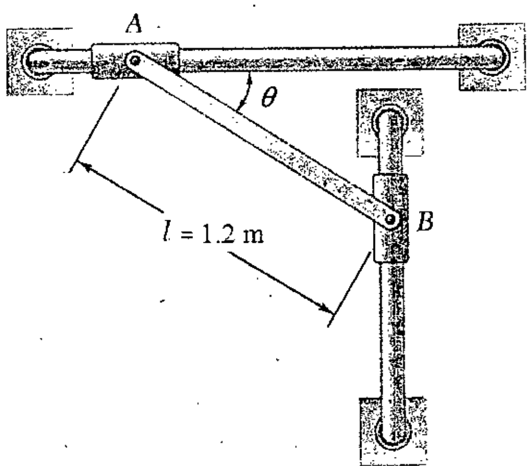


Figure 2

3. The quick return mechanism of a shaping machine is shown in Figure 3. The crank OA of length 200 mm rotates in clockwise direction at a speed of 90 rev/min. The length QP is 800 mm. Draw the necessary velocity diagram and determine the velocity of point P. Consider the angle, $\theta = 30 + \frac{2}{3}X$; where, X is the last three significant digits your student ID number in degree. **(30)**

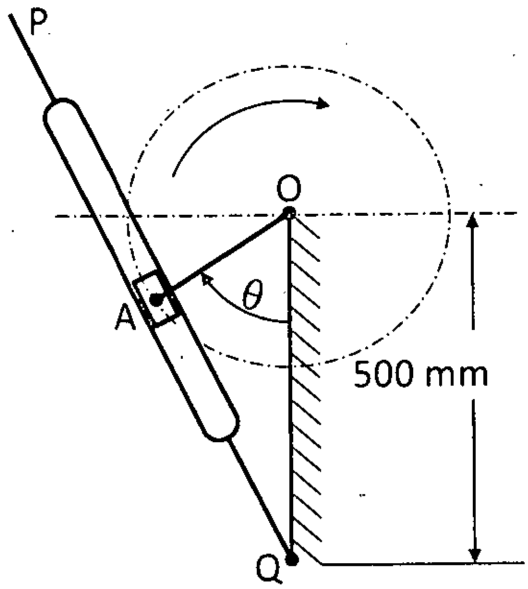


Figure 3

4. A bullet of mass 40 g is fired with a horizontal velocity of 550 m/s into the slender 7.5 kg bar of length L = 800 mm, as shown in Figure 4. Knowing that h = 40+2X, where X is the last three significant digit of your student ID number, and that the bar is initially at rest. Determine <u>using the energy and momentum method</u> (*a*) the angular velocity of the bar immediately after the bullet becomes embedded, (*b*) the impulsive reaction at *C*, assuming that the bullet becomes embedded in 0.001 s. Note, the distance h is in mm. **(30)**

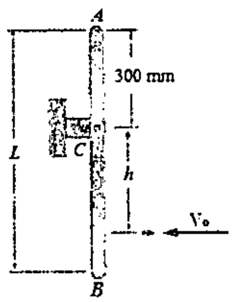


Figure 4

SECTION-B

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

5. The elevator shown in the Figure 5 moves downward with a constant velocity of 4 m/s. Determine (a) the velocity of the cable *C*, (b) the velocity of the counterweight *W*, (c) the relative velocity of the cable *C* with respect to the elevator (d) the relative velocity of the counterweight *W* with respect to the elevator. **(30)**

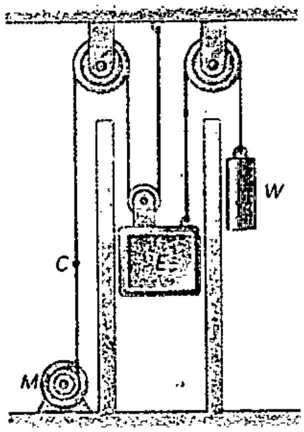


Figure 5

6. A child having a mass of 22 kg sits on a swing and is held in the position shown by a second child in Figure 6. Neglecting the mass of the swing, determine the tension in rope *AB* (a) while the second child holds the swing with his arms outstretched horizontally, (b) immediately after the swing is released. **(30)**

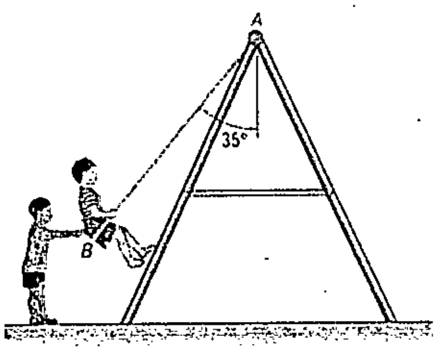


Figure 6

7. A package shown in Figure 7 is projected up a 15° incline at A with an initial velocity of 8 m/s. Knowing that the coefficient of kinetic friction between the package and the incline is 0.12, determine (a) the maximum distance d that the package will move up the incline, (b) the velocity of the package as it returns to its original position. **(30)**

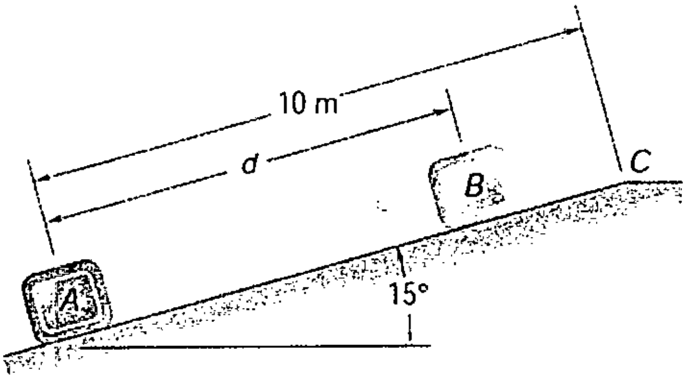


Figure 7

8. A truck shown in Figure 8 is hauling a 300-kg log out of a ditch using a winch attached to the back of the truck. Knowing the winch applies a constant force of 2500 N and the coefficient of kinetic friction between the ground and the log is 0.45, determine the time for the log to reach a speed of 0.5 m/s. **(30)**

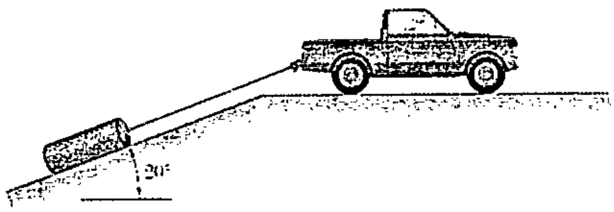


Figure 8

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-2/T-2 B.Sc. Engineering Examinations **2019-2020**

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

Full Marks: 180 Time: 2 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**

1. (a) Find the root of the following equation using the Newton's method, **(15)**

$$8 - 4.5(x - sinx) = 0$$

Use initial guess, x_0 = 2.0 and ε_s = 0.1%. From your solution show that Newton's method converges quadratically.

(b) A simplified model of the suspension of a car consists of a mass, m, a spring with stiffness, k, and a dashpot with damping coefficient, c. A bumpy road can be modeled by a sinusoidal up-and-down motion of the wheel y = Ysin(ωt). From the solution of the equation of motion for this model, the steady-state up-and-down motion of the car (mass) is given by x = Xsin(ωt - ϕ). The ratio between amplitude X and amplitude Y is given by: **(15)**

$$\frac{X}{Y} = \sqrt{\frac{mc\omega^3}{k(k - m\omega^2) + (\omega c)^2}}$$

Assuming m = 2000 kg, k = 500 kN/m, and c = 38×10^3 Ns/m, determine the frequency ω for which X/Y = 0.2. Rewrite the equation such that it is in the form of a polynomial in ω and solve using false position method using ω_l = 2.0 and ω_u = 10.0. Show three iterations.

2. (a) In a linear coiled spring, the relation between spring force (F) and displacement (x) is described by F = kx, where k is the spring constant. Testing on a certain spring has led to the data recorded in the following Table (All values are in consistent physical units). **(18)**

Displacement, x	0.2	0.3	0.5	0.6	0.8	0.9
Force, F	43.5	65.7	109.8	133	176.2	198.2

(i) Using least-squares regression, find a straight line that best fits the data.

(ii) Using the linear fit, find the estimated value for the spring constant, and the displacement corresponding to F = 150.

(b) What modifications are needed to fit the data of problem 2(a) with **(12)**

(i) weighted linear regression

(ii) quadratic polynomial regression

3. (a) (i) Solve the following system of equations ([A]{x} = {b}) by using Gauss elimination method with partial pivoting. **(18)**

$$x_1 + x_2 - x_3 = 2$$
$$2x_1 + 3x_2 - 5x_3 = -3$$
$$3x_1 + 2x_2 - 3x_3 = 6$$

(ii) using the results obtained in (i), find the [L] matrix required for solving the system with the LU decomposition method.
(iii) using the results obtained in (i), find the determinant of the coefficient matrix [A].

(b) Consider the following linear system, **(12)**

$$\mathbf{Ax} = \mathbf{b}, \quad \mathbf{A} = \begin{bmatrix} 4 & 1 & -1 \\ -2 & 5 & 0 \\ 2 & 1 & 6 \end{bmatrix}, \quad \mathbf{b} = \begin{Bmatrix} 1 \\ -7 \\ 13 \end{Bmatrix}, \quad \mathbf{x} = \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \end{Bmatrix}, \quad \underset{\text{Initial vector}}{\mathbf{x}^{(0)}} = \begin{Bmatrix} 0 \\ 1 \\ 1 \end{Bmatrix}$$

(i) Solve the above system using the Gauss-Seidel method. Show at least one iteration.
(ii) Will this system converge to a solution using the Gauss-Seidel method?

4. (a) Discuss how the total error can be minimized for solving a problem numerically. **(6)**

(b) The mid-point deflection of a transversely loaded rotating shaft can be estimated experimentally by the following equation, **(15)**

$$y = \frac{WL^3}{48EI}$$

where, W is the weight of the shaft, L is the length of shaft, E is the modulus of elasticity of the shaft material and I is the moment of inertia. During an experiment following data were recorded, W = $3100 \pm 75\ N$, L = $2.5 \pm 0.1\ m$, and I = $0.0003 \pm 0.00005\ m^4$.
Considering, E = 2 GPa for the shaft material to be exact, estimate the error in deflection y for the given data.

(c) Use zero- through third-order Taylor series expansions to predict f(3) for f(x) = $25x^3 - 6x^2 + 7x - 88$ using a base point at x = 1. Compute the true percent relative error ε_t for each approximation. Discuss the meaning of the results. **(9)**

SECTION-B

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

5. (a) The record of velocity (v) and acceleration (a) of a particle is given below: **(20)**

t (min)	1	2	3.25	4.5	6
$v = \frac{dy}{dt}$ (m/s)	5	6	5.5	7	5.5
$a = \frac{dv}{dt}$ (m/s^2)	0.01	0.02	-0.007	0.02	-0.02

(i) Determine the total distance (y) travelled by the particle using Trapezoidal Rule. What is the order of Truncation Error associated with the result?

(ii) Can the acceleration (a) data be used to obtain a more accurate value of distance (y)? If yes, determine that more accurate value and the order of Truncation Error associated with it.

(b) For Simpson's 1/3rd Rule, determine the minimum number of divisions required to guarantee a result within the 0.2% of the exact result of integration of the function- **(10)**

$$f(x) = 15e^{-x} \text{ from } x = 0.2 \text{ to } 1.5$$

6. (a) With necessary diagrams, describe Forward Difference, Backward Difference and Central Difference approach of Numerical Differentiation. Explain their applicability and relative advantage/disadvantage in context to practical problems. **(14)**

(b) A Simply Supported Beam (length, L = 6m, Bending Stiffness, $EI = 26 \times 10^4$ N-m²) has the following deflections under a partial distributed loading- **(16)**

x (m)	0	1	2	3	4	5	6
y (m)	0	0.0102	0.0282	0.0413	0.0368	0.0173	0

Where, x = axial location, y = vertical deflection.

Determine bending moments, $M = EI\frac{d^2y}{dx^2}$ at x = 2m and 4m with-

(i) accuracy of $O(h^2)$

(ii) accuracy of $O(h^4)$ using Richardson's Extrapolation Scheme.

7. (a) The general form of Newton's interpolating polynomial is- **(14)**

$$f_n(x) = b_0 + b_1(x - x_0) + b_2(x - x_0)(x - x_1)\ldots\ldots + b_n(x - x_0)(x - x_1)\ldots\ldots(x - x_{n-1})$$

Show that, the coefficients $b_0, b_1, b_2, \ldots, b_n$ actually indicate derivatives by Newton's Divided Difference Method.

(b) The table below gives the values of $f(x)$ from x = 2.0 to x = 4.0. **(16)**

x	2.0	2.5	3.2	4
f(x)	8	14	15	8

(i) Is it possible to formulate interpolating polynomials of different orders to estimate $f(2.8)$ from the given data? If yes, how many different polynomials of different orders are possible?

(ii) Estimate $f(2.8)$ using the interpolating polynomial of the highest order by a suitable method.

8. (a) "Heun's method is a Predictor-Corrector approach for solving 1st order ODEs"- justify. **(10)**

(b) The governing equation of a particle under vibration is found to be- **(20)**

$$\frac{d^2x}{dt^2} + 0.6\frac{dx}{dt} + 0.8t = 0$$

Where, x = displacement of the particle, t = time. $x(0) = 4$, $x'(0) = 0$.

Determine the velocity at t = 2 and 4 by 4th order R-K method.

L-2/T-2/ME **Date: 09/01/2021**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2018-2019

Sub: **MATH 263 (Complex Variables, Harmonic Analysis and Partial Differential Equations)**

Full Marks: 240 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

SECTION-A

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

1. (a) If the ratio of $\frac{z-i}{z+i}$ is purely imaginary, then show that the point z lies on a circle whose centre is at the origin and radius 1. **(10)**

(b) Test the analyticity of the function $w = \ln(z)$ and find its derivative. **(15)**

(c) Prove that under the bilinear transformation, $w = \frac{1}{z}$ the image of straight line $y - x + 1 = 0$ in z-plane is transformed into a circle of w plane. Also sketch the figure. **(15)**

2. (a) Show that $v(x,y) = 2x(1-y)$ is a harmonic function. Find an analytic function $f(z)$ and express $f(z)$ in terms of z. **(20)**

(b) Evaluate $\int_{(0,3)}^{(2,4)} (2y + x^2)dx + (3x - y)dy$ along the straight line from $(0,3)$ to $(2,3)$ and then from $(2,3)$ to $(2,4)$. Is the integral is independent of path? **(20)**

3 (a) Evaluate the integral $\oint_C \frac{e^{3z}}{(z-i)^4} dz$ by Cauchy integral formula where, $C = \{(x,y) : |x| \leq 2, |y| \leq 2\}$ is positively oriented. **(20)**

(b) Express $f(z) = \frac{1}{z+3}$ in a Laurent series valid in the region $5 < |z - (1-3i)| < \infty$. **(20)**

4 (a) Use Cauchy's residue theorem evaluate the integral **(20)**

$$\oint_C \frac{z\,dz}{(z^2-1)(z-3)^2} \text{ where } C = \{z : |z-1| = 2, \text{ positively oriented}\}.$$

4 **(b)** Evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta}\, d\theta$ by using the method of contour integration. **(20)**

SECTION-B

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

5. (a) Use Lagrange's method to solve $(3x+y-z)p+(x+y-z)q=2(z-y)$. **(20)**

(b) Solve the partial differential equation $px + qy = pq$ using Charpit's method. **(20)**

6. Solve the following partial differential equations **(20)**

(a) $(x^2D^2 - y^2D'^2 + xD - yD')z = \ln x$.

(b) Expand $f(x) = x$, $0 < x < 3$, in a half range sine series. Also sketch the graph. **(20)**

7. (a) (i) Find the Fourier coefficients corresponding to the function

$$F(x) = \begin{cases} 0 & , \text{for } -5 < x < 0 \\ 4 & , \text{for } \quad 0 < x < 5 \end{cases}; \quad \text{Period} = 10$$ **(25)**

and write down the corresponding Fourier series.

(ii) How should F(x) defined at $x = -5$, $x = 0$ and $x = 5$ in order that the Fourier series will converge to F(x) for $-5 \le x \le 5$?

(b) Find the Fourier cosine integral represantation of the function

$$f(x) = \begin{cases} 3 & if \ 0 < x < 2 \\ 0, & if \quad\quad x > 2 \end{cases}$$ **(15)**

Sketch $f(x)$ and its periodic extensions. Show the answer in details.

8. Solve the following boundary value problem using Fourier integrals and interpret physically. **(20)**

$$\frac{\partial u}{\partial t} = \kappa \frac{\partial^2 u}{\partial x^2};$$

$$u(x,0) = f(x), \quad u(0,t) = 0, \ |u(x,t)| < M, \text{ where, } -\infty < x < \infty, \ t > 0.$$

(b) By letting u = $R\Theta$, where R depends only on r and Θ only on θ, in Laplace's equation $\nabla^2 u = 0$ expressed in spherical coordinates, show that R and Θ satisfy the equations $r^2 \frac{d^2R}{dr^2} + 2r\frac{dR}{dr} + \lambda^2 R = 0$ and $\frac{d}{d\theta}(\sin\theta \frac{d\Theta}{d\theta}) - \lambda^2(\sin\theta)\Theta = 0$ **(20)**

L-2/T-2/ ME Date: 19/01/2021

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B.Sc. Engineering Examination 2018-2019

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

Full Marks: 90 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

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

1. (a) What factors affect the plastic deformation of materials by slip process? **(08)**

   (b) If same force is applied at room temperature along axial direction on an FCC material and a BCC material, which one will plastically deform most? **(12)**

   (c) How Fe (Iron) and Cu (Copper) will deform when force is applied at 0^0C? **(10)**

2. (a) Which type of cast iron is obtained by heat treating white cast iron? Explain the mechanism of formation of its microstructure. **(12)**

   (b) A ferrous alloy is required that has good castability, good wear resistance and a high degree of ductility.

   i. Suggest an alloy and explain how each desired property is present in your alloy.

   ii. If a little more strength is required instead of ductility, can you think of a way to fulfill the requirement without changing the composition of your chosen alloy? **(18)**

3. (a) "Iron making is a reduction process, while steelmaking is an oxidation process"- justify this statement. **(08)**

   (b) Suppose you have ordinary low carbon steel (%C<0.2) and the option of adding C, Ni. Cr as alloying elements. Your target is to make steel blades suitable for surgical instruments. State with clear reasoning(s) which alloying elements you will add and in what amount. **(14)**

   (c) With necessary diagrams, explain the changes in mechanical properties that will occur when Tin is added to Cu-Zn alloys. **(08)**

4. (a) Suggest a non-ferrous material with appropriate reasoning for designing a turbine blade which has to withstand an operating temperature of around 1500^0C and also the problems associated with creep and fatigue. **(15)**

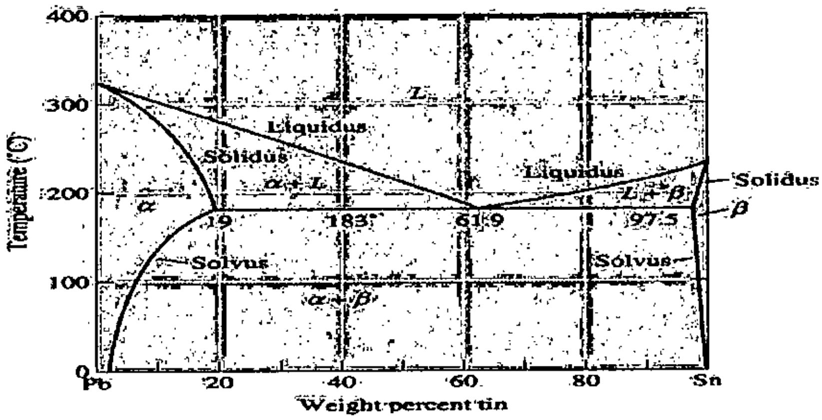
   (b) Which material will be suitable for bone plates which help in pulling bones together to promote healing? Give the reasons for choosing this material. **(15)**

SECTION-B

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

5. (a) Differentiate between phase and element. **(7)**

   (b) Using the equilibrium diagram shown below, answer the following questions for an alloy of 70%Pb-30%Sn: (i) Calculate the fractions of pro-eutectic α and eutectic α at just above and below the eutectic temperature respectively. (ii) Draw microstructures of the alloy at 300°C, 225°C and room temperature. **(23)**



6. (a) Among the main classes of material, which one has highest potential for utilization in Bangladesh? Justify your answer. **(12)**

   (b) Outline a NDT technique suitable for detecting internal defects in a steel body. **(18)**

7. (a) Describe a surface hardening process suitable for hardening low carbon gear part. **(20)**

   (b) How hardenablity of steel can be increased? **(10)**

8. (a) Design a steel requiring high yield strength in service. **(22)**

   (b) Cast iron is cheaper than steel-Justify. **(8)**