KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B. Sc. Engineering 2nd Year 2nd Term Examination, 2019
ME 2221
(Computer Programming)

Time: 3 Hours. Full Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

SECTION – A

1(a) Describe different types of variable and their data type in *C* programming. 10

1(b) For each of the following statements. State True or False and justify your answer in brief. 15

(i) `x = 100; y = 200; a = (x < y)? x:y;` The value of *a* is 200.
(ii) `x = 10; y = x++;` Then the value of *y* is 10.
(iii) tan(x) function return the tangent of *x*.
(iv) <stdio.h> contain the mathematical functions.
(v) The statement `#define N 5` is valid but `#define x = 10.0` is invalid.

1(c) Determine the output generated by following code segments: 10

(i)
```
int a = 500; b = 100; c;
if (!a >= 400){
b = 300; c = 200;}
printf("b=%d c=%d\n", b, c);
```

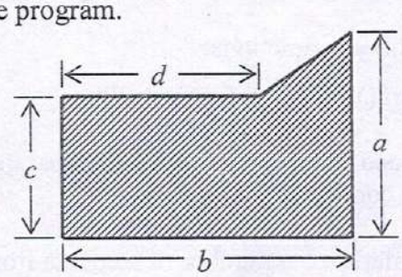
(ii)
```
for (i = 1; i < 5, i++){
  if (i = = 3)
  continue;
  printf("%d", i);}
```

(iii)
```
char *S= "hello";
 char *P= S;
 printf("%c\t %c", P[0], S[1]);
```

2(a) Write down the purposes of using 'goto', 'break' and 'continue' statement. Explain with example. 08

2(b) Write a loop that will calculate the sum of the series: $s = 2 + 5 + 8 + 11 + \cdots\cdots + n$. Write the loop three different ways: (i) using a `while` statement, (ii) using a `do-while` statement, and (iii) using a `for` statement. 15

2 (c) Find the area of the following shape by using *C* program code. Use the dimensions as the only input variables for the program. 12



3(a) Compare the use of `switch` statement with the use of nested `if-else` statements. Which is more convenient? 10

3(b) Write a `switch` statement that will examine the value of a `char`-type variable called 'color' and print one of the following message, depending on the character assigned to 'color'. 12

(i) Red, if '*r*' is assigned to 'color'
(ii) Green, if 'g' is assigned to 'color'
(iii) Blue, if '*b*' is assigned to 'color'
(iv) Black, if 'color' is assigned any other character.

3(c) Find the sum of the series using *C* program: $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}-\frac{1}{6}+\cdots\cdots\cdots\cdots$ upto *n* terms. 13

4(a) In what way array differ from an ordinary variables? Briefly explain the syntax of multidimensional array. 10

4(b) Calculate the sum of the diagonal elements of a 3×3 matrix by writing a *C* program. 15

4(c) Read in the first m elements of a one dimensional floating point array. Calculate sum of these elements and the mean value of the elements. 10

SECTION – B

5(a) What is meant by string? Write down the purposes of following string functions: 10
(i) `strcpy()` (ii) `strcat()` (iii) `strcmp()` (iv) `strlwr()` (v) `strrev()`.

5(b) Write a *C* program which will read a word as a string and it will reverse the letter to check whether the word is a palindrome word. 13

5(c) Write a *C* program to calculate the power (a^n) using recursion, where a and n are the natural integer. 12

6(a) Define user defined function and write the declaration syntax. Also, state the advantages of user defined function. 10

6(b) Write a *C* program to find prime numbers between any two intervals using user defined function. 10

6(c) What is passing reference in *C* programming? Write a *C* program that will pass two pointer variable to a function and the function will return largest value between them. 15

7(a) How a structure variable is declared? How the individual structure member is accessed and processed? 10

7(b) Briefly explain the following terms: 08
(i) dynamic memory allocation and static memory allocation,
(ii) `malloc()` and `calloc()` functions.

7(c) Write a *C* program using structure to calculate total marks of 10 students from class test, attendance and final exam. Print the name, roll number and total marks in tabular form. 17

8(a) Write down the use of the following library functions: 08
(i) `fopen()`, (ii) `fputs()`, (iii) `scanf()`, and (iv) `fprintf()`.

8(b) Write a program to calculate the area and perimeter of a circle by passing argument as reference to a user defined function. Use pointer concept in your program. 14

8(c) Write a *C* program to read name and marks of n number of students from user and store them in a file. 13

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 2nd Year 2nd Term Examination, 2019

ME 2209

(Engineering Mechanics II)

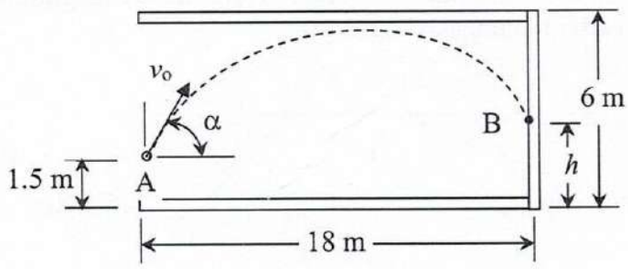
Time: 3 Hours | Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

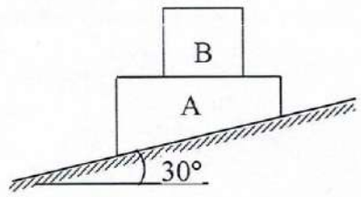
SECTION-A

1(a) A bus is accelerated at the rate of 0.75 m/sec^2 as it travels a distance of 180 m from A to B. Knowing that the speed of the bus was v_o = 90 km/hr as it passed A. Determine (i) the time required for the bus to reach B; (ii) the corresponding speed as it passes B; (iii) the time required for the bus to reach B, if the acceleration is zero. 15

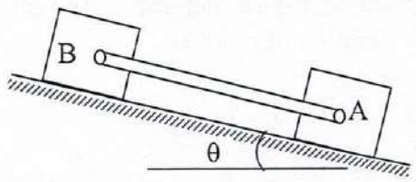
1(b) A player throws a ball with an initial velocity v_o of 15 m/sec from a point located 1.5 m above the floor. Knowing that the ceiling of the gymnasium is 6 m high, determine the highest point B at which the ball can strike the wall 18 m away. 20



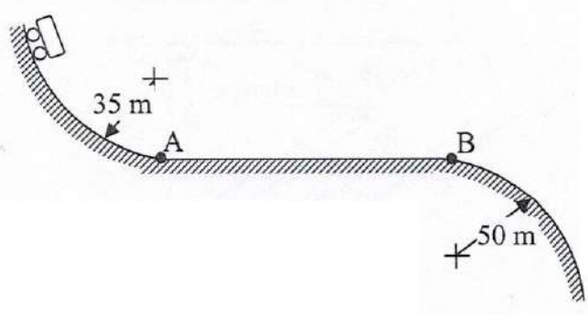
2(a) A 12 kg block B rests as shown on the upper surface of 30 kg wedge A. Neglecting friction, determine– (i) the acceleration of A, (ii) the acceleration of B relative to A, immediately after the system is released from rest. 17



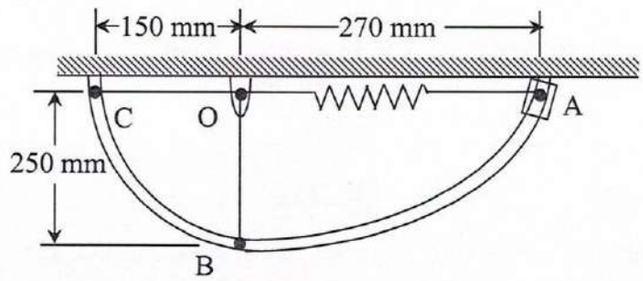
2(b) In figure, the bodies A and B are in motion down the plane. The rigid bar AB of negligible weight. If m_A = 5 kg and m_B = 10 kg, μ_A = 0.2 and μ_B = 1/3 and θ = 35°. Find the acceleration of the bodies and the force in bar AB. Also, calculate their velocities after 5 sec. 18



3(a) The roller-coaster track shown is contained in a vertical plane. The position of the track between A and B is straight and horizontal, while the position to the left of A and to the right of B have radii of curvature as indicated. A car is travelling at a speed of 72 km/hr when the brakes are suddenly applied, causing the wheels of the car to slide on the track (μ_k = 0.25). Determine the initial acceleration of the car if the brakes are applied as the car (i) has almost reached A, (ii) is travelling between A and B, (iii) has just passed B. 17

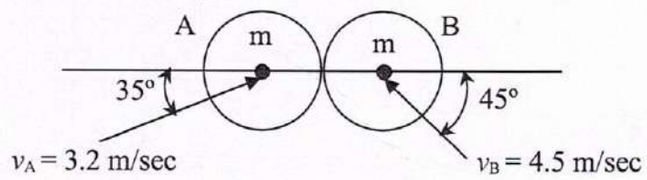


3(b) 2.5 kg collar is attached to a spring and slides without friction in a vertical frame along the curved rod ABC. The spring is undeformed when the collar is at C and its constant is 600 N/m. If the collar is released at A with no initial velocity, determine its velocity (i) as it passes through B, and (ii) as it reaches at C. 18



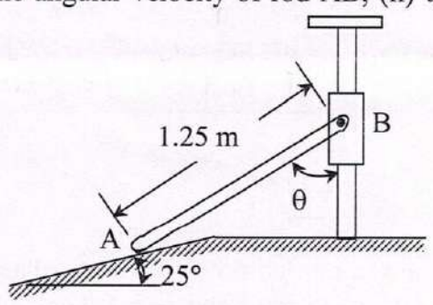
4(a) Distinguish between impulse and impact. For direct central impact show that in case of perfectly elastic impact the energy of the system is conserved. 17

4(b) The magnitude and direction of the velocities of two identical frictionless balls before they strike each other are as shown. Assuming $e = 0.90$, determine the magnitude and direction of the velocity of each ball after the impact. 18

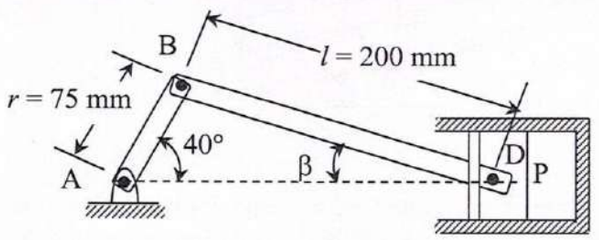


SECTION-B

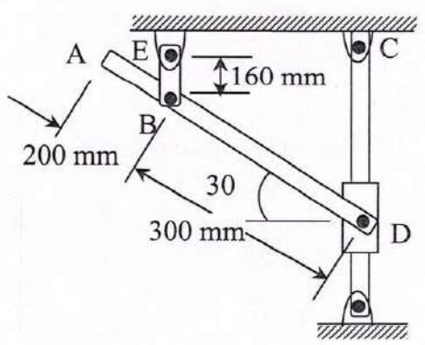
5(a) Collar B moves upward with a constant velocity of 1.8 m/sec. At the instant when $\theta = 50°$, determine (i) the angular velocity of rod AB; (ii) the velocity of end A of the rod. 17



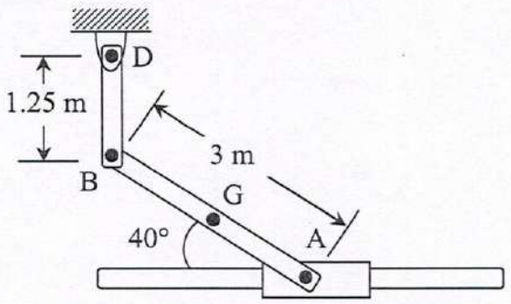
5(b) Crank AB of the engine system has a constant clockwise angular velocity of 2000 rpm. For the crank position as shown in figure, determine the angular acceleration of the connecting rod BD and the acceleration of point D. 18



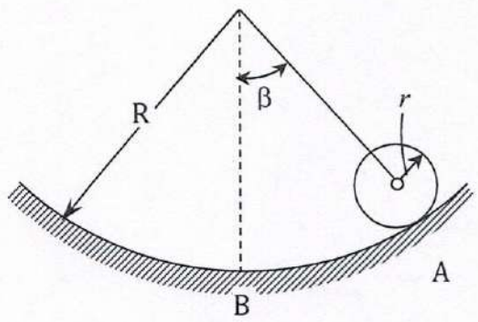
6(a) Knowing that at the instant shown in figure, the angular velocity of rod BE is 3 rad/sec counter clockwise; determine (i) the angular velocity of the link AD, and (ii) the velocity of A and D. 17



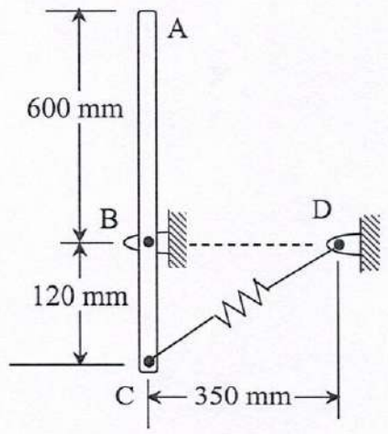
6(b) End A of rod AB has velocity of 2.5 m/sec and an acceleration of 1.5 m/sec^2 both directed to right. Determine (i) the angular acceleration of rod AB, and (ii) the acceleration of the midpoint of rod AB. 18



7(a) A sphere of weight W and radius r rolls without sliding inside a curved surface of radius R. Knowing that the sphere is released from rest in the position shown, derive an expression (i) for the linear velocity of the sphere as it passes through B, (ii) for the magnitude of the vertical reaction at that instant. 18

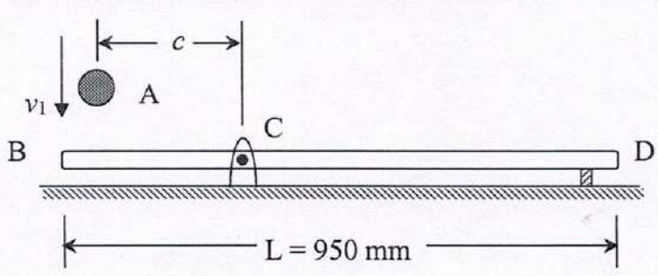


7(b) A 4 kg slender rod rotates in a vertical plane about a pivot at B. A spring of constant K = 210 N/m and unstretched length 160 mm is attached to the rod as shown. Knowing that in the position shown, the rod has an angular velocity of 3.5 rad/sec counter clockwise, determine the angular velocity of the rod after it has rotated through (i) 90°, (ii) 180°. 17



8(a) Prove that, the kinetic energy of a rigid body, $T = \frac{1}{2}m\bar{v}^2 + \frac{1}{2}\left(\bar{I}_x w_x^2 + \bar{I}_y w_y^2 + \bar{I}_z w_z^2\right)$. 17

8(b) A sphere of mass m is dropped onto the end of a slender rod BD of length L and the mass of 2 kg. The rod is attached to a pin support at C which is located at a distance c = L/4 from the end B. Denoting by v_1, the velocity of the sphere just before it strikes the rod and assuming perfectly elastic impact, determine immediately after impact (i) the velocity of the sphere, (ii) the angular velocity of the rod. 18



KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B. Sc. Engineering 2nd Year 2nd Term Examination, 2019
ME 2213
(Fluid Mechanics II)

Time: 3 Hours. Total Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any missing.

SECTION - A

1(a) Define average velocity of a pipe flow and determine its mathematical expression. 05

1(b) What are meant by Reynolds number and hydraulic diameter? Also discuss their significance in fluid flow problems. 08

1(c) Show that the velocity profile in fully developed laminar flow in a pipe is parabolic. Also demonstrate that the velocity is maximum at the centerline and minimum at the pipe wall. 12

1(d) Water flow at a steady mean velocity of 1.5 m/sec through a 50 mm diameter pipe sloping upward at 45° to the horizontal. At a section some distance downstream of the inlet the pressure is 700 kPa and at a section 30 m further along the pipe, the pressure is 462 kPa. Determine the average shear stress at the wall of the pipe. 10

2(a) Distinguish between hydrodynamic entrance region and hydrodynamically fully developed region with a neat sketch. 08

2(b) Prove that the friction factor for laminar flow in circular pipe is a function of Reynold number only and is independent of the roughness of the pipe surface. 10

2(c) Water at 20°C (ρ = 998 kg/m^3 and μ = 15.40×10^{-4} kg/m.s) is flowing steadily through a 3 mm diameter and 9 m long horizontal pipe at an average velocity of 1.1 m/sec. Determine: (i) the head loss, (ii) the pressure drop, and (iii) the pumping power required to overcome this pressure drop. 17

3(a) Illustrate the difference between the laminar and turbulent flow with sketches. 08

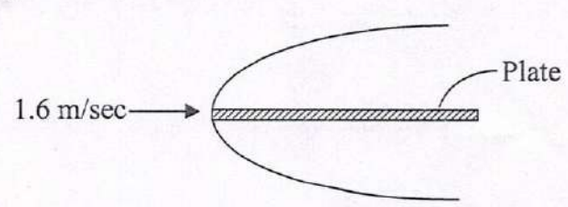
3(b) What are the law of the wall, logarithmic law and velocity defect law in the concept of turbulent flow? 09

3(c) Deduce the general form of integral momentum equation of the boundary layer over a flat plate. 18

4(a) What are the factors that affect boundary layer thickness? 05

4(b) Discuss the flow separation phenomena in a diverging flow over a surface. How the flow separation is affected by pressure gradient? 13

4(c) A thin flat plate is installed in a water tunnel as a splitter. The plate is 0. 3 m long and 1 m wide. The free-stream speed is 1.6 m/sec. Assume laminar boundary layers form on both sides of the plate and the velocity profile is approximated as parabolic. Determine the total drag on the plate. Assume ρ = 1000 kg/m^3 and μ = 1×10^{-3} Pa.s. 17



SECTION - B

5(a) Explain the terms with significance: drag coefficient and lift coefficient for external viscous flows. 08

5(b) Prove that the exerted force of a jet on semi-circular cup is the same whether striking at the centre of the cup or striking tangentially at one tip. Explain the reason. 12

5(c) A liquid jet of velocity V_j of area A_j strikes a single 180° bucket on a turbine wheel rotating at angular velocity ω. Derive an expression for power delivered to this wheel. At what angular velocity is the maximum power delivered? How would the analysis differ if there mounted many buckets on the wheel so that the jet continuously striking at least one bucket? 15

6(a) Explain why sonic condition could not be attained in a bulge (diverging-converging duct)? 05

6(b) Why sonic condition is the limit for maximum mass flow rate for isentropic flow with area variation? Derive the maximum mass flow rate equation. 15

6(c) An airplane flies at 644 km/hr through still air at 90 kPa and –20°C. Find the pressure, temperature and air density at the stagnation points. 15

7(a) For a variable flow cross-sectional area, show that $\frac{dA}{dV} = \frac{A}{V}\left(Ma^2 - 1\right)$. Also explain variation of velocity with change in area for the subsonic and supersonic velocities. 17

7(b) A fuel-air mixture, approximated as air with k = 1.4, enters a duct combustion chamber at v_1 =75 m/sec, P_1 = 150 kPa, and T_1 = 300 K. The heat addition by combustion is 900 kJ/kg of mixture. Compute (i) the exit Mach number and (ii) the extra heat that should be added to cause a sonic exit flow. 18

8(a) When and how a supersonic velocity is obtained in a converging-diverging duct? 05

8(b) Explain with illustration how the critical conditions are used in Rayleigh flow problem analysis? 15

8(c) Air in an automobile tire is maintained at a pressure of 220 kPa (gauge) in an environment where the atmospheric pressure is 100 kPa. The air in the tire is at the ambient temperature of 25°C. A 4 mm diameter leak develops in the tire as a result of an accident. Approximating the flow as isentropic, determine the initial mass flow rate of air through the leak. Take R = 0.287 kPa.m^3/kg.K, k = 1.4 and $\frac{p^*}{p_o} = 0.5283$. 15

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 2nd Year 2nd Term Examination, 2019

ME 2211

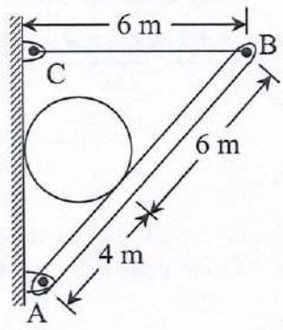
(Mechanics of Solid)

Time: 3 Hours | Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any missing.
iv) Necessary table may be supplied on request.

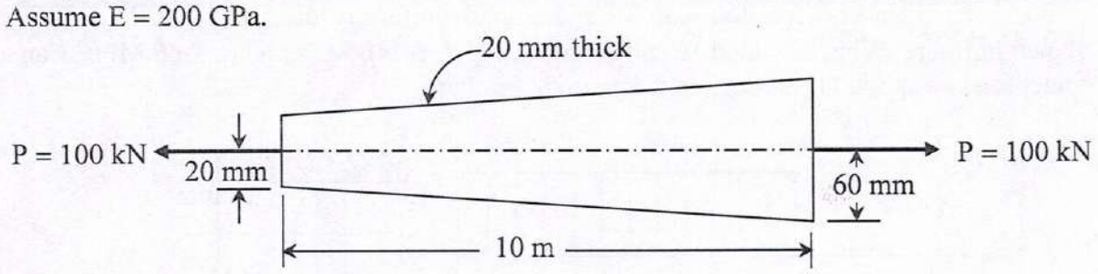
SECTION-A

1(a) Determine the weight of the heaviest cylinder which can be placed in the position shown in figure without exceeding a stress of 50 MPa in the cable BC. Neglect the weight of bar AB. The cross-sectional area of cable BC in 100 mm^2. 10

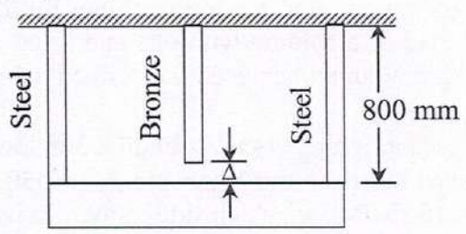


1(b) Derive the expression of hoop stress in a thin-walled spherical shell of diameter D and wall thickness t subjected to internal pressure p. 10

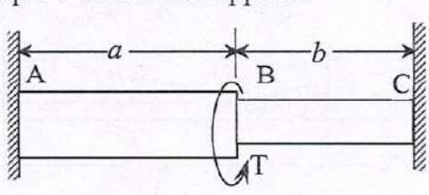
1(c) Compute the total elongation caused by an axial load of 100 kN applied to a flat bar 20 mm thick, tapering from a width of 120 mm to 40 mm in a length of 10 m as shown in figure. Assume E = 200 GPa. 15



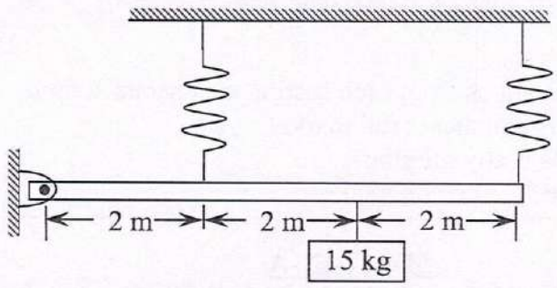
2(a) At 20°C, there is a gap $\Delta = 0.2$ mm between the lower end of the bronze bar and the rigid slab supported by two steel bars as shown in figure. Neglecting the mass of the slab, determine the stress in each rod when the temperature of the assembly is increased to 100°C. For the bronze rod, A = 600 mm^2, E = 83 GPa and α = 18.9 μm/(m°C). For each steel rod, A = 400 mm^2, E = 200 GPa and α = 11.7 μm/(m°C). 18



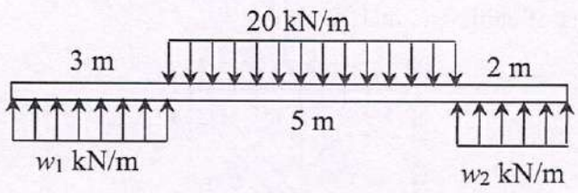
2(b) The compound shaft shown in figure is attached to the rigid supports. For the bronze segments AB, the diameter is 70 mm, $\tau \leq 65$ MPa, and G = 35 GPa. For the steel segments BC, the diameter is 50 mm, $\tau \leq 85$ MPa, and G = 80 GPa. If a = 2.5 m and b = 2 m, compute the maximum torque T that can be applied. 17



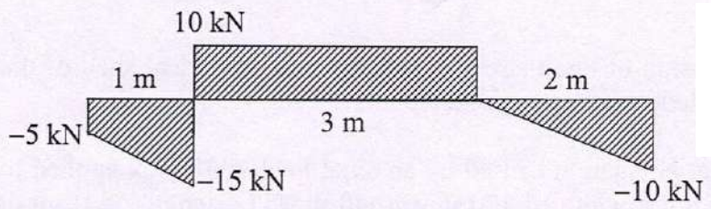
3(a) A rigid bar, hinged at one end is supported by two identical springs as shown in figure. Each spring consists of 20 turns of 10 mm wire having a mean diameter of 150 mm. Compute the maximum shearing stress in the springs. Neglect the mass of the rigid bar. 17



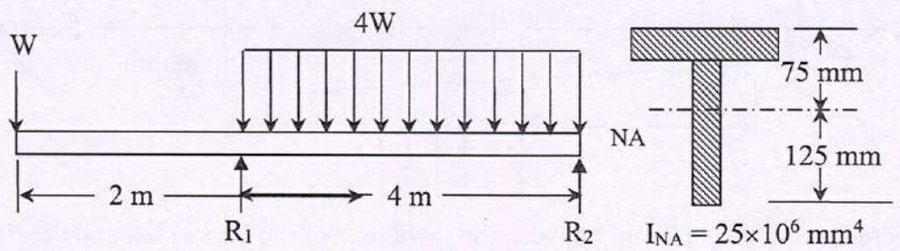
3(b) Without writing shear and moment equations, draw shear and moment diagrams for the beam with a distributed load, supported by two distributed load as shown in figure. 18



4(a) Draw moment and load diagrams corresponding to the given shear diagram as shown in figure. Specify values at all change of load positions and at all points of zero shears. 17



4(b) A beam carries a concentrated load W and a total uniformly distributed load of 4W as shown in figure. What safe load W can be applied if $\sigma_c \leq 110$ MPa and $\sigma_t \leq 65$ MPa? Can a grater load be applied if the section is inverted? Explain. 18

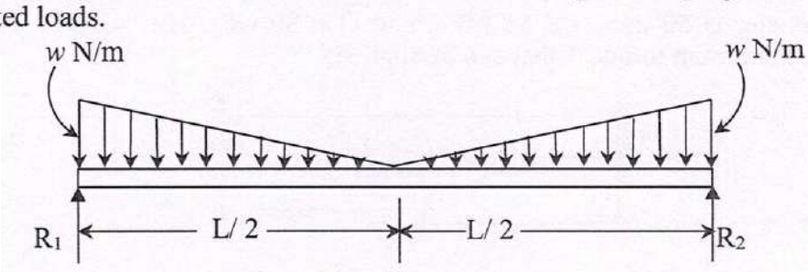


SECTION-B

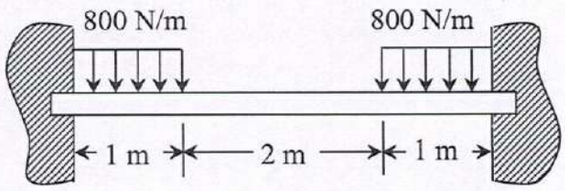
5(a) Derive the expression of critical load for long column by following Euler's method. Also show that critical load of a column with one end fixed and other hinged is twice the critical load of a hinged column; hence define "effective length". 16

5(b) A C310×45 channel is used as a hinged-end column 2.2 m long. How far off center can a load of 50 kN be placed on the x axis? Assume $\sigma_{yp} = 350$ MPa and that the tensile stress is to be limited to 150 MPa. On which side of the y axis must the load be placed? 19

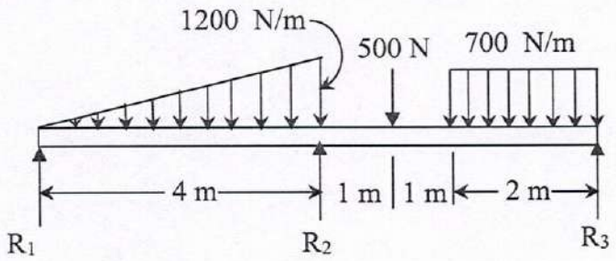
6(a) Find the midspan deflection δ for the beam shown in figure carrying two triangularly distributed loads. 18



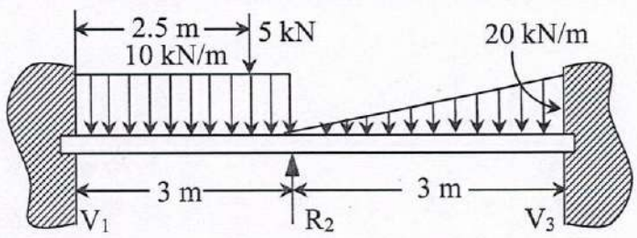
6(b) Determine the end moment and maximum EIδ for the restrained beam as shown in figure. 17



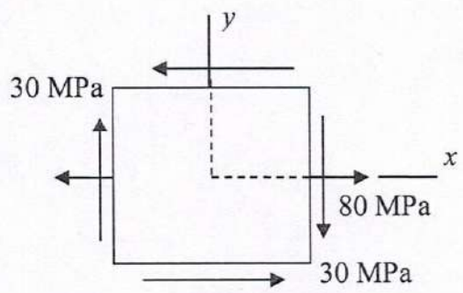
7(a) The continuous beam as shown in figure is supported on the rigid foundations that are at the same level. Determine the bending moments in the beam over the supports. 17



7(b) Determine the support moments and reactions for the beam as shown in figure. 18



8(a) For the state of stress as shown in figure, determine the principal stresses and the maximum shearing stress. Show all results on complete sketches of differential elements. 18



8(b) For the riveted connection as shown in figure, determine the allowable load P if the shearing stress in the 20 mm rivets is limited to 120 MPa. 17