**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

***Department of Mechanical Engineering***

B. Sc. Engineering 2nd Year Special (Covid-19) Examination, 2020

**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 any is missing.

## SECTION-A

1(a) Write down the structure of a C program and explain each of the statement. 10

1(b) What is meant by operator precedence? What are the relative precedence of arithmetic operators? Explain with example. 05

1(c) Write down print statement to print octal and hexadecimal numbers. 05

1(d) Write a C program that takes n number of positive integers. Find the integer that appears the least number of times among the said numbers. If there are multiple such integers, select the smallest one. 15

2(a) What is meant by control statement? Describe three control statements with example. 05

2(b) Write a program to find average of even numbers between 1 to 200. 15

2(c) Write a C program to check two given integer values, and return true if one of them is 30 or if their sum is 30. 15

3(a) Write a C program to find the third angle of triangle, if two angles are given. 05

3(b) Write a program to find the eligibility of a candidate to appear in the admission test of KUET based on the following criteria: 20

if marks in Math $\geq$ 65 and
marks in Physics $\geq$ 60 and
marks in Chemistry $\geq$ 55 and
total in three subjects $\geq$ 190 or
total in Math and Physics $\geq$ 140.

3(c) Write a program to read the roll number, name, and marks of three subjects and print the roll number, name, marks obtained in three subjects and percentage of marks obtained if the total marks in each subject is 100. 10

4(a) Write a program using `for` loop to print the following pattern: 15

```
1
2 2
3 3 3
4 4 4 4
```

4(b) At the end of a Term in the Department of Mechanical Eng., 3 Class Tests marks are averaged (out of 20), attendance marks (out of 10) and final exam marks (out of 70) are computed. The total marks are rounded and used to determine the corresponding letter grades for 120 students. The grades are computed as follows: 20

| Range | $\geq 80$ | $< 80$ & $\geq 70$ | $< 70$ & $\geq 60$ | $< 60$ |
|---|---|---|---|---|
| Grade | A+ | A | B | F |

Write a C program to read 3 CT marks, average them to round figure, read attendance and final exam marks and use the data to determine the letter grade of 120 students.

## SECTION-B

5(a) Given an array of 100 numbers, write a program to count the frequency of each element of the array. 15

5(b) Write a recursive user-defined function to sum the series: 2 + 4 + 6 + 8 ..... + 20. 10

5(c) Write a UDF to check whether a number is prime. 10

6(a) Write a C program to sort an array of numbers using pointer variable. 10

6(b) Write a program in C to print a string in reverse order using pointer variable. Do not use the string function `strrev()`. 20

6(c) Write down five string functions and explain their purposes. 05

7(a) Write a C program to create and display a linked list. 20

7(b) Write a program to swap two numbers using user-defined function. 15

8(a) Write down the use of the following library functions: 09

(i) `fopen()` (ii) `fprintf()` (iii) `fputs()`

8(b) Write a program to open a data file naming 'info.doc' and store the information of 120 students in your class (Roll no., Name, Section, CGPA etc.) 16

8(c) Define an appropriate structure to store the information of a student (ID, name, birth date) and write a program to store and display student information using the structure. 10

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**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

***Department of Mechanical Engineering***

B. Sc. Engineering 2nd Year Special (Covid-19) Examination, 2020

**Math 2205**

(Mathematics IV)

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 any is missing.

## SECTION-A

1(a) Write the Legendre's polynomial of degree $n$. Show that $P_n(x)$ is the coefficient of $t^n$ in the expression of $(1-2xt+t^2)^{-1/2}$ in ascending power of $t$. 13

1(b) Expand the function $f(x)=\begin{cases}0 & \text{where } -1<x<0\\ 1 & \text{where } 0<x<1\end{cases}$ in a series of Legendre polynomials. 12

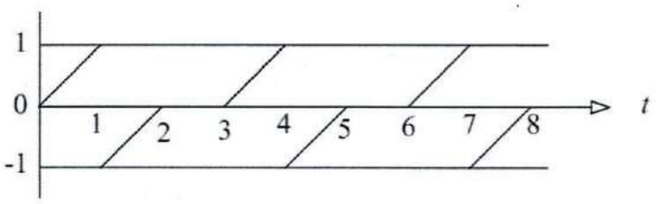
1(c) Evaluate $\int_{-1}^{1}(1-x^2)\{P_n'(x)\}^2dx$, where $P_n(x)$ is the Legendre polynomial of degree $n$. 10

2(a) Prove that $J_{3/2}(x)=\sqrt{\frac{2}{\pi x}}\left(\frac{\sin x}{x}-\cos x\right)$. 10

2(b) Prove that $J_n(x)=\frac{1}{\pi}\int_0^{\pi}\cos(n\varphi-x\sin\varphi)d\varphi$ for all integer $n$. 12

2(c) Define Bessel's function of the first kind of order n. Also, derive the relation between $J_n(x)$ and $J_{-n}(x)$, where, $n$ being an integer. 13

3(a) Construct the function whose graph is given below. Determine what kind of function is this. Hence, evaluate its Laplace transform. 12




3(b) Evaluate the integral using Laplace transform 10

$$\int_0^{\infty}\frac{\cos 6t-\cos 4t}{t}dt$$

3(c) Define Laplace transform. Evaluate $L\{f(t)+g(t)\}$ 13

$$\text{where } f(t)=\frac{\sin ht}{t} \qquad g(t)=\int_0^t t^2e^{4t}dt$$

4(a) Using convolution theorem evaluate $L^{-1}\left\{\frac{1}{s^2(s+1)^2}\right\}$ 11

4(b) Solve the following simultaneous differential equation by the Laplace transform 16

$$(D-2)x+3y=0; \quad D=\frac{d}{dx}$$

$$2x+(D-1)y=0$$

subject to $x(0)=8$, $y(0)=3$.

4(c) Given the function $U(x,t)$ defined for $a\le x\le b,\ t>0$. Find $L\left\{\frac{\partial^2U}{\partial t^2}\right\}$ 08

## SECTION-B

5(a) Define Fourier series of a function $f(x)$ in the interval $(a, b)$. Write the sufficient conditions for the convergence of a Fourier series. 11

5(b) Expand the function $f(x) = e^x$ in the interval $-\pi < x < \pi$ in Fourier series. 12

5(c) Obtain a series of sines and cosines of multiples of x which will represent $f(x)$ in the interval $-\pi < x < \pi$ when 12

$$(x) = \begin{cases} 0 & -\pi < x < 0 \\ \frac{\pi}{4}x & 0 < x < \pi \end{cases}$$

6(a) Find the Fourier series expansion of the function 11

$$f(x) = \begin{cases} 0, & \text{when } -5 < x < 0 \\ 3, & \text{when } 0 < x < 5 \end{cases}$$

6(b) Expand the function $f(x) = x,\ 0 \le x \le \pi$ in a half-range Fourier sine series. 09

6(c) The turning moment $T$ on the crankshaft of a steam engine for the crank angle $\theta$ degrees is given as follows: 15

| $\theta$ | 0 | 30 | 60 | 90 | 120 | 150 | 180 |
|---|---|---|---|---|---|---|---|
| $T$ | 0 | 5.2 | 8.1 | 7.9 | 5.5 | 2.6 | 0 |

Expand $T$ in a series of sines up to third harmonics.

7(a) Form the partial differential equation by eliminating arbitrary constants from the following equation $(x-a)^2 + (y-b)^2 + z^2 = r^2$ 10

7(b) Classify the given partial differential equations as hyperbolic, parabolic or elliptic: 10

(i) $u_{xx} + 2u_{xy} + u_{yy} + u_x - 6u_y = 0$

(ii) $u_{xy} - u_{yy} + 2u_x = 0$

7(c) Solve Laplace's equation in three-dimensional Cartesian coordinates. 15

8(a) Write one-dimensional wave equation. A tightly stretched string with fixed end points at $x = 0$ and $x = a$ is initially in a position given by $y = k \sin\frac{\pi x}{a}$. If it is reduced from rest, find the displacement of the string at any time $t$. 20

8(b) Write down the three-dimensional steady-state heat conduction equation. Hence solve the Laplace equation in cylindrical coordinates. 15

**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

***Department of Mechanical Engineering***

B. Sc. Engineering 2nd Year Special (Covid-19) Examination, 2020

**ME 2209**

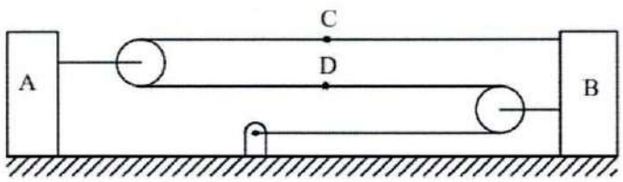
(Engineering Mechanics II)

Time: 3 Hours | Full Marks: 210

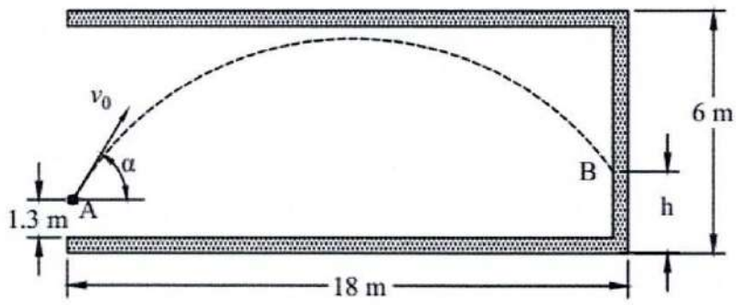
**N.B.**: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any is missing.

## SECTION-A

1(a) The slider block B moves to the right with a constant velocity of 460 mm/s. Determine (i) the velocity of block A, (ii) the velocity of portion D of the cable, (iii) the relative velocity of A with respect to B, (iv) the relative velocity of portion C of the cable with respect to portion D. 17



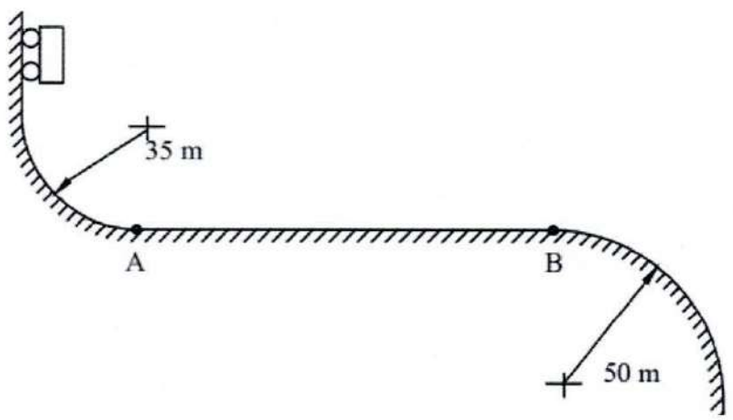

1(b) A player throws a ball with an initial velocity of 16 m/s from a point A located 1.3 m above the floor. Knowing that $h = 3.2$ m, determine the angle $\alpha$ for which the ball will strike the wall at point B. 18



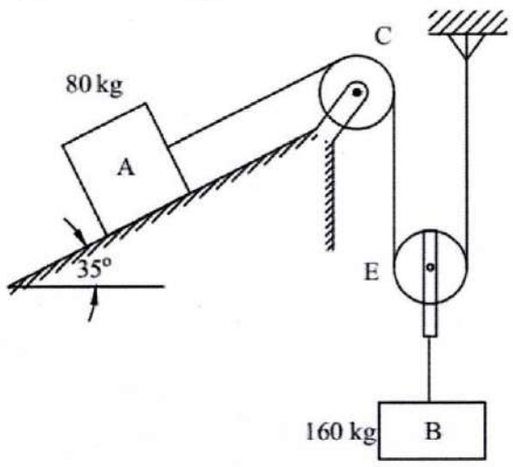

2(a) Define areal velocity for a body under central force motion. Derive the differential equation that defines the trajectory followed by the particle moving under central forces. 17

2(b) A satellite is launched in a direction parallel to the surface of the earth with a velocity of 36900 km/hr from an altitude of 500 km. Determine the maximum altitude reached by the satellite and the periodic time of the satellite. 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 traveling at a speed of 75 km/hr when the brakes are suddenly applied, causing the wheels of the car to slide on the track ($\mu_k = 0.25$). Determine the initial acceleration of the car if the brakes are applied as the car (i) has almost reached A, (ii) is traveling between A and B, (iii) has just passed B. 17

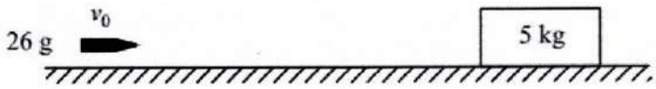


3(b) Two blocks as shown are originally at rest. Neglecting the masses of the pulleys, determine (i) the acceleration of each block, (ii) the tension in the cable, (iii) the distance traveled by block B in 3.5 seconds. Assume that the coefficient of friction at pulley C and between block A and the incline arc are $\mu_s = 0.25$ and $\mu_k = 0.20$. 18



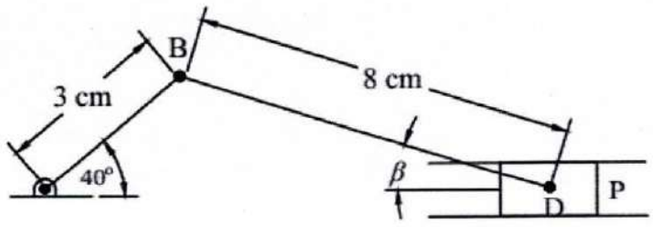

4(a) What is the coefficient of restitution? Deduce the expression for the velocity after impact in terms of relative velocity before impact and the coefficient of restitution. 17

4(b) A 26 g bullet is fired with a velocity of magnitude $v_0 = 550$ m/s onto a 5 kg block of wood. Knowing that the coefficient of friction between the block and the floor is 0.30, determine (i) how far the block will move, (ii) the percentage of the initial energy lost in friction between the block and the floor. 18

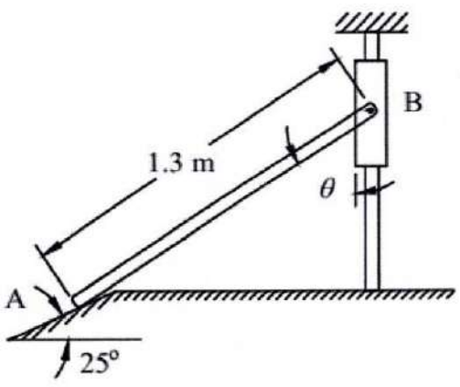



## SECTION-B

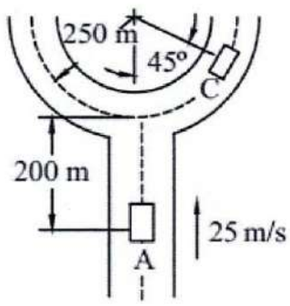
5(a) In the engine system shown, the crank AB has a constant anti-clockwise angular velocity of 200 rpm. For the crank position indicated, determine (i) the angular velocity of the connecting rod BD, (ii) the velocity of point P. 17



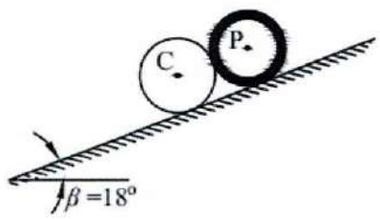

5(b) Collar B moves upward with a constant velocity of 1.8 m/sec. At the instant when $\theta = 55°$C, determine (i) the angular velocity of rod AB and (ii) the velocity of end A of the rod. 18



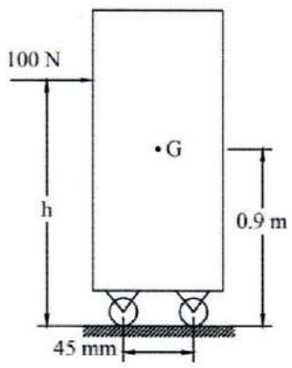
6(a) At the instant shown, car A travels with a speed of 25 m/s while car C travels with a speed 15 m/s. Determine the velocity of car A with respect to car C. 17



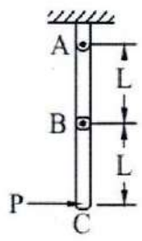

6(b) A homogeneous cylinder C and a section of pipe P are in contact when they are released from rest. Knowing that both the cylinder and the pipe roll without slipping, determine the clear distance between them after 4.5 seconds. 18




7(a) A 20 kg cabinet is mounted on castors, assuming that the castors are locked and slide on the floor ($\mu_k = 0.25$). If a 100 N force is applied as shown, determine the range of the values of 'h' for which the cabinet will not tip over. 18




7(b) Each of the bars AB and BC is of the length $L = 42$ cm and weight 17 N. A horizontal force P of magnitude 20 N is applied at C. Determine the angular acceleration of each bar. 17




8(a) What is steady precession of a gyroscope? Deduce the expression of the motion of the gyroscope. 17

8(b) A 50 gm bullet is fired with a horizontal velocity of 410 m/s into a 12 kg wooden disk suspended from a pin support at A. The disk is initially at rest, determine (i) the required distance h, if the impulsive reaction at A is to be zero, (ii) the corresponding velocity of the center G of the disk immediately after the bullet becomes embedded. 18