L-2/T-1/IPE **Date : 27/03/2024**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2022-2023

Sub : **ME 245** (Engineering Mechanics and Theory of Machines)

Full Marks : 280 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 **All** questions.

1. Answer either **(a) or (b)**

   (a) Determine the force in each member of the truss shown in Figure for Q. 1(a). State whether each member is in tension or compression. **(35)**

   OR

   (b) For the machine element shown in Figure for Q. 1(b), locate the "y" and "z" coordinate of the center of gravity. **(35)**

2. Answer either **(a) or (b)**

   (a) The magnitude and direction of the velocities of two identical frictionless balls, "A" and "B", of mass "m" are shown in Figure in Figure for Q, 2(a), before they strike each other, Assuming coefficient of restitution, e = 0.90, determine the magnitude and direction of the velocity of each ball after the impact. **(35)**

   OR

   (b) The two blocks shown in Figure for Q. 2(b) are originally at rest. Assuming that the coefficients of static and dynamic friction between block A and the inclined surface are respectively, $\mu_s = 0.25$ and $\mu_k = 0.20$, determine (i) the acceleration of each block, (ii) the tension in the cable. Neglect the masses of the pulleys. **(35)**

3. (a) The bracket BCD, as shown in Figure for Q. 3(a), is hinged at C and attached to a control cable at B. For the loading shown, determine (i) the tension in the cable, (ii) the reaction at C. **(17)**

   (b) A container of weight W, as shown in Figure for Q. 3(b), is suspended from ring A. Cable BAC passes through the ring and is attached to fixed supports at B and C. Two forces $\underline{\mathbf{P}} = P\underline{\mathbf{i}}$ and $\underline{\mathbf{Q}} = Q\underline{\mathbf{k}}$ are applied to the ring to maintain the container in the position shown. Assuming that the tension is the same in both portions of cable BAC and W = 376 N, determine $\underline{\mathbf{P}}$ and $\underline{\mathbf{Q}}$. **(18)**

4. (a) The elevator, "E", shown in Figure for Q. 4(a) moves downward with a constant velocity of 4 m/s. Determine (i) the velocity of the cable C, (ii) the velocity of the counterweight W, (iii) the relative velocity of the cable C with respect to the elevator, (iv) the relative velocity of the counterweight W with respect to the elevator. **(17)**

   (b) A 3-lb collar, "C", as shown in Figure for Q. 4(b) may slide without friction along a horizontal rod. It is attached to three springs, each of constant k = 2 lb/in, and undeformed length of 6-in. Knowing that the collar is released from rest in the position shown, determine the maximum speed it will reach in the ensuing motion. **(18)**

Contd P/2

ME 245 (IPE)

SECTION - B

Questions 5 and 6 has alternate options and questions 7 and 8 are compulsory.

5. (a) Briefly describe positive and negative drives of power transmission. **(6)**

(b) In a flat belt drive, the coefficient of friction between the belt and the pulley is 0.3 and the angle of lap on the smaller pulley is 150°. The smaller pulley has a radius of 200 mm and rotates at 500 rpm. Find the power in kW transmitted by the belt. **(12)**

(c) An epicyclic gear train consists of three gears A, B and C as shown in Fig. 5(c). The gear A has 72 internal teeth and gear C has 32 external teeth. Gear B meshes with both A and C and is carried on an arm P which rotates about the centre of A at 18 rpm. If gear A is fixed, determine the speeds of gear B and C. **(17)**

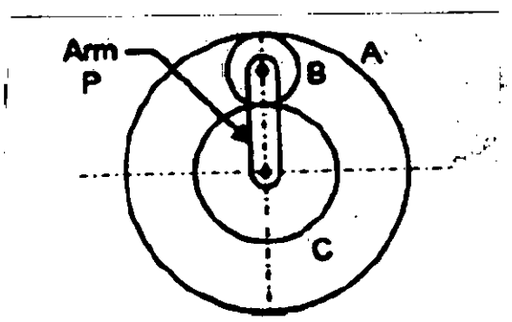


Fig. 5(c)

Or

(a) Discuss the advantages and disadvantages of V-belt drive. **(6)**

(b) Power is transmitted from a pulley of 1.0 m diameter running at 200 rpm to a pulley of 2.25 m diameter by means of a belt. Find the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack side of the belt is 1.4 MPa and 0.5 MPa respectively. The Young's module for the material of the belt is 100 MPa. **(12)**

(c) A cantilever beam as shown in Fig. 5(c) (Or) has a load m kg at the free end of the beam. The beam tip is suddenly displaced by a small distance along x and released. Find the natural frequency of vibration of the system about the equilibrium position. Deflection of the free end due to load m kg is given by $\delta = mgl^3/3EI$. The various parameters are given as; $m = 2\ kg$, $l=0.9\ m$; $E= 200\ GPa$, $I=1x10^{-9}\ m^4$. **(17)**

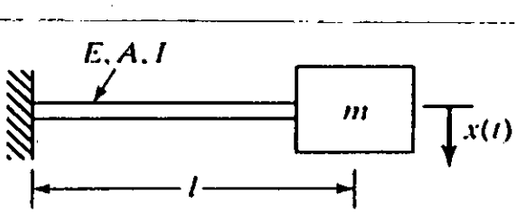


Fig. 5(c) (Or)

Contd P/3

ME 245 (IPE)

6. (a) Define whirling speed and critical speed of a rotating shaft. **(10)**

(b) In the mechanism shown in Fig. 6(b), the slider C is moving to the right with a velocity of 1 m/s. Link AB has a length of 3m and inclined at 45° with the vertical and link BC has a length of 1.5m and inclined at 45° with the horizontal. Determine the angular velocity of the links AB and BC. **(25)**

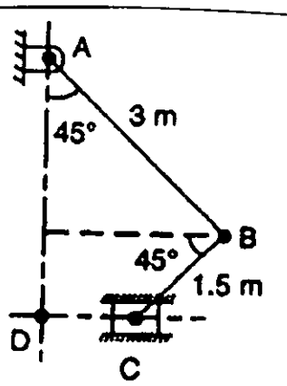


Fig. 6(b)

Or

(a) Briefly describe two degrees of freedom vibration system with examples. **(10)**

(b) Four masses m_1, m_2, m_3, and m_4 are 100 kg, 400 kg, 200 kg and 250 kg respectively. The corresponding radii of rotation are 0.3 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 40°, 90° and 150°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.3 m. **(25)**

7. A cam with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below: **(35)**

(i) to move outwards through 40 mm during 100° rotation of the cam;

(ii) to dwell for the next 80°;

(iii) to return to its starting position during the next 90°. and

(iv) to dwell for the rest of the period of a revolution i.e. 90°.

The displacement of the follower is to take place with uniform velocity. Draw the profile of the cam when the line of stroke of the follower passes through the center of the camshaft.

8. (a) A spring mass damper system as shown in Fig. 8(a) is subjected to a harmonic disturbing force F(t) = 400sin(30t) N. Calculate the forced vibration amplitude and the phase angle. Various parameters of the system are as following: **(23)**

m = 5 kg, k = 10 kN/m, and C = 150 Ns/m.

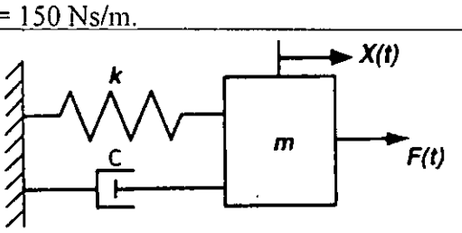


Fig. 8(a)

(b) Describe with the help of necessary diagrams, why a shaft speed much higher than the critical speed is desired in machineries. **(12)**

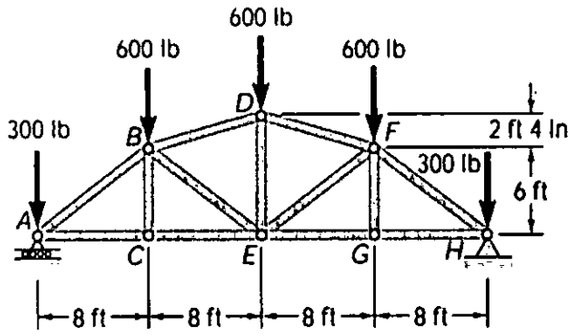


Figure for Q. 1(a)

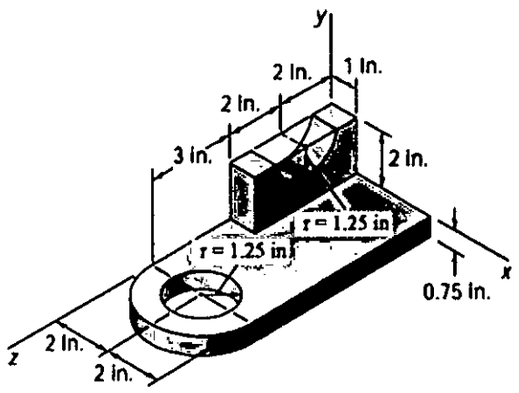


Figure for Q. 1(b)

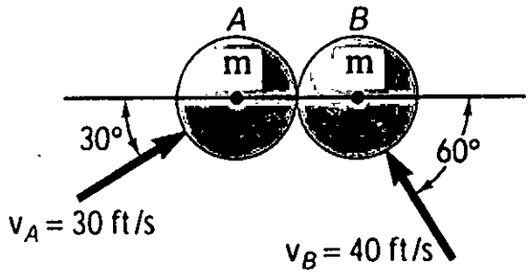


Figure for Q. 2(a)

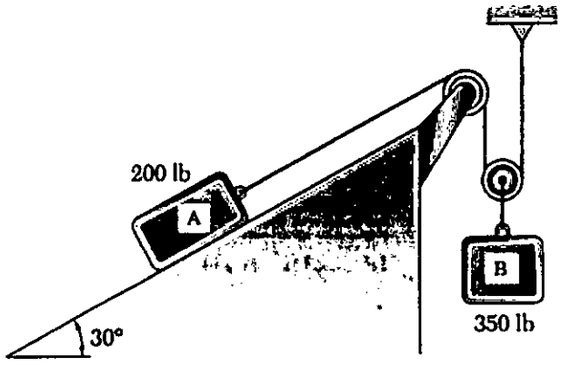


Figure for Q. 2(b)

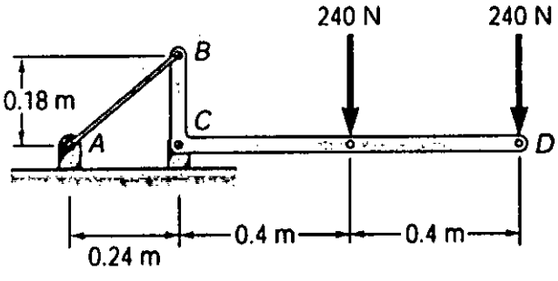


Figure for Q. 3(a)

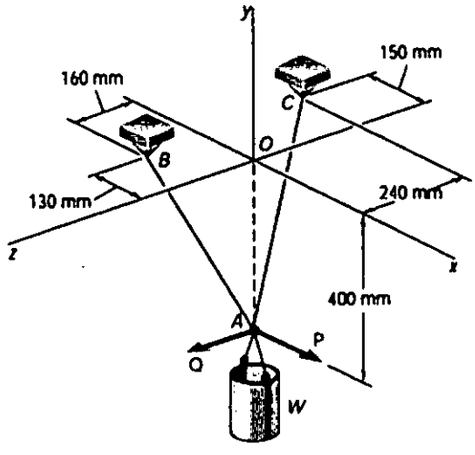


Figure for Q. 3(b)

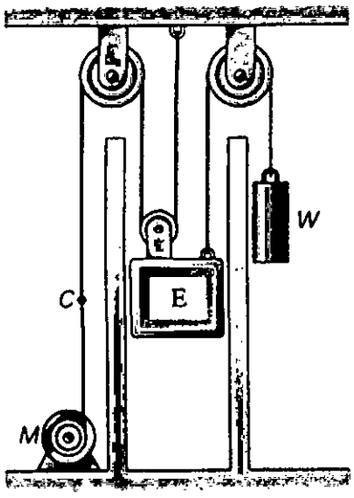


Figure for Q. 4(a)

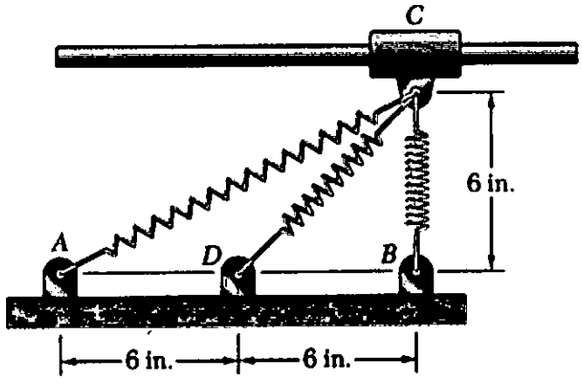


Figure for Q. 4(b)

L-2/T-1/IPE **Date: 22/04/2024**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B.Sc. Engineering Examinations 2022-2023

Sub: **MATH 291 (Differential Equations, Vector Calculus and Laplace Transform)**

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 questions.

Symbols have their usual meaning.

1. (a) What do you mean by differential equations? Explain the degree and the order of a differential equation with an example. **(10)**

   (b) Find the integrating factor of the following differential equation $y\ln y dx + (x - \ln y)dy = 0$ and solve it. **(12)**

   (c) A thermometer is removed from a room where the temperature is 70°F and is taken outside where the air temperature is 10°F. After one-half minute the thermometer reads 50°F. What is the reading of the thermometer at t = 1 min? How long will it take for the thermometer to reach 15°F? **(13)**

2. (a) Define the exactness condition of a first-order ordinary differential equation. **(5)**

   (b) Solve the Bernoulli's equation: $\frac{dy}{dx} + \frac{y}{2x} = \frac{x}{y^3}$ subject to initial condition $y(1) = 2$. **(10)**

   (c) Solve the higher order differential equation $(D^2 - 2D + 1)y = xe^x \sin x$. **(10)**

   (d) A spring with a mass of 2 kg has natural length 0.5 m. A force of 25.6 N is required to maintain it stretched to a length of 0.7 m. If the spring is stretched to a length of 0.7 m and then released with an initial velocity of 0 ms^{-1}, find the position of the mass at any time t. **(10)**

3. (a) Define singular points of a differential equation. **(5)**

   (b) Locate and classify the singular point of the following differential equation **(10)**

   $$x^3(x-1)y'' - 2(x-1)y' + 3xy = 0$$

   (c) Use the method of Frobenius to obtain a series solution of the differential equation **(20)**

   $x(1-x)y'' - 3xy' - y = 0$ near $x = 0$.

4. (a) Define Bessel's equation of order n. **(5)**

   (b) For Bessel function $J_n(x)$, if $n > -1$ then show that $\int_0^x x^{n+1} J_n(x)dx = x^{n+1} J_{n+1}(x)$. **(10)**

Contd..... Page/2

(c) Show that the Rodrigue's formula for Legendre polynomial $P_n(x)$ can be expressed in the form $P_n(x)=\frac{1}{2^n(n!)}\frac{d^n}{dx^n}(x^2-1)^n$. **(13)**

(d) Applying Rodrigue's formula prove that, $\int_{-1}^{1} P_n(x)dx = 0,\ if\ n \geq 1$. **(7)**

SECTION – B

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

5. (a) Define Sine Integral function and find its Laplace Transform. Hence show that **(10)**

$$L\left\{\int_0^t \frac{\sin u}{u}du\right\} = \frac{1}{s}\tan^{-1}\frac{1}{s}$$

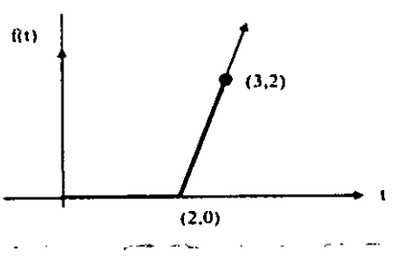
(b) Discuss Heaviside Expansion formula. Apply this formula to find **(12)**

$$L^{-1}\left\{\frac{s+5}{(s^2+1)(s^2+3)}\right\}$$

(c) Solve $y''+y=\sqrt{2}\sin(\sqrt{2})t$ subject to the initial condition: $y(0)=10,\ y'(0)=0$. **(13)**

6. (a) State Convolution theorem. Apply this theorem to find $L^{-1}\left\{\frac{1}{(s+2)(s^2+9)}\right\}$ **(15)**

(b) Translate the following graph with the help of a piece-wise function f(t). Hence find Laplace transform of f(t). **(10)**



(c) Apply Laplace Transform to evaluate $\int_0^\infty te^{-2t}\sin 3t\,dt$. **(10)**

7. (a) Define directional derivative. Find the direction along which the directional derivative of $Q=5x^3y^2z$ at $(2,-1,-2)$ is the greatest. Determine the greatest value as well. **(10)**

(b) Discuss divergence and curl of a vector function. Find curl of **F** where $\mathbf{F}=(x^2-y^2+2xz)\mathbf{i}+(xz-xy+yz)\mathbf{j}+(z^2+x^2)\mathbf{k}$. Also show that the vectors given by curl **F** at the points P(1, 2, -3) and Q(2, 3, 12) are orthogonal. **(13)**

(c) Demonstrate that the gradient of a scalar function f is a vector in the direction of the normal to the level curve defined by f. **(12)**

Contd..... Page/3

MATH 291 (IPE)

8. (a) State Grauss's divergence theorem and Green's theorem for the plane. **(8)**

(b) Apply Gauss's divergence theorem to find the flux for $\mathbf{F} = 2xy\mathbf{i} - 3yz\mathbf{j} - zx^2\mathbf{k}$ taken over region bounded by the cylinder $y^2 + z^2 = 4$ and the planes $x = 0,\ x = 3$. **(12)**

(c) Describe the work done by the force field $\mathbf{F} = (3x^2 - y)\mathbf{i} + (y^2 - x^2)\mathbf{j} + (zy^2 + 3x)\mathbf{k}$ on a particle that moves it along the line segments from (0, 0, 0) to (1, -2, -1) then to (2, -3, 2). **(15)**

L-2/T-1/IPE Date : ~~27/04/2024~~ 18/05/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2022-2023

Sub : **CSE 295** (Computer Programming Techniques)

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. **Question No. 1 is mandatory.**

Answer **Q. No. 1** and any **TWO** from the rest.

All questions are related to C Programming Language.

1. (a) Write the output of the following program. **(8)**

```
#include<stdio.h>
void main ()
{  int a=3, b=2, c=10, d=3;
   b=++a/b;
   c=a++/d;
   d=--a/b;
   printf("%d %d %d %d", a,b,c,d);
}
```

(b) Construct a C Program that takes an integer number as input and outputs the sum of digits of that number. **(15)**

(c) Write a program that takes n (an integer) integers as input and outputs the integers in ascending sorted order using bubble sort. **(12)**

2. (a) Write three characteristics of binary search algorithm. Now write a function *binarySearch(int arr[], int n, int key)* that searches the element key in an array of integers (arr) of n elements and returns the index (an integer) of key in arr using binary search algorithm. **(6+15=21)**

(b) Draw the flow chart to find $base^{exponent}$ where base (an integer) and exponent (a nonnegative integer) are user inputs. **(14)**

3. A number may have several factors. For example the factors of 24 and 54 are as follows:

24 = 1, 2, 3, 4, 6, 8, 12, 24 and,

54 = 1, 2, 3, 6, 9, 18, 27, 54

For 24 and 54, there are four common factors namely, 1, 2, 3, and 6. Now do the following in a single program: **(15+10+10=35)**

Contd P/2

CSE 295/IPE

Contd ... Q. No. 3

(i) Write down a function *numberOfCommonFactors(x,y)* that will return how many common factors are there between two numbers x and y.

(ii) Two numbers are called relatively prime numbers if there is no common factor other than 1. Write down another function *RelativelyPrime(x,y)* that will return 1 if x and y are relatively prime and 0 otherwise. In this function you must use *numberOfCommonFactors(x,y)* function.

(iii) In your main function take two integers *p*, *q* as input and use the above functions to print the following results:

- Number of common factors of p and q.
- Whether p and q are relatively prime or not.

Sample Input	Output
24 54	4 common factors They are not Relatively prime
4 9	1 They are Relatively prime

4. (a) A string is palindrome if the reverse of the string is equal to the original string. Now write a C program that takes a string as input and checks whether the string is palindrome or not. **(15)**

Sample Input	Output
ewe	Palindrome
Read	Not a Palindrome

(b) What will be the output of the following program? **(6)**

```
#include <stdio.h>
void main()
{
  int a = 1;
  switch(a)
  {
  case 1:
    printf("Try to be ");
  case 2:
    printf("a good person");
  case 3:
    printf(", not only a good student");
    break;
  case 4:
    printf("and be sincere.");
    break;
  }
}
```

CSE 295/IPE

Contd ... Q. No. 4

(c) Write the output of the following program. **(6)**

```
#include<stdio.h>
int x;
int func1(int a);
int main()
{
   int x, y, z;
   x=100;
   y=6;
   z=func1(y);
   printf("Result is: %d\n",z);
}

int func1(int a)
{
   return (a+x)/2;
}
```

(d) Convert the following for loop into a do-while loop preserving its functionality. **(8)**

```
for(i=0;i!=0;i++)
printf("A");
```

SECTION – B

There are **FOUR** questions in this section. **Question No. 5 is mandatory.**

Answer **Q. No. 5** and any **TWO** from the rest.

5. (a) Look at the code snippet and memory segment carefully. The memory segment shows variables value after the execution of the code below. **(10)**

```
int main(){
   int a, *p1, **p2, ***p3;

   a=500;
   p1=&a;
   p2=&p1;
   p3=&p2;
}
```

address	content	Variable
5000	212	
5004	500	a
5008	2112	
5012	5004	P1
5020	5050	
5024	5012	P2
5032	5033	
5036	5024	P3

Suppose, the statement *"(**p2)=300;"* is included at the last line of the main function. Then find the values of a, p1, *p1, p2, ***p3 with explanation after the execution of the code?

Contd P/4

CSE 295/IPE

Contd ... Q. No. 5

(b) Defend why a *char** variable and an *int** variable occupies same size in memory while a *char* is usually 1 byte and an *int* is 4 byte in size. **(5)**

(c) Take two integers as input indicating the number of rows and columns of an integer 2D matrix. Then input all the elements of that array. Finally, you have to input another integer value, *check*. **(12)**

Your task is to measure the summation of all elements for individual rows. If the sum of any row is greater than the *check*, eliminate that row. Then store the "not eliminated" rows in another 2D matrix and print that resultant matrix. Design the C program.

[N.B. Use Pointer and Dynamic Memory Allocation. Do not use any[]-operator. Free the memory if it is no longer needed]

(d) Write the output of the code snippet below. Explain the reasons behind the output. **(8)**

```
#include<stdio.h>

void fun(int a, int b, int *c){
   a=a+b;
   b=b+*c+a;
   *c=*c**c;
   printf("%d %d %d\n", a, b, *c);
}

int main(){
   int x=10, y=20, z=3;
   fun(x,y,&z);
   printf("%d %d %d", x, y, z);
}
```

6. (a) Take two integers *m* and *n* indicating the number of rows and columns respectively of an "integer 2D-matrix". Then take all the elements of the matrix as input. You have to identify the largest element from each column of the matrix and print them. Now, design the C program. **(10)**

(b) (i) Design the recursive function *void sort(int ara[], int pos, int n)* for sorting in ascending order where *ara* is representing the unsorted list of integers with size, *n* and *pos* means the first index/position of the unsorted portion. The procedure of sorting is to swap the position of the lowest element of the unsorted portion with the first position of the unsorted portion. **(10+5=15)**

(ii) Implement the recursive tree for - *sort ({5, 1, 7, 4, 12, 9}, 0, 6)*.

Contd P/5

CSE 295/IPE

Contd ... Q. No. 6

(c) Write the output of the following C program. Also distinguish between *cy_vol1* and *cy_vol2*. **(10)**

```
#include<stdio.h>
#define PI 3.1416

#define cy_vol1(r, h) ((PI)*(r)*(r)*(h))
#define cy_vol2(r, h) PI*r*r*h

int main(){
   float rad=2.2;
   float height= 4.7;
   printf("%.2f\t %.2f",cy_vol1(rad+1, height+1), cy_vol2(rad+1, height+1));
   return 0;
}
```

7. (a) Write down the decimal values (with calculations) of the binary representations below considering that they are assigned to a char (signed char) variable: (Answer any Two) **(4+4=8)**

   (i) 0b11010111

   (ii) 0b11011001

   (iii) 0b01011011

   (b) Take two integers as input and design the C program for swapping their values without using any temporary variables. **(7)**

   (c) Take two integer variables n and r (r<32) as input. Design a C program to left rotate the binary representation of n by r bits. After left rotation, the binary value of n will be left shifted by r bits and the leftmost r bits of initial n will be stored in the rightmost r bits of left-shifted n. Finally, print the output in decimal. **(12)**

   (d) Demonstrate the procedure of detecting the sign (positive or negative) of an integer value without using any relational operators. No need to write the code. **(8)**

Contd P/6

CSE 295/IPE

8. (a) Consider the following structure definition for storing the information of a cricket player for three matches: **(5+10+10=25)**

```
struct Player_Info
{
  //declare a member for player's nickname
  //declare a member for the runs of first match
  //declare a member for the runs of second match
  //declare a member for the runs of third match
  //declare a member for the average runs of three matches
};
```

(i) Complete the above structure definition by declaring members for storing player's nickname (a player's nickname can be 10 characters long), the runs (integer) of three matches, and the average runs (float) of three matches.

(ii) Consider a text file entitled "player_Runs.txt". The first line of this file is an integer indicating the number of players. The following lines represent the information of all individual players where each line includes player's nickname and the runs of three different matches which are "whitespace" separated.

Write a C code to read all players information from the file, measure their average runs and keep them in the dedicated structure member. Finally store all players' information in a "struct Player_Info"-type array.

(iii) Write the C program (in the same main function of 8(a)(ii)) to sort the array generated at 8(a)(ii) based on the descending order of the average runs of three matches and write the sorted players' nicknames (in separate lines) in the text file named "Player_Rank.txt".

(b) Take an integer as input. Now write a C program to print the binary representation of the input by declaring a union that includes a structure with bit-fields. **(10)**

L-2/T-1/IPE **Date: 02/05/2024**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2022-2023

Sub: **MME 295** (Engineering Materials-II)

Full Marks: 140 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. **Question 1** is **Compulsory**.

Answer any **TWO** questions from the remaining questions.

1. A continuous fiber-reinforced composite is to be produced to withstand a maximum strength of 2000 MPa utilizing aramid fibers and a polycarbonate matrix. Design the composite with a suitable composition of fiber and matrix percentage considering the different orientations of fibers with respect to the loading direction. Mechanical characteristics of these two materials are as follows: Modulus of Elasticity-131 GPa (Aramid Fiber), 2.4 GPa (Polycarbonate); Tensile Strength-3600 MPa (Aramid Fiber), 65 MPa (Polycarbonate). For this composite, compute **(35)**

   (a) the longitudinal tensile strength, and

   (b) the longitudinal modulus of elasticity.

   Assume that the composite consists of 30% aramid fibers and 70% polycarbonate matrix, has a cross-sectional area of 320 mm^2 and is subjected to a longitudinal load of 44,500 N.

   (c) Calculate the fiber-matrix load ratio.

   (d) Calculate the actual loads carried by both fiber and matrix phases.

   (e) Compute the magnitude of the stress on each of the fiber and matrix phases.

   (f) What strain is experienced by the composite?

2. Which glass-forming method would you choose to produce plates and dishes? Justify your answer. Analyze how the differences in the production processes (Foucault vs. Float) can influence the final properties of the glass sheet, such as surface quality, defects, optical clarity, and mechanical strength. **(17 ½)**

3. Explain the vulcanization process and consider the following three cases: **(17 ½)**

   A: 1 part of S added to 100 parts of rubber

   B: 5 parts of S added to 100 parts of rubber

   C: 20 parts of S added to 100 parts of rubber

   Draw stress-strain curves for them and analyze how the degree of vulcanization can affect the mechanical properties of the final rubber product, such as tensile strength, modulus of elasticity, and resilience. Provide specific examples.

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4. Consider two processing techniques used for semi-crystalline polymers: annealing and cold drawing. How do these processing methods influence the polymer's microstructure (e.g., crystal size, perfection, chain orientation)? Based on these microstructural changes, explain how these processing techniques ultimately affect the mechanical properties of the polymer. **(17 ½)**

SECTION – B

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

Notations used carry usual meanings.

5. Fe^{2+} has four unpaired electrons, resulting in strong magnetic moments. Determine the crystal structure of FeO and, based on the structure, analyse the possibility of observing ferromagnetism in FeO. (Given, $r_{Fe^{2+}} = 0.077$ nm, $r_{O^{2-}} = 0.140$ nm). **(17 ½)**

6. Examine the importance of crack size in the design of a critical ceramic component. Additionally, debate the effectiveness of calculating allowable stress of the component solely based on yield stress. **(17 ½)**

7. Imagine you are working in the ceramic industry. During the sintering of Al_2O_3, you are experiencing excessive grain growth. Compare the flexural strength and modulus of elasticity of your sintered products with a defect-free Al_2O_3 product. Also, predict and analyse the changes in the properties if 0.25% MgO is added during sintering. **(17 ½)**

8. Select an appropriate forming process for producing thin-walled articles with intricate shapes. Additionally, analyse the requirements of the feed material for your chosen process. **(17 ½)**

9. Suppose you want to increase the profit of a sintering unit by reducing time and temperature in the sintering cycle. Instead of using a mixture of coarse and fine particles, you have decided to use only fine particles. Critically assess the impact of such a decision on the quality of the sintered product. **(17 ½)**
