L-1/T-1/CSE **Date: 19/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **CSE 101** (Structured Programming Language)

Full Marks: 210 Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

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

1. (a) Consider the following program codes: **(2+4+3=9)**

```
int i = 8, j = 5, k;
float x = 0.005, y = -0.01;
char c = 'c', d = 'd';
-----------------------------
k = (i - 3 * j) % (c + 2 * d) / (x - y);
-----------------------------
```

Rewrite the last program code within two dotted lines using type casting to avoid any error or warning. Evaluate the equation to find the value of k with the corrected code. How many times do the type auto conversion take place while evaluating the equation?

(b) Upon getting admission into BUET, a student gets a student ID comprising 7 digits. The first two digits are used for representing year, the next two digits for dept code and the last three digits for serial number as shown below: **(8+8=16)**

Year		Dept Code		Serial number		
2	0	0	5	4	5	6

Consider that the program uses student ID for interface i.e., input and output purposes but use a **student code** for storing it inside computer memory. The 2 digits year in student ID is converted into 4 digits in student code. For example, if the year in student ID is 20, then it is converted to 2020 in student code. 4-byte integer variables are used for representing both the student ID and the student code. The most significant 1 bit, i.e., sign bit of student code is kept unused and always contains zero. The numbers of bits used for representing Year, Dept code and Serial number in student code are 13, 9 and 9, respectively, as showing below-

Unused	Year	Dept code	Serial number
1 bit	13 bits	9 bits	9 bits

Write a C function using the following prototype to convert a student ID to a student code.

```
int getStdCode(int stdID);
```

Contd P/2

CSE 101

Contd... Q. No. 1(b)

Also write a C function to convert a student code into a student ID using the function prototype given below-

```
int getStdID(int stdCode);
```

Use bitwise operations to solve the problem along with simple multipliers (like, 10 or 100). Don't use any array, pointer or big hard-coded multiplier (say, multiplying by 512) in your functions.

(c) A palindromic number is a number that remains the same when its digits are reversed. For example, 984489 and 12321 are palindromes, however, 1234 and 985489 are not. Write a C function that takes a number N as an argument and returns 1, if the number is a palindrome and returns 0, otherwise. Don't use any array or pointer in your function. Use the following function prototype- **(10)**

```
int isPalindrome(int x);
```

2. (a) Write down the desirable characteristics of a good program. Define escape sequence with examples. **(6+3=9)**

(b) Some program codes are given as follows: **(6+7=13)**

```
int a = 0x7c5;
float x = 13.25;
------------------------------
printf("%-07X %#7g %10.2e", a, x, x);
------------------------------
```

Show the output to be generated by the print() function. Also show the bit-stream to be stored inside the computer memory while storing 13.25 using 4-byte floating point number representation. Demonstrate your workout.

(c) A tree has exactly one path from the root (e.g., the node marked with 8 in the Figure for Q. 2(c) is the root) to any node. A binary tree is a tree where each node has at most two children. For example, node 3 and node 10 are the children of node 8; similarly, node 1 and node 6 are the children of node 3. Moreover, node 3 is the left child and node 10 is the right child of node 8. Also note that, nodes 1, 3, 4, 6 and 7 are in the left subtree and nodes 10, 13 and 14 are in the right subtree of node 8. **(6+7=13)**

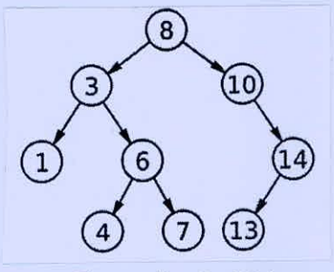


Figure for Q. 2(c)

Contd P/3

CSE 101

Contd... Q. No. 2(c)

A binary search tree is a binary tree where the value of each node in the left subtree of a node is smaller than the value of that node, while the value of each node in the right subtree is equal to or higher than the value of that node. A binary search tree is represented by a 1D array as follows-

(i) The root is placed at index 1.

(ii) If a node is in index i, then its left child is placed at index 2i and the right child is placed at index 2i + 1.

(iii) -1 indicates the node does not exist.

Write a recursive C function that will generate a binary search tree from some given values by inserting one value at a time using the following function prototype-

```
int insertNode(int *tree, int x);
// x will be inserted into tree as a node.
```

Also write a recursive C function that counts the number of nodes available in the tree.

3. (a) What is meant by token? Describe that the difference between the reserved word and the key word is significant in natural language but not in programming language. **(3+4=7)**

(b) Write a C function to delete an integer element from a sorted integer array. Assume that the name of the array A, and the number of elements already inserted in the array, represented by the identifier, N, is declared globally. The prototype of the function is as follows- **(8)**

```
int deleteSorted(int x);
```

The function returns the index from where the element is deleted, otherwise returns – 1 if the element to be deleted is not found in the list. Assume that there is no duplicate element in the list.

(c) The sine of x can be calculated approximately by summing the first n terms of the infinite series **(10)**

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots\ldots\ldots$$

where x is expressed in radians. (Note: π radians = 180°)

Write a C function that takes the angle (in degree) as an input argument and returns the value of sinx. Assume that the result will be calculated up to 3 decimal points accuracy. Don't use any mathematical library function in your program. Use the following function prototype-

```
double sin(double x);
```

Contd P/4

CSE 101

Contd... Q. No. 3

(d) Write a complete C program that takes two suitable integer matrices (not necessarily square matrices) as inputs, multiply them and display the resultant matrix as the output. The sizes and elements of the matrices are to be taken as inputs. Use necessary prompt while taking inputs and necessary indentations while showing outputs. Use minimum number of variables in your program. **(10)**

4. (a) Re-declare the following using pointer and malloc() function. Do not use [] operator. **(5)**

```
double A[10][20][30];
```

(b) Consider the following declaration: **(4+6=10)**

```
int p[2][3][2] ={ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12};
```

If memory location p contains a value of B040 (in hexadecimal) and an integer in represented by 2 bytes, then show the addresses of each of the integers in the list.

Also write down the values of the following expressions:

(i) **p (ii) *(*(*p+1)+2) (iii) *(**(p+2)) (iv) *(*p+1)+1

(c) Suppose a variable for storing a list of several country names is declared as follows: **(4+8=12)**

```
char *countries[100];
```

Write a C loop statement to read the names of the countries until the word "end" is typed. Make sure to allocate necessary memory, if required.

Also write a C function that follows the following function prototype for sorting the list in dictionary order.

```
void reorder(int n, char *list []);
```

(d) Describe the output of the following code-segment. **(8)**

```
int a = 8, b, *pa, *pb;
float x = 0.001, y = 0.2, *px = &x, *py = &y;
-------------------------------------
pb = &a;
b = *pb + 7;
pa = pb;
*px *= *pa + *pb;
*py += *pa;
printf("%x %x %d %.2f", pa + 2, &(*pa), a, x);
```

Suppose each integer quantity occupies 2 bytes and each floating-point quantity occupies 4 bytes of memory. The values assigned to a, b, x and y begins at (hexadecimal) addresses F9C, F9E, A130 and B2C3, respectively.

Contd P/5

CSE 101

SECTION – B

There are **NINE** questions in this section. Answer any **SEVEN** questions.

5. In each line of a file named "***in.txt***" there is a string and a number. For example, the file might look like below:

ABED 21
ABSBA 23
NIBIR 26

Write C code inside main function that reads until End-Of-File from ***in.txt***, and for each line determines whether the string is palindrome or not and whether the number is odd/even and for each line of ***in.txt***, writes a line in another file named ***out.txt.*** For example, for the ***in.txt*** sample shown above, the ***out.txt*** will look like this: **(15)**

Not-Palindrome Odd
Palindrome Odd
Not-Palindrome Even

6. You are given a C structure called "student" defined as below:

```
struct student
{
   int id;
   char name[50];
}
```

Write a C code to sort the following array based on alphabetic names. In case of tie in name, place the student first who has lower id number. **(15)**

```
struct student students[50];
```

7. Look at the following C code: **(15)**

```
#include <stdio.h>
struct X
{
   short s;
   int i;
   char c;
};
```

Contd P/6

CSE 101
Contd... Q. No. 7

```
struct Y
{
   int i;
   short s;
   char c;
};
struct Z
{
   int i;
   char c;
   short s;
};

const int sizeX = sizeof(struct X);
const int sizeY = sizeof(struct Y);
const int sizeZ = sizeof(struct Z);

int main()
{
   print{"%d %d %d\n", sizeX, sizeY, sizeZ);
   return(0);
}
```

Write down the output of the code. Also provide very brief justification for each of the sizeX, sizeY and sizeZ.

You can assume that int, char, & short takes 4, 1, & 2 bytes of space respectively.

8. Parity of a number refers to whether it contains an odd or even number of 1-bits. The number has "odd parity", if it contains odd number of 1-bits and is "even parity" if it contains even number of 1-bits.

Write a function with the following signature to check the parity of the binary representation of a given unsigned integer. If the argument given has "odd parity", it returns 1, otherwise, it returns 0. **(15)**

```
int check_parity(unsigned int n);
```

You must use bitwise operations, and cannot use any arithmetic operations on the given number ***n***.

Contd P/7

CSE 101

9. Look at the signature of the function below:

```
char* dbl_dbl(char *str, char ch);
```

The function ***dbl_dbl*** should return a string where all the single occurrences of ***ch*** in string "str" is repeated once. For clarification look at the following examples: **(15)**

dbl_dbl("baba", 'a') should return the string "baabaa"
dbl_dbl("aa", 'a') should return the string "aaaa"

10. Look at the following code snippet that uses dynamic memory allocation: **(15)**

```
#include <memory.h>

int funny(int a, int b)
{
  char *hog = malloc(1024*1024*1024*50);
  return a + b;
}

int main(void)
{
  int sum =funny(funny(6, 8), funny(3, 7));
  return 0;
}
```

Is it possible that this code might fail to run? Why? Or why not? How can you prevent this from happening? Explain very briefly.

11. Write down the output of the following code snippet: **(15)**

```
#include <stdio.h>
#include <string.h>

union test{
  unsigned int value : 3;
  unsigned int value2 : 4;
};
```

Contd P/8

CSE 101
Contd... Q. No. 11

```
int main(){
  union test t;
  printf("Sizeof(t) : %d\n", sizeof(t) );

  t.value2 = 5;
  printf("t.value : %d, ", t.value);
  printf("t.value2 : %d\n", t.value2);

  t.value2 = 9;
  printf("t.value : %d, ",t.value);
  printf("t.value2 : %d\n", t.value2);

  t.value2 = 13;
  printf("t.value : %d, ",t.value);
  printf("t.value2 : %d\n", t.value2);

  return 0;
}
```

You can assume that memory sharing starts from the least-significant bit.

12. (a) Why do we need ***dynamic memory allocation***? **(5)**

(b) Suppose we have defined two macros **SQ & CUB** like below: **(10)**

```
#define SQ(x)((x)*(x))
#define CUB(x)(SQ(x)*(x))
```

Define a third macro ***F_POW(x)*** using the above two macros in your definition that will produce:

$$\frac{x^3}{x^8}$$

13. (a) You are given two unsigned integers **a** and **b**. Write a function void swap_swag (unsigned int* a, unsigned int* b) to swap their values using **only** bitwise operations. You **cannot** use any temporary variable and/or arithmetic operations. **(10)**

(b) BUET CSE knows its student either by their nickname (which is a string of maximum 10 characters) or by their student id (an integer) but **not both**. Declare a data-structure that allows BUET CSE to store the information stated above for 120 students. Briefly explain why your chosen data-structure gets the job done. **(5)**

L-1/T-1/CSE **Date: 22/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **EEE 163** (Introduction to Electrical Engineering)

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.

All symbols represent usual meaning.

1. (a) An industrial coil is modeled as a series combination of an inductance L and resistance R, as shown in Fig for Q. 1(a). Given, $|V_s| = 145$ V, $|V_1| = 50$ V, $|V_o| = 110$ V. Determine the values of L and R. **(20)**

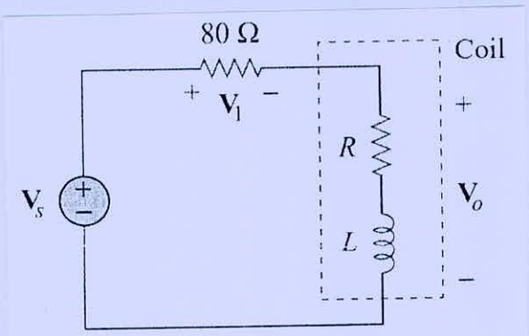


Fig. for Q. 1(a)

(b) In the circuit shown in Fig for Q. 1(b), calculate the value of inductance L across the R-C series combination so that the net impedance is resistive at a frequency of 5 MHz. **(15)**

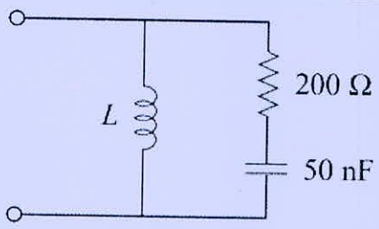


Fig. for Q. 1(b)

2. (a) Find $i_x(t)$ in the circuit of Fig for Q. 2(a) using nodal analysis. **(20)**

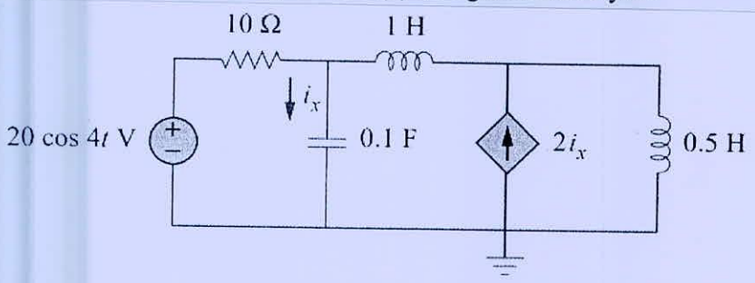


Fig. for Q. 2(a)

Contd P/2

EEE 163/CSE
Contd... Q. No. 2

(b) Find the Thevenin equivalent at terminals a-b of the circuit shown in Fig for Q. 2(b). **(15)**

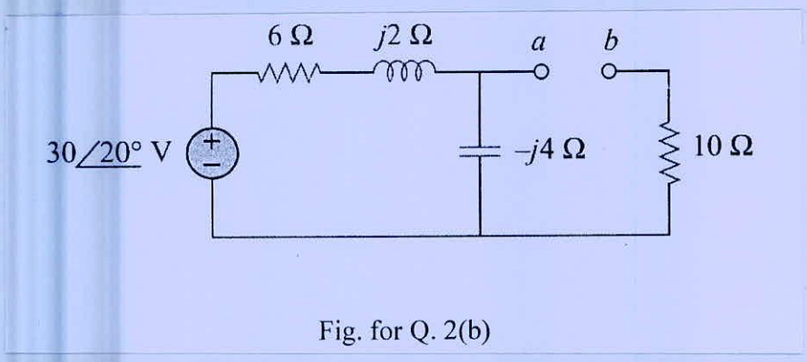


Fig. for Q. 2(b)

3. (a) For the circuit in Fig for Q. 3(a), find I_o and the input power factor. **(18)**

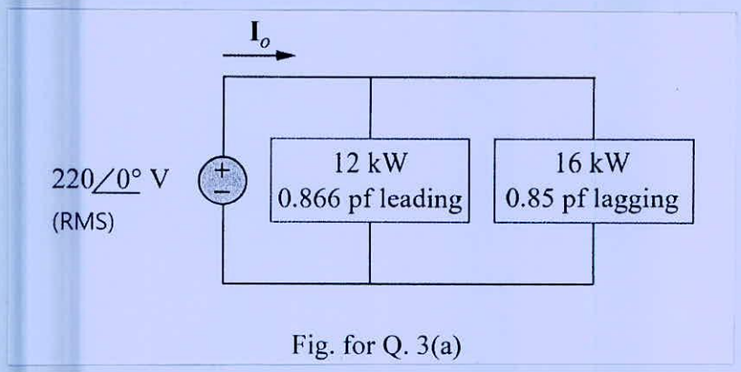


Fig. for Q. 3(a)

(b) Calculate the effective value of the current waveform shown in Fig for Q. 3(b) and the average power delivered to a 12 Ω resistor when the current runs through the resistor. **(17)**

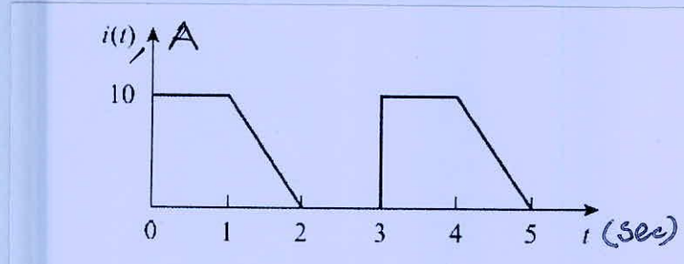


Fig. for Q. 3(b)

EEE 163/CSE

4. (a) For the series magnetic circuit shown in Fig for Q. 4(a), find the value of I required to develop a magnetic flux of 0.6×10^{-3} Wb. Here, M_1 is sheet steel, M_2 is cast steel, N = 50, $A_1 = 10^{-3}$ m^2, $A_2 = 0.67 \times 10^{-3}$ m^2, $r_1 = r_2 = 0.1$ m. Neglect fringing effect. B-H curve is attached. **(20)**

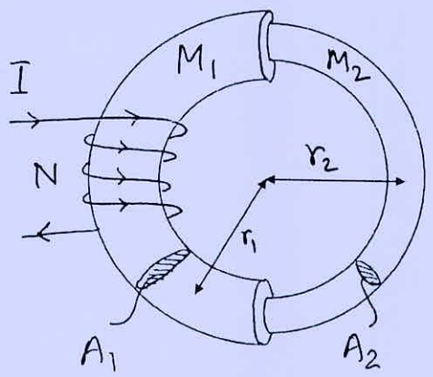


Fig. for Q. 4(a)

(b) Find the magnetic flux Φ for the series magnetic circuit of Fig. for Q. 4(b) for the specified impressed mmf. **(15)**

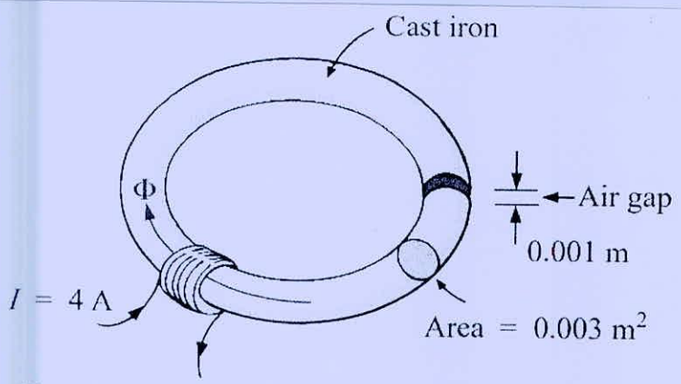


Fig. for Q. 4(b)

SECTION – B

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

5. (a) Using node-voltage analysis, find the node voltages v_1, v_2, v_3 for the circuit shown in Fig for Q. 5(a). **(20)**

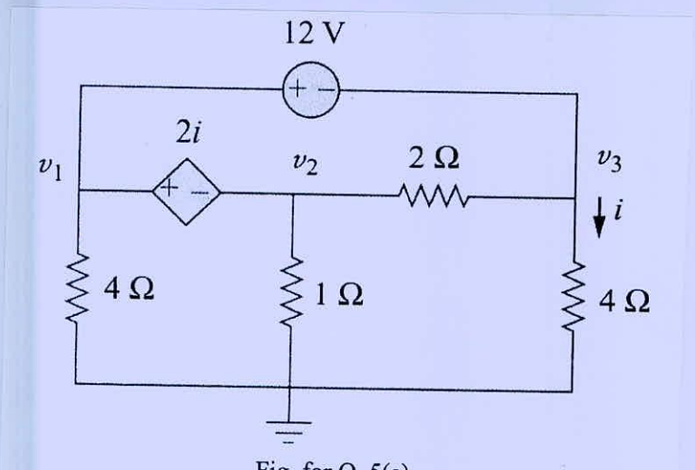


Fig. for Q. 5(a)

Contd P/4

EEE 163/CSE

Contd... Q. No. 5

(b) Using mesh-current analysis, compute the current i_o for the circuit shown in Fig for Q. 5(b). **(15)**

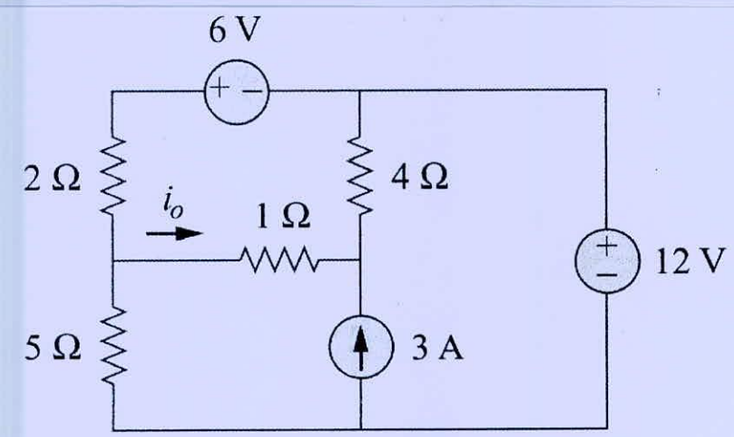


Fig. for Q. 5(b)

6. (a) For the circuit shown in Fig for Q. 6(a), use the superposition principle to find the current i and thereby calculate the power dissipated in the 3Ω resistor. **(25)**

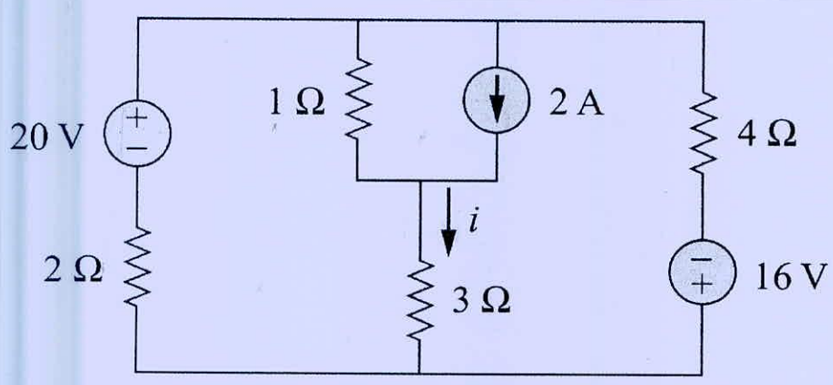


Fig. for Q. 6(a)

(b) For the circuit shown in Fig for Q. 6(b), find the current i and the power delivered by the 120V source. **(10)**

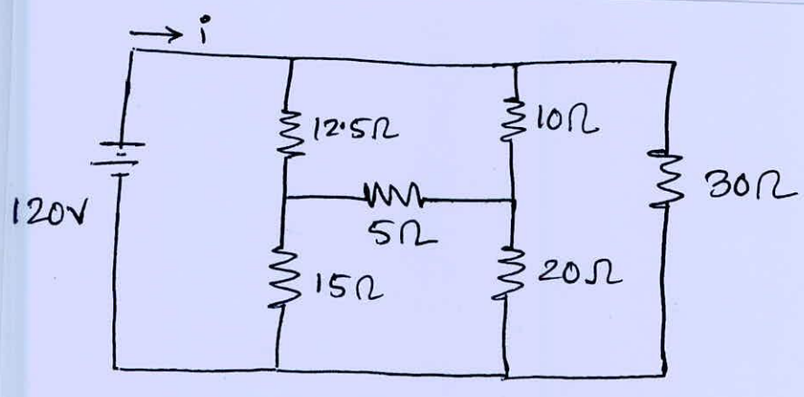


Fig. for Q. 6(b)

EEE 163/CSE

7. (a) Using source transformation, find the value of i_x and thereby compute the power dissipated in the 15Ω resistor for the circuit shown in Fig for Q. 7(a). **(25)**

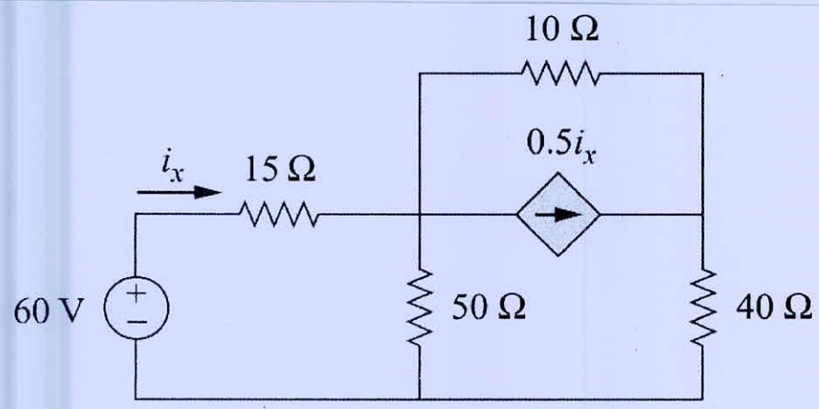


Fig. for Q. 7(a)

(b) Using Thevenin's theorem, find the resistance value (to be connected across terminals $a - b$) that will receive the maximum power from the network shown in Fig for Q. 7(b). **(10)**

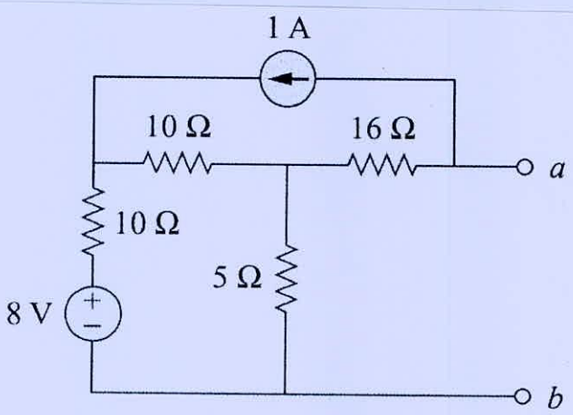


Fig. for Q. 7(b)

8. (a) Obtain the Norton equivalent circuit at terminals $a - b$ for the circuit shown in Fig for Q. 8(a). **(25)**

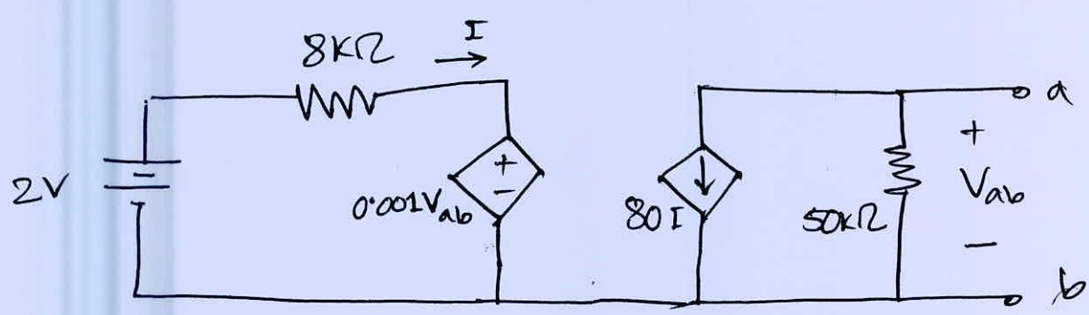


Fig. for Q. 8(a)

EEE 163/CSE
Contd... Q. No.8

(b) For the combination of resistors shown in Fig for Q. 8(b), find the equivalent resistance R_{ab}. **(10)**

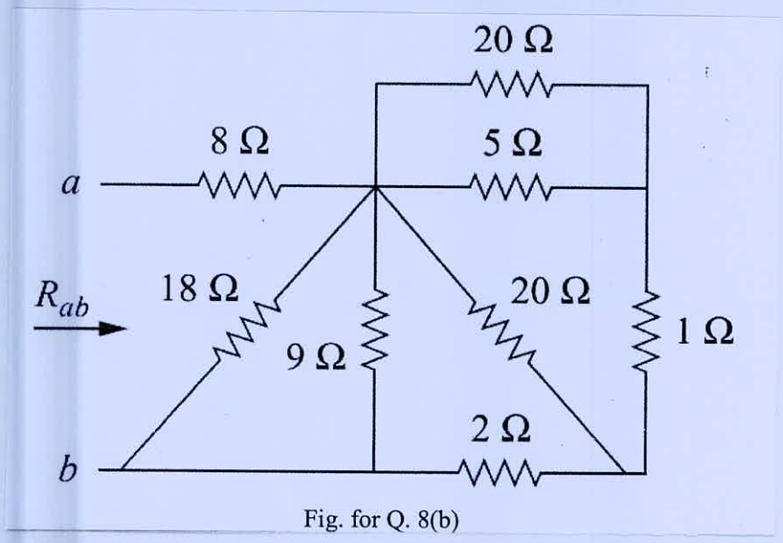
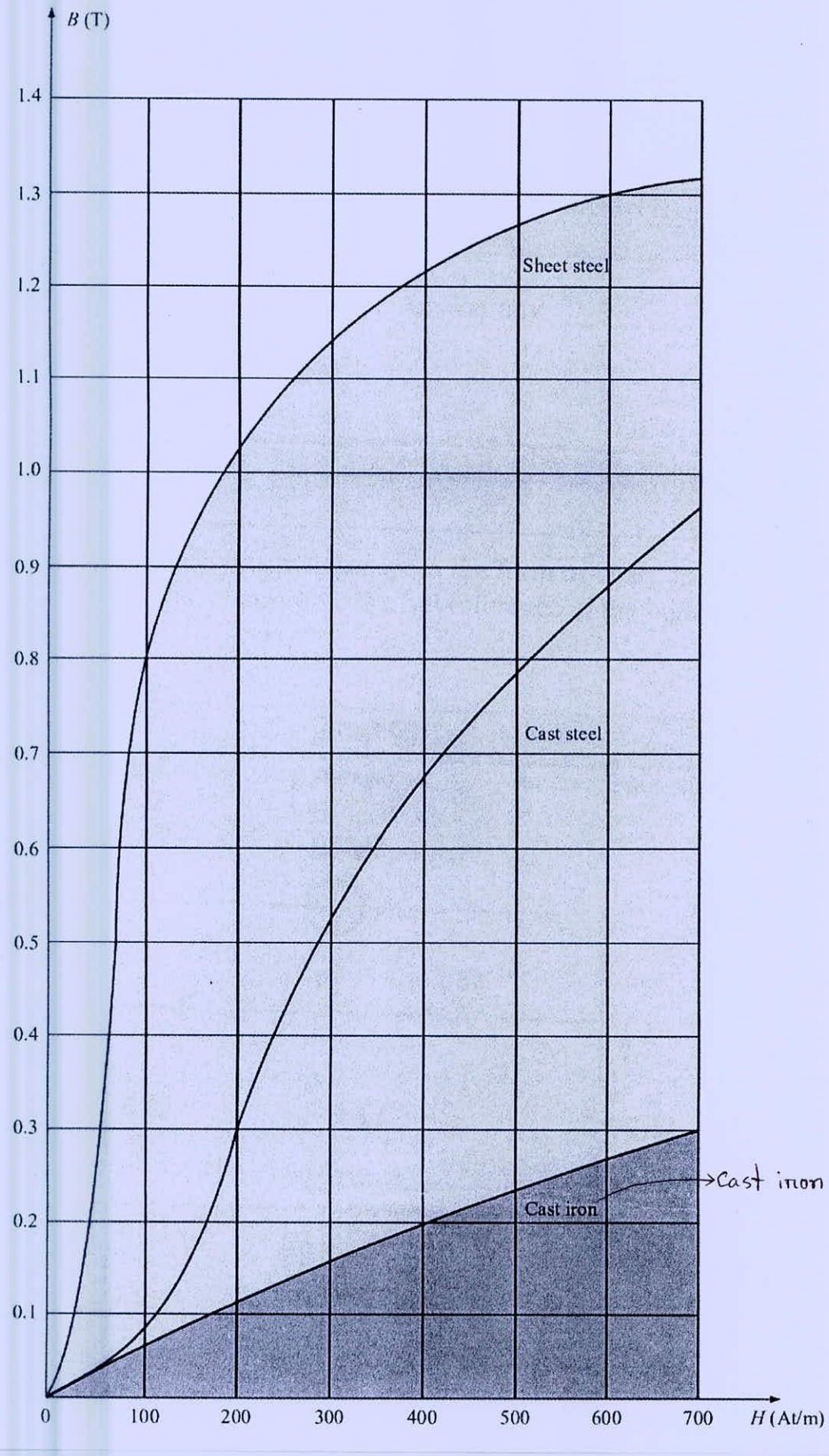


Fig. for Q. 8(b)

B-H Curve for Q. 4(a) and Q. 4(b)



L-1/T-1/CSE **Date : 28/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **ME 165** (Basic Mechanical Engineering)

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**.

Necessary charts are attached.

1. (a) What is heating value of a fuel? Describe its types. (10)

   (b) Write short notes on: (10)

   (i) Fissile and fissionable nuclei,

   (ii) Geothermal energy.

   (c) Define internal combustion engine. Briefly discuss its classification in terms of arrangement of cylinder and ignition method. (15)

2. (a) With neat sketch, describe the operation of a four-stroke SI engine. (17)

   (b) A 200-cc single cylinder square SI engine has a compression ratio of 10. Calculate the following parameters: (18)

   (i) Clearance volume of the engine,

   (ii) The bore and stroke of the engine,

   (iii) Air standard efficiency and

   (iv) Air standard MEP if the engine takes an input of 150×10^{-6} J heat in each cycle.

3. (a) Give examples of the following psychrometric processes and show them by drawing a schematic psychrometric chart. (10)

   (i) Heating with humidification

   (ii) Cooling with humidification

   (b) A refrigerator uses R134a as working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.40 MPa and 1.4 MPa. If the mass flow rate of the refrigerant is 0.22 kg/s, determine the rate of heat removal from refrigerated space. (8)

   (c) Describe the working process of a vapor absorption refrigeration cycle. How is it advantageous over vapor compression refrigeration cycle? (17)

4. (a) Write short notes on the followings: (15)

   (i) Teach programming

   (ii) Lead-through programming

   (iii) Accuracy and repeatability of a robot

Contd P/2

ME 165/CSE

Contd ... Q. No. 4

(b) Classify grippers. Draw a schematic diagram of a common two-finger mechanical gripper. (12)

(c) In a production chain, a manipulator drills a hole in a sheet of metal that comes via conveyor. If there is a missing piece in the production chain (i.e., the next sheet of metal is placed at twice the distance it was supposed to be placed), how will the manipulator react if it is a parallel manipulator? How would it react if it was a serial one? (8)

SECTION – B

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

5. (a) Why is equilibrium of particles different from equilibrium of rigid bodies?- explain briefly with necessary example. (5)

(b) Three cables are used to tether a balloon as shown in Fig. for Q. 5(b). Determine the vertical force $\vec{P}$ exerted by the balloon at A knowing that the tension in cable AD is 481 N. (16)

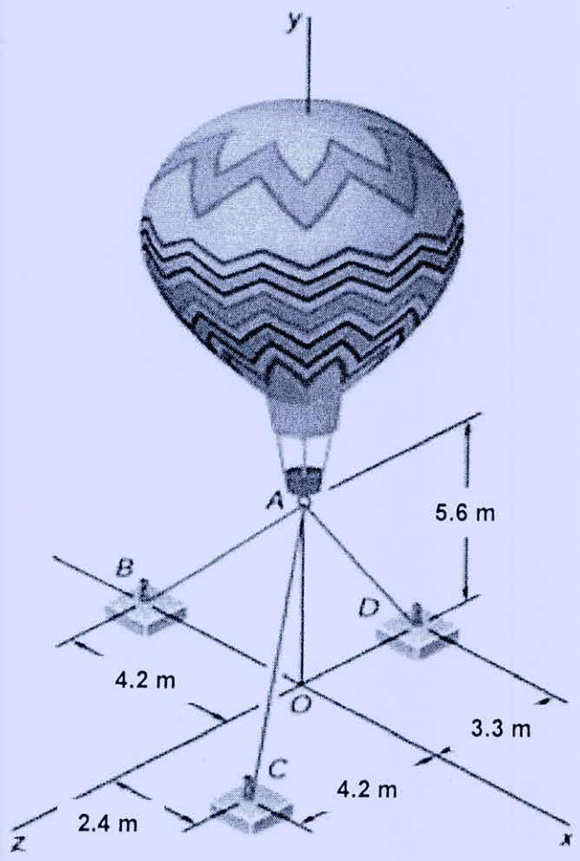


Fig. for Q. 5(b)

ME 165/CSE

Contd ... Q. No. 5

(c) Two links AB and DE are connected by a bell crank as shown in Fig. for Q. 5(c). Knowing that the tension in link AB is 720 N, determine (i) the tension in link DE, (ii) the reaction at C. (14)

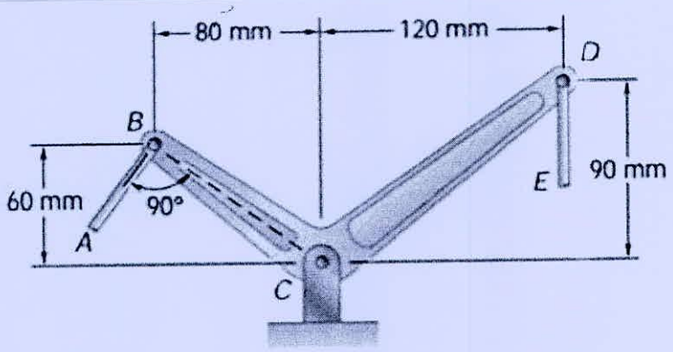


Fig. for Q. 5(c)

6. (a) A pitched flat roof truss is shown in the Fig. for Q. 6(a). Determine the force in members EG, GH and HJ. (17)

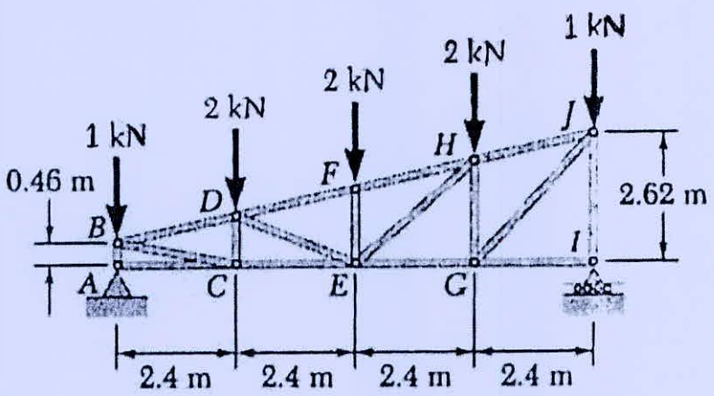


Fig. for Q. 6(a)

(b) For the frame and loading shown in Fig. for Q. 6(b), determine the components of the forces acting on member DABC at B and D. (18)

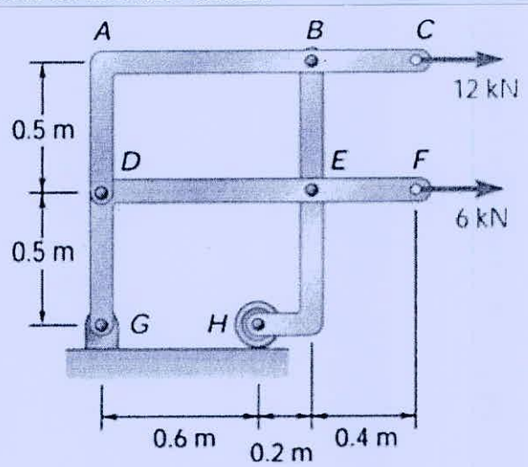


Fig. for Q. 6(b)

Contd P/4

ME 165/CSE

7. (a) At the instant shown in Fig. for Q. 7(a), slider block B is moving with a constant acceleration, and its speed is 150 mm/s. Knowing that after slider block A has moved 240 mm to the right its velocity is 60 mm/s, determine (i) the accelerations of A and B, (ii) the acceleration of portion D of the cable, (iii) the velocity and the change in position of slider block B after 4 s. (17)

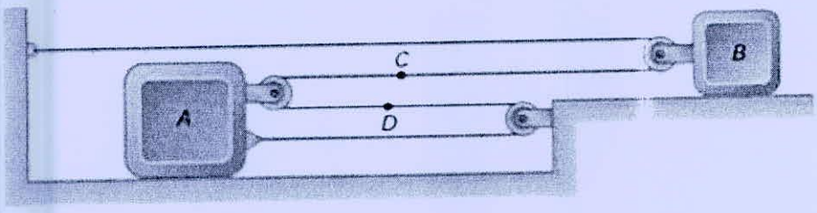


Fig. for Q. 7(a)

(b) At the instant shown in Fig. for Q. 7(b), cars A and B are traveling at velocity of 40 m/s and 30 m/s, respectively. If B is increasing its velocity by 2 m/s^2, while A maintains a constant velocity, determine the velocity and acceleration of B with respect to A. The radius of the curvature at B is $\rho = 200$ m. (18)

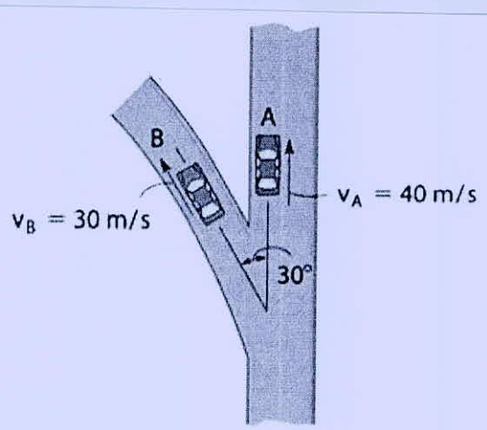


Fig. for Q. 7(b)

8. (a) Block B of mass 10-kg rests, as shown in Fig. for Q. 8(a), on the upper surface of a 22-kg wedge A. Knowing that the system is released from rest and neglecting friction, determine the acceleration of B. (18)

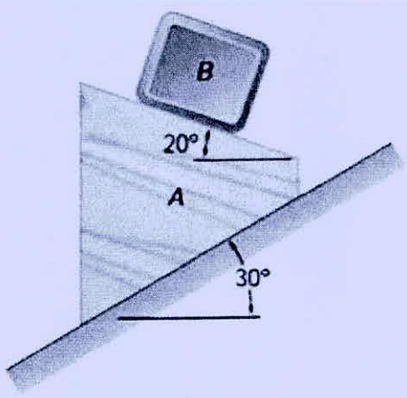


Fig. for Q. 8(a)

Contd P/5

ME 165/CSE

Contd ... Q. No. 8

(b) In Fig. for Q. 8(b), the arm is rotating at a rate of $\dot{\theta}$ = 4 rad/s when $\ddot{\theta}$ = 3 rad/s^2 and θ = 180°. Determine the force it must exert on 0.5-kg smooth cylinder if it is confined to move along the slotted path. Note that motion occurs in the horizontal plane. (17)

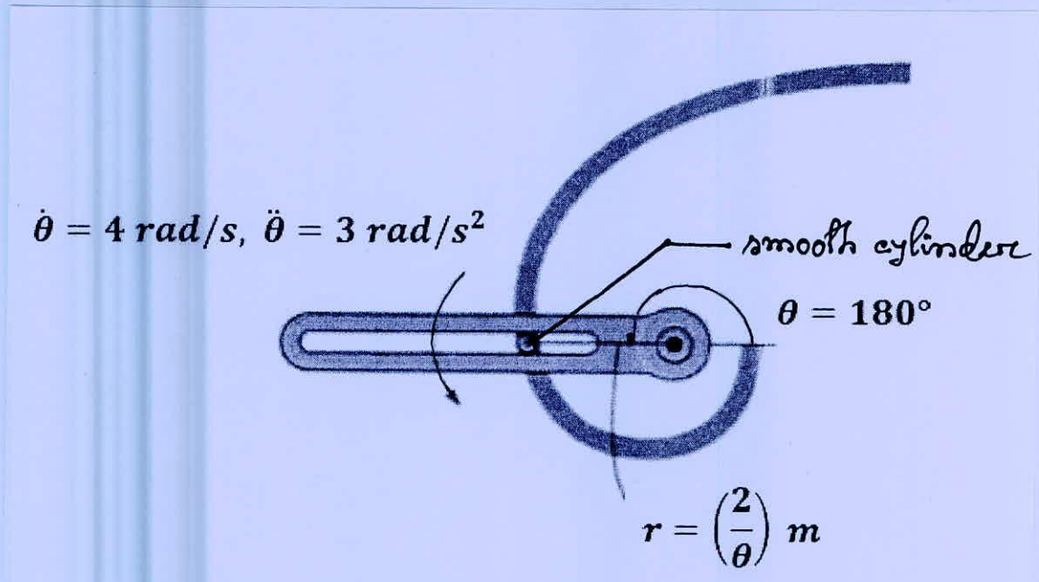


Fig. for Q. 8(b)

ME 165

Saturated refrigerant-134a—Pressure table

		Specific volume, m^3/kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg·K		
Press., P kPa	Sat. temp., T_{sat} °C	Sat. liquid, v_f	Sat. vapor, v_g	Sat. liquid, u_f	Evap., u_{fg}	Sat. vapor, u_g	Sat. liquid, h_f	Evap., h_{fg}	Sat. vapor, h_g	Sat. liquid, s_f	Evap., s_{fg}	Sat. vapor, s_g
60	−36.95	0.0007097	0.31108	3.795	205.34	209.13	3.837	223.96	227.80	0.01633	0.94812	0.96445
70	−33.87	0.0007143	0.26921	7.672	203.23	210.90	7.722	222.02	229.74	0.03264	0.92783	0.96047
80	−31.13	0.0007184	0.23749	11.14	201.33	212.48	11.20	220.27	231.47	0.04707	0.91009	0.95716
90	−28.65	0.0007222	0.21261	14.30	199.60	213.90	14.36	218.67	233.04	0.06003	0.89431	0.95434
100	−26.37	0.0007258	0.19255	17.19	198.01	215.21	17.27	217.19	234.46	0.07182	0.88008	0.95191
120	−22.32	0.0007323	0.16216	22.38	195.15	217.53	22.47	214.52	236.99	0.09269	0.85520	0.94789
140	−18.77	0.0007381	0.14020	26.96	192.60	219.56	27.06	212.13	239.19	0.11080	0.83387	0.94467
160	−15.60	0.0007435	0.12355	31.06	190.31	221.37	31.18	209.96	241.14	0.12686	0.81517	0.94202
180	−12.73	0.0007485	0.11049	34.81	188.20	223.01	34.94	207.95	242.90	0.14131	0.79848	0.93979
200	−10.09	0.0007532	0.099951	38.26	186.25	224.51	38.41	206.09	244.50	0.15449	0.78339	0.93788
240	−5.38	0.0007618	0.083983	44.46	182.71	227.17	44.64	202.68	247.32	0.17786	0.75689	0.93475
280	−1.25	0.0007697	0.072434	49.95	179.54	229.49	50.16	199.61	249.77	0.19822	0.73406	0.93228
320	2.46	0.0007771	0.063681	54.90	176.65	231.55	55.14	196.78	251.93	0.21631	0.71395	0.93026
360	5.82	0.0007840	0.056809	59.42	173.99	233.41	59.70	194.15	253.86	0.23265	0.69591	0.92856
400	8.91	0.0007905	0.051266	63.61	171.49	235.10	63.92	191.68	255.61	0.24757	0.67954	0.92711
450	12.46	0.0007983	0.045677	68.44	168.58	237.03	68.80	188.78	257.58	0.26462	0.66093	0.92555
500	15.71	0.0008058	0.041168	72.92	165.86	238.77	73.32	186.04	259.36	0.28021	0.64399	0.92420
550	18.73	0.0008129	0.037452	77.09	163.29	240.38	77.54	183.44	260.98	0.29460	0.62842	0.92302
600	21.55	0.0008198	0.034335	81.01	160.84	241.86	81.50	180.95	262.46	0.30799	0.61398	0.92196
650	24.20	0.0008265	0.031680	84.72	158.51	243.23	85.26	178.56	263.82	0.32052	0.60048	0.92100
700	26.69	0.0008331	0.029392	88.24	156.27	244.51	88.82	176.26	265.08	0.33232	0.58780	0.92012
750	29.06	0.0008395	0.027398	91.59	154.11	245.70	92.22	174.03	266.25	0.34348	0.57582	0.91930
800	31.31	0.0008457	0.025645	94.80	152.02	246.82	95.48	171.86	267.34	0.35408	0.56445	0.91853
850	33.45	0.0008519	0.024091	97.88	150.00	247.88	98.61	169.75	268.36	0.36417	0.55362	0.91779
900	35.51	0.0008580	0.022703	100.84	148.03	248.88	101.62	167.69	269.31	0.37383	0.54326	0.91709
950	37.48	0.0008640	0.021456	103.70	146.11	249.82	104.52	165.68	270.20	0.38307	0.53333	0.91641
1000	39.37	0.0008700	0.020329	106.47	144.24	250.71	107.34	163.70	271.04	0.39196	0.52378	0.91574
1200	46.29	0.0008935	0.016728	116.72	137.12	253.84	117.79	156.12	273.92	0.42449	0.48870	0.91320
1400	52.40	0.0009167	0.014119	125.96	130.44	256.40	127.25	148.92	276.17	0.45325	0.45742	0.91067
1600	57.88	0.0009400	0.012134	134.45	124.05	258.50	135.96	141.96	277.92	0.47921	0.42881	0.90802
1800	62.87	0.0009639	0.010568	142.36	117.85	260.21	144.09	135.14	279.23	0.50304	0.40213	0.90517
2000	67.45	0.0009887	0.009297	149.81	111.75	261.56	151.78	128.36	280.15	0.52519	0.37684	0.90204
2500	77.54	0.0010567	0.006941	167.02	96.47	263.49	169.66	111.18	280.84	0.57542	0.31701	0.89243
3000	86.16	0.0011410	0.005272	183.09	80.17	263.26	186.51	92.57	279.08	0.62133	0.25759	0.87893

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **MATH 145** (Differential Calculus, Integral Calculus and Co-ordinate Geometry)

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.

1. (a) Sketch the graph of the function $f(x)=\begin{cases}1-x^2 & \text{for } x<0\\ 1 & \text{for } 0\le x<1\\ \frac{1}{x} & \text{for } x>1\end{cases}$ **(25)**

and discuss continuity and differentiability of $f(x)$ at $x = 0$ and at $x = 1$.

(b) Test whether the limit $\lim\limits_{x\to\frac{\pi}{2}}\dfrac{e^{\tan x}-1}{e^{\tan x}+1}$ exists. **(10)**

If exist find the value of the limit.

2. (a) If $y=e^{a\sin^{-1}x}$ then show that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-(n^2+a^2)y_n=0$ and find the value of y_n at $x = 0$. **(20)**

(b) If normal to the curve $x^{2/3}+y^{2/3}=a^{2/3}$ makes an angle ϕ with the axis of x, show that its equation is $y\cos\phi - x\sin\phi = a\cos 2\phi$. **(15)**

3. (a) (i) State and prove Role's theorem. (ii) Find the two x-intercepts of the function $f(x)=x^2-5x+4$ and confirm that $f'(c)=0$ at some point c between those intercepts. Sketch the graph. **(17)**

(b) If $u=\tan^{-1}\dfrac{x^3-y^3}{x+y}$; then show that $x\dfrac{\partial u}{\partial x}+y\dfrac{\partial u}{\partial y}=\sin 2u$ and evaluate $x^2u_{xx}+2xyu_{xy}+y^2u_{yy}$. **(18)**

4. (a) For the function $f(x)=x^4-8x^3+22x^2-24x+5$ discuss maximum and minimum and concavity then sketch the graph of $f(x)$. **(15)**

(b) Evaluate $\displaystyle\int_0^{\pi/2}\frac{x\,dx}{\sin x+\cos x}$. **(10)**

(c) Find the area under the parabola $f(x)=9-x^2$ over the interval [0, 3] using summation of series considering the values of $f(x)$ at the midpoint of each subinterval. **(10)**

Contd P/2

MATH 145/CSE

SECTION – B

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

5. (a) Prove that $\int_0^1 \frac{x^{m-1}(1-x)^{n-1}}{(a+x)^{n+m}}\,dx = \frac{\Gamma m\,\Gamma n}{a^n(a+1)^m\,\Gamma(m+n)}$. **(11)**

(b) Evaluate $\int_0^\infty \frac{dx}{\sqrt{(1-x^2)(1-k^2x^2)}}$, $k^2 < 1$. **(12)**

(c) Find the arc length of the curve $r = \left(sin\frac{\theta}{4}\right)^4$ for $\theta = 0$ to π. **(12)**

6. (a) Calculate the area of the inner loop of the curve $r = b(-1+2\cos\theta)$. **(11)**

(b) Find the surface area of the solid generated by revolving the portion of the catenary $y = \frac{a}{2}\left(e^{\frac{x}{a}} - e^{-\frac{x}{a}}\right)$ between $x = 0$ to a about OY. **(12)**

(c) Using spherical co-ordinate system find the volume of the region common to both the sphere $x^2 + y^2 + z^2 = 4$ and the cylinder $x^2 + y^2 = 1$. **(12)**

7. (a) By transforming to parallel axes through a properly chosen point (h, k), prove that the equation $3x^2 - 5xy + y^2 + 7x + 5y = 23$ can be reduced to one containing only terms of the second degree. **(11)**

(b) Find the point of intersection of the pair of straight lines $10x^2 - 13xy + 4y^2 + 13x - 14y = 30$. Hence compute the area of triangle formed by these lines and the x-axis. **(12)**

(c) Find the equation of the circle passing through the points of intersection of the circles $x^2 + y^2 = 2ax$ and $x^2 + y^2 = 2by$ and having its center on the line $\frac{x}{a} - \frac{y}{b} = 2$. **(12)**

8. (a) Find the equation of the directrix and the axis of the parabola $(\tau x + \mu y)^2 = 2\rho x$. Also locate the focus. **(11)**

(b) Find the product of the semi-axes of the ellipse $x^2 - xy + 2y^2 - 2x - 6y = -7$. Also, find the equation of its axes. **(12)**

(c) Find the asymptotes of the hyperbola $x^2 - y^2 + 3x - 7y = 3$. **(12)**

L-I/T-I/CSE **Date : 25/05/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-I/T-I B. Sc. Engineering Examinations 2020-2021

Sub : **PHY 109** (Heat and Thermodynamics, Electricity and Magnetism, Waves and Oscillations and Mechanics)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Assume reasonable values for missing data, if any. Symbols carry their usual meanings.

SECTION – A

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

1. (a) Derive an expression for the potential energy of an electric dipole placed in a uniform external electric field. Draw the corresponding energy graph and give a very brief explanation. **(14)**

   (b) Prove that the electric field intensity due to an electric dipole at a point on the axial line is double the electric field intensity at a point on the equatorial line. Also, find out the direction of electric field intensity with respect to the direction of the dipole moment in both cases. **(20⅔)**

   (c) A uniformly charged conducting sphere of 160 *cm* in diameter has a surface charge density of 7.6 $\mu C/m^2$. (i) Find the net charge on the sphere (ii) What is the total electric flux leaving the surface of the sphere? **(12)**

2. (a) State and explain Faraday's law and Lenz's law for electromagnetic induction. **(12)**

   (b) A circuit contains an inductance L and a resistance R placed in series with a battery of emf ε. Obtain expressions for the growth and decay of current in the circuit. What is the inductive time constant of the circuit? **(22⅔)**

   (c) The time constant of an inductance coil is 2.2 *ms*. If resistance of 90 *ohms* is added in series, the time constant reduces to 0.75 *ms*. Find the inductance and resistance of the coil. **(12)**

3. (a) From the Maxwell-Boltzmann Distribution, $f(c)=4\pi\left(\frac{m}{2\pi kT}\right)^{\frac{3}{2}}c^2e^{\frac{mc^2}{2kT}}$ obtain expressions for average velocity, root mean square velocity and most probable velocity. Evaluate the ratio of these velocities. **(38⅔)**

   (b) The mean free path of molecules of a certain gas at pressure P and temperature T is 2×10^{-6} *cm*. Find the mean free path under the following conditions: **(8)**

   (i) pressure P $\times10^{-6}$ *cm* and temperature T.

   (ii) pressure $\frac{P}{2}$ and temperature $2T$.

Contd P/2

PHY 109

4. (a) Given Van der Waal's equation of state $\left(P+\frac{a}{V^2}\right)(V-b)=RT$, find critical volume. V_C critical temperature, T_c and critical pressure, P_c in terms of a and b. Show that $\frac{RT_c}{P_cV_c}=2.67$. **(26⅔)**

(b) Using appropriate Maxwell's thermodynamic relations, deduce that for a Van der Waal's gas $C_P-C_V=R\left(1+\frac{2a}{VRT}\right)$. The terms have their usual meaning. **(20)**

SECTION – B

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

5. (a) Define effective mass of a spring mass system. If a spring of mass m be clamed vertically at a point and loaded with a mass m_0 at the other end, then find out the expression for effective mass of the spring mass system. **(4⅔+20)**

(b) Explain how to determine the effective mass of the spring mass system graphically. **(10)**

(c) A block of mass m moving horizontally at speed v collides with a spring of non-linear restoring force, $F = -k_1x - k_1x^3$ on a frictionless surface, where the symbols have their usual meaning. Find the maximum compression, x, of the spring. **(12)**

6. (a) Define Lissajous figures. Find out the general equation for the composition of two simple harmonic motions acting on a body at right angle to each other having frequency ratio 2:1. **(4⅔+20)**

(b) Explain how to determine the unknown frequency using Lissajous figures. **(4+6)**

(c) Two independent simple harmonic motions having displacement $x = 3$ and $y = 4\sin(\omega t+\pi/2)$ acting on a particle simultaneously, where symbols indicate their usual meaning. Illustrate the resultant motion of that particle using the graphical method. **(6+6)**

7. (a) State Heisenberg's Uncertainty principle. In case of two matter-waves that superimpose to each other at any instant, show that, $\Delta x.\Delta p \geq \frac{h}{2\pi}$ **(4⅔+20)**

where, the symbols have their usual meaning.

(b) What is Hermitian Operator? Show that eigenvalues of a Hermitian operator is real. **(4+6)**

(c) Using commutation relation on wavefunction ψ show that, **(6+6)**

$$(i)\ \left[\hat{l}_x, \hat{y}\right] = i.\hbar\hat{z}$$

$$(ii)\ \left[\hat{z}, \hat{p}_y\right] = 0$$

where, the symbols have their usual meaning.

Contd P/3

PHY 109

8. (a) Consider a particle is moving in one dimension whose wavefunction can be expressed by,

$\Psi(x,t) = Ae^{i(kx-\omega t)}$

where, A is a constant quantity. If k and ω denote corresponding wave number and angular frequency, then obtain **(4⅔ +20)**

(i) Quantum mechanical linear momentum operator $(\hat{p})$

(ii) Quantum mechanical angular momentum operators $(\hat{l}_x, \hat{l}_y, \hat{l}_z)$

In the steady state condition, obtain time independent Schrödinger equation.

(b) Consider a particle of mass m is bouncing back and forth inside a box along x direction. The box is supposed to have insurmountable walls of potential at $x = 0$ and at $x = L$. The boundary conditions for the potential energy V of the particle are given below. **(7+7+8)**

$$V = o \quad for \quad 0 < x < L$$
$$V = \infty \quad for \quad x \leq 0$$
$$V = \infty \quad for \quad x \geq L$$

(i) Obtain the expression of energy of that particle.

(ii) Obtain the normalized wave function.

Show that, the expectation value of the linear momentum of that particle is 0.
