L-2/T-1/IPE **Date : 17/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

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

Full Marks: 280 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**.

1. (a) A cube of side 'a' is acted upon by a force $\overline{P}$ as shown in fig. for Q. No. 1(a). Determine the moment of $\overline{P}$. **(26⅔)**

   (i) about A,

   (ii) about the edge AB and

   (iii) determine the perpendicular distance between AG and FC.

   (b) The uniform beam has a mass of 50 kg per meter of length. Compute the reaction at the support O. The forces/loads shown in fig. for Q. No. 1(b) lie in vertical plane. **(20)**

2. (a) The horizontal x-axis is drawn through the centroid C of the area shown in fig. for Q. No. 2(a), and it divides the area into two component areas A_1 and A_2. Determine the first moment of each component area with respect to the x-axis. **(20)**

   (b) Determine the volume and total surface area of the body shown in Fig. for Q. No. 2(b). **(26⅔)**

3. (a) Two slender rods of negligible weight are pin-connected at C and attached to blocks A and B, each of weight W. Knowing that $\theta = 80^\circ$ and that the coefficient of static friction between the blocks and the horizontal surface is 0.30, determine the largest value of P for which equilibrium is maintained for the fig. shown in fig. for Q. No. 3(a). **(23⅓)**

   (b) The pulley shown in fig. for Q. No. 3(b), has a radius of 50 mm. Determine the components of the reactions at B and E. **(23⅓)**

4. (a) Determine the mass moment of inertia and radii of gyration of the steel machine element as shown in fig. for Q. No. 4(a) with respect to the x axis. The density of steel is 7850 kg/m^3. **(30)**

   (b) A satellite is launched in a direction parallel to the surface of the earth with a velocity of 18,820 mi/h from an altitude of 240 mi as shown in fig. for Q. No. 4(b). Determine the velocity of the satellite as it reaches its maximum altitude of 2340 mi. The radius of the earth is 3960 mi. **(16⅔)**

Contd P/2

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SECTION – B

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

5. (a) A roller coaster starts from rest at *A*, rolls down the track to *B* as shown in fig 5(a), passes a circular loop of 12 m diameter, and moves up and down past point *E*. Knowing that *h*= 20 m and assuming no energy loss due to friction, determine (i) the force exerted by his seat on a 70 kg rider at B and *D*, (ii) the minimum value of the radius of curvature at *E* if the roller coaster is not to leave the track at that point. **(26⅔)**

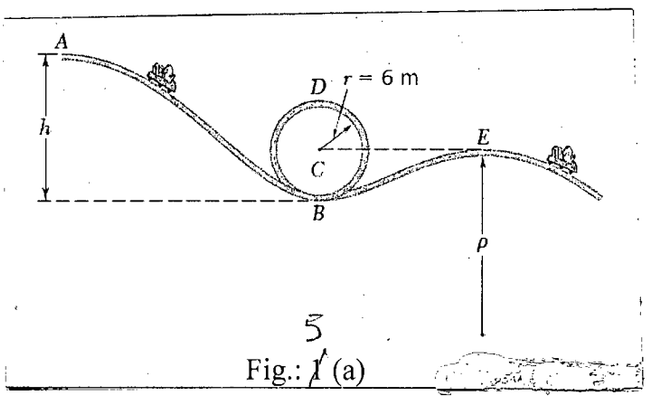

Fig.: 5 (a)

(b) Ball *B* is hanging from an inextensible cord *BC* as in Fig. 5(b). An identical ball *A* is released from rest when it is just touching the cord and acquires a velocity v_0 before striking ball *B*. Assuming perfectly elastic impact (e = 1) and no friction, determine the velocity of each ball immediately after impact. **(20)**

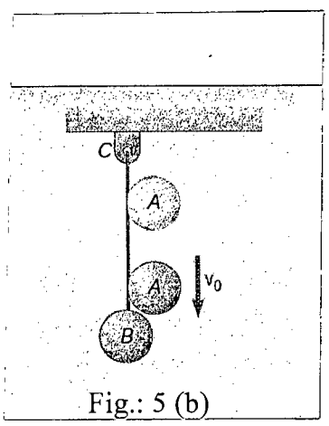

Fig.: 5 (b)

6. (a) In a link work, as shown in Fig. 6(a), the crank *AB* rotates anti-clockwise about *A* at a uniform speed of 150 rpm. The level DC oscillates about the fixed point *D*, being connected to *AB* by the connecting link *BC*. The block *F* moves in horizontal guides being driven by the link *EF*. The dimensions of the various links are: **(26⅔)**

AB = 150 mm; *BC* = 450 mm; CE = 300 mm; *DE* = 150 mm; *EF* = 350 mm.

Find, for the given configuration, (i) Velocity of slider *F*, (ii) Angular velocity of *DC*, and (iii) Rubbing speed at pin *C* which is 50 mm in diameter.

Contd P/3

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Contd... Q. No. 6

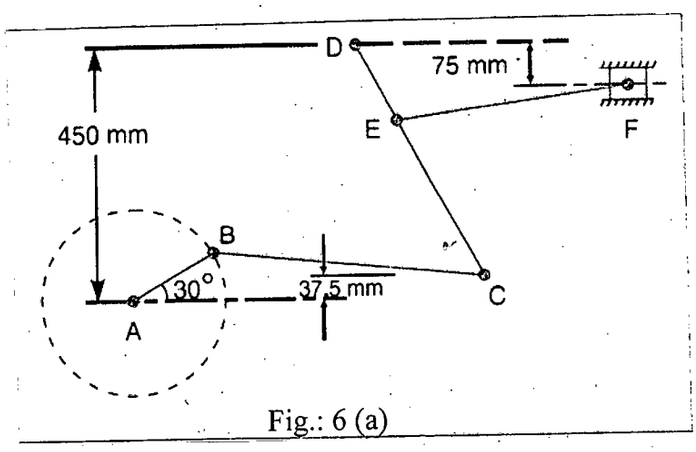

Fig.: 6 (a)

(b) A shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4 m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt for an open belt drive. [Take $\mu = 0.3$] **(20)**

7. (a) A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg and 12 kg at radii 50 mm, 60 mm, 70 mm and 60 mm respectively. The 2nd, 3rd and 4th masses revolve in planes 80 mm, 160 mm and 280 mm respectively measured from the plane of the first mass and are located at 60°, 135° and 270° angle respectively measured clockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 50 mm radii and revolving in planes mid-way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine, graphically or otherwise, the magnitudes of the masses and their respective angular positions. **(26⅔)**

(b) In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 rpm clockwise. **(20)**

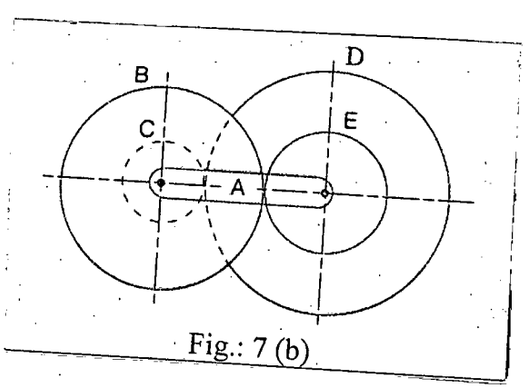

Fig.: 7 (b)

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8. A cam is required to raise a valve with simple harmonic motion through 50 mm in 1/3 of a revolution, keep it fully raised through 1/12 revolution and to lower it with simple harmonic motion in 1/6 revolution. The valve remains closed during the rest of the revolution. The diameter of the roller follower is 20 mm and the minimum radius of the cam is 25 mm. The diameter of the camshaft is 25 mm. The axis of the valve rod passes through the axis of the camshaft. The camshaft rotates clockwise at a uniform speed of 100 rpm; draw the (i) displacement, velocity and acceleration diagrams and (ii) profile of the cam. **(46⅔)**

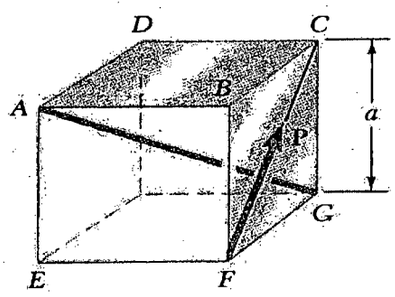


Fig. for Que. No. 1(a)

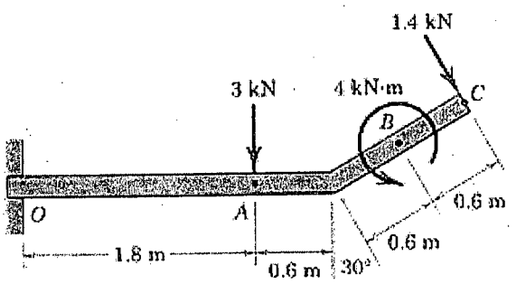


Fig. for Que. No. 1(b)

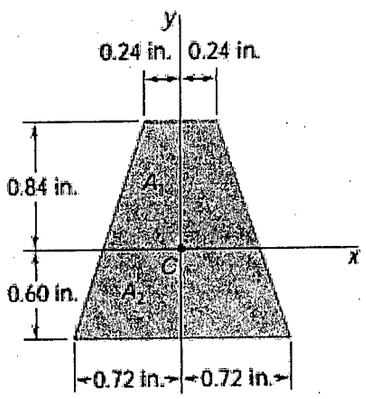


Fig. for Que. No. 2(a)

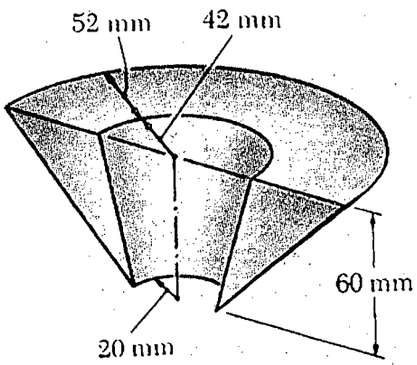


Fig. for Que. No. 2(b)

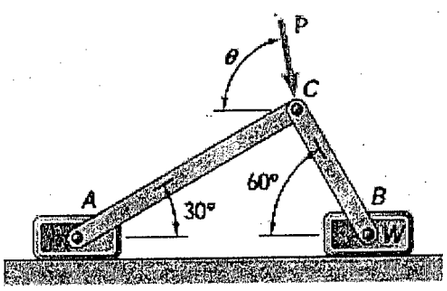


Fig. for Que. No. 3(a)

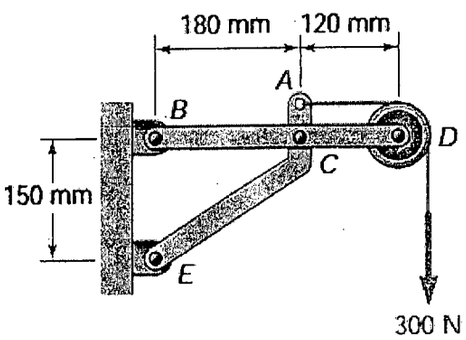


Fig. for Que. No. 3(b)

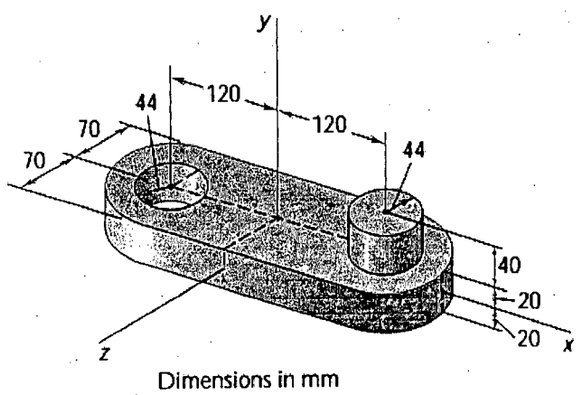


Fig. for Que. No. 4(a)

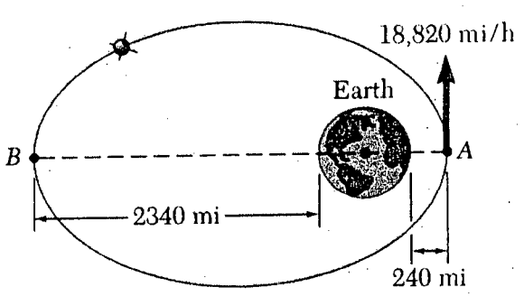


Fig. for Que. No. 4(b)

L-2/T-1/IPE **Date : 23/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

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

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**.

1. (a) Sketch a suitable diagram illustrating the structure of a computer system according to Von Neumann Computer Architecture. **(7)**

   (b) What is the advantage of using 2's complement instead of 1's complement in subtraction? Perform the subtraction $65_{10} - 15_{10}$ using 2's complement method. **(3+9=12)**

   (c) State which of the following operations are legal and which are illegal. **(4×2=8)**

   (i) to add a pointer and an integer.
   (ii) to add a pointer and a floating point data.
   (iii) to add two pointers of the same type.
   (iv) to multiply two pointers of the same type.

   (d) Show the general form to define an enumeration. State two main uses of an enumeration. **(4+2×2=8)**

2. (a) Based on linear search algorithm, write a function linear-search (int x[], int size, int key) that takes as argument an array of integer x, the number of elements in the array size and an integer key and returns the index of x if key is found in x and –1 otherwise. **(9)**

   (b) M is an upper triangular 4×4 matrix, where **(18)**

$$M[i][j] = \begin{cases} 0 & for \ \ i > j \\ 1 & for \ \ i \le j \end{cases}$$

   N is a lower triangular 4×4 matrix, where

$$N[i][j] = \begin{cases} 1 & for \ \ i \ge j \\ 0 & for \ \ i < j \end{cases}$$

   Write a C program to initialize M and N appropriately, then add M and N and show output (result of addition) in matrix format.

   (c) Convert the following binary number into octal and hexadecimal: 110011010100.1111101011 **(4+4=8)**

3. (a) Write a C program that takes as input an unsigned integer and shows its binary representation as output. Your program must use a recursive function base-convert which prints the binary representation of its argument. The function prototype is as follows: **(10)**

   void base-convert (unsigned x)

Sample Input	Output
25	11001

Contd P/2

CSE 295

Contd... Q. No. 3

(b) Write the output of the following C program. **(9)**

```
# include<stdio.h>
void f(int x, int y int *z)
{
    *z = 5*x;
    x = 5*y + 2;
    y = 4*x + 3;
    x = 4**z + 3*y;
}
    void main ()
{
    int a = 5, b = 3, c = 55;
    f (a, b, &c);
    printf ("%d %d %d", a,b,c);
}
```

(c) "Pointer subtraction can be used to find the length of a string" — demonstrate this by writing a function strlen(char *s) that takes as argument a string *s* and returns the length of the string. **(8½)**

(d) Write the output of the following C program. **(7½)**

```
# include <stdio.h>
void fn()
{
    int i, *pa;
    int x[] = {1, 5, 10, 15, 20};
    pa = x;
    for (i = 0; i < 5; i++)
    {
        *pa * = 2;
        (*pa) ++;
        printf ("%d  ", *pa++);
    }
}
void main ()
{
    fn();
}
```

Contd P/3

CSE 295

4. (a) Writ a C program that uses the union of a structure containing bit-fields and a character to display the binary representation of the character typed at the keyboard. **(14)**

Sample Input	Output
A	01000001

(b) Using ternary operator write a macro ISDIGTT(CH) that returns 1 if ch is a digit and 0 otherwise. **(8)**

(c) What problem might arise if one does not use parenthesis appropriately in the expression of a parameterized macro? Explain with a suitable example. **(8)**

(d) Show how to make Dl a new name for double and declare a variable named depth using Dl. **(3+2=5)**

SECTION – B

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

5. (a) What will be the output of the following code segment? **(6)**

```
include<stdio.h>
int main(){
    int x,n;
    n=5;
    x=n++;
    printf("The first value of x is: %d",x);
    x=++n;
    printf("The second value of x is: %d",x);
    return 0;
}
```

(b) Suppose x is an integer and y is a floating point variable. What will be the data type of the expression x+y? **(4)**

(c) Mr. Arif wants to take loan from bank. The bank has given the following 2 conditions. **(13)**

(i) A customer can take a fixed amount of loan ranging from 10,000 to 50,000 Tk.

(ii) A customer must repay the loan within 20 installments.

Now Mr. Arif is planning to take Tk. x and wants to repay the loan in y installments. Now write a C program to calculate installment amount. Enter the inputs x and y into the program using keyboard. Your program must notify the user immediately if any input violates any of the given two rules.

[Installment amount = x/y]

(d) The digit sum of a given integer is the sum of all its digits (e.g.: the digit sum of 125 is calculated as 1+2+5=8). Now draw a flowchart showing the steps of calculating digit sum of an integer. **(12)**

Contd P/4

CSE 295

6. (a) How does do-while loop differ from while loop? **(7)**

(b) A perfect number is a positive integer that is equal to the sum of its proper positive divisors, that is, the sum of its positive divisors excluding the number itself. The number 6 is called a perfect number because 6 = 1 + 2 + 3, the sum of all its proper divisors, (i.e. divisors less than 6). Another example of a perfect number is 28, because $28 = 1+2+4+7+14$, and 1, 2, 4, 7 and 14 are the divisors of 28 less than 28. Now write a function that will take a positive integer as input and determine whether the input is a perfect number or not. Return 1 if the input is a perfect number, otherwise return 0. **(13)**

(c) Complete the following code segment to find out the largest number and summation of the largest two numbers of the array. Variable x will contain the largest number and y will contain the summation of largest two numbers. You can add variables if necessary. **(5+10=15)**

```
#include<stdio.h>
int main(){
    int a[6]={3,2,6,8,1,2};
    int x,y;
    //insert your code here

    printf("%d",x);
    printf("%d",y);
    return 0;
}
```

7. (a) (i) Write a function strappend(s,t) that copies the string t to the end of s. **(7+8)**

(ii) Write a function strcompare(s,t) that compares the character string s and t, and returns negative, zero or positive if s is lexicographically less than, equal to or greater than t respectively.

[Do not use library functions to solve the above problems.]

(b) Write a C program using nested for loop to generate the following pattern. You have to take input of variable n from keyboard. **(10)**

Input: n=5

Output:

```
*
**
***
****
*****
****
***
**
*
```

Contd P/5

CSE 295

Contd... Q. No. 7(b)

Do not write out simple strings. Instead, develop a formula to generate the appropriate output for each line.

(c) A regular palindrome is a string of numbers or letters that is the same forward as backward. For example, the string "MADAM" is a palindrome because it is the same when the string is read from left to right as when the string is read from right to left. Write a function that will take a string as input and determine whether the string is a palindrome or not. Return 1 if the string is a palindrome, otherwise return 0. **(10)**

[Do not use any library function]

8. (a) What is structure? How does a structure differ from an array? **(5)**

(b) Write a C program that reads several different names and addresses into the computer, rearranges the names into alphabetical order, and writes out the alphabetized list. Make use of structure variables within the program. **(15)**

(c) Write a program that counts the number of bytes in a file (text or binary) and displays the result. The file name will be specified on the command line. **(15)**

L-2/T-1/IPE **Date : 31/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 271** (Electrical Machines and Electronics)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols have their usual meanings.

SECTION – A

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

1. (a) A 208 V, 45 kVA, 0.8 p.f. lagging Δ connected, 60 Hz synchronous machine has a synchronous reactance of 2.5 Ω and a negligible armature resistance. Its friction and windage losses are 1.5 kW and its core loss is 1.0 kW. Initially the shaft is supplying a 15-hp load. **(20)**

   (i) Sketch the phasor diagram of the motor indicating the values of I_A, I_L and E_A.

   (ii) Now, assume that shaft load is increased to 30 hp. Also assume that terminal voltage and p.f. remain constant. What have to be done in order to maintain these constraints?

   (b) Describe the effect of field current change on a synchronous motor with appropriate figures and phasor diagrams. **(15)**

2. (a) Derive the torque-speed equation of a shunt DC motor. Explain the effect of change of armature resistance and armature voltage on the speed of the motor from the equation. **(15)**

   (b) Why a DC motor rotates with the help of commutator and brushes when fed by a DC voltage source. **(10)**

   (c) How speed of a shunt DC motor can be controlled by changing field current. Explain this effect from torque-speed equation. When speed control of a DC motor by changing the field is chosen? Explain. **(10)**

3. (a) Derive the terminal characteristics of a series DC motor. Explain how speed will vary with the change of armature resistance from the equation. **(15)**

   (b) Write a short note on the permanent magnet DC motor. **(10)**

   (c) A 50 HP, 250 V, 1200 rpm DC shunt motor has **(10)**

$$R_A = 0.05\,\Omega$$
$$R_F = 50\,\Omega$$

   and no load speed 1200 rpm

   Find the speed of the motor when its input current is 100 A.

Contd P/2

EEE 271

4. (a) Explain the two transistor model of an SCR. Describe how an SCR can control supply power to a resistive load. **(15)**

(b) How can we measure force and strain by **(10)**

- Piezoelectric method and load cell

Explain the thermistor's resistance - temperature characteristics.

(c) What is secondary transducer? Explain resistive and inductive pressure transducers. **(10)**

SECTION – B

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

5. (a) Starting from the generation of rotating magnetic field, derive the per-phase equivalent circuit of three phase induction motor. **(20)**

(b) A 460 V, 25-hp, 60 Hz, four pole, Y-connected induction motor has the following impedances in ohm per phase referred to the stator circuit: **(15)**

$$R_1 = 0.641\,\Omega \qquad R_2 = 0.332\,\Omega$$
$$X_1 = 1.106\,\Omega \qquad X_2 = 0.464\,\Omega \qquad X_M = 26.3\,\Omega$$

Total rotational losses are 1100 W and assumed to be constant. The core loss is lumped in with rotational losses. For a rotor slip of 2.2% at rated voltage and rated frequency, find the power factor of the motor.

Also, draw the power flow diagram of a typical inductor motor.

6. (a) A 15 kVA, 8000/230 V distribution transformer has an impedance referred to primary of $80 + j300\,\Omega$. **(20)**

$$R_C = 350\,\Omega \qquad X_M = 70\,k\Omega$$

(i) If the primary voltage is 7967 V and the load impedance is $Z_L = 3.0 + j\,1.5\,\Omega$, what is the secondary voltage of the transformer? Also, what is the voltage regulation of the transformer?

(ii) If the load is disconnected and a capacitor of –j4.0Ω is connected in its place, what is the secondary voltage of the transformer? What is the voltage regulation in this case?

(b) From which side (High Tension/Low Tension) short circuit and open circuit tests of a transformer are performed and why? **(15)**

Draw the phasor diagram of transformer operating at a lagging, leading, and unity power factor.

Contd P/3

EEE 271

7. (a) A 20 kVA, 20000/480 V, 60 Hz distribution transformer is tested with following data– **(20)**

Open Circuit test (From Secondary Side)	Short Circuit Test (From Primary Side)
V_{OC} = 480 V	V_{SC} = 1130 V
I_{OC} = 1.60 A	I_{SC} = 1.00 A
P_{OC} = 305 W	P_{SC} = 260 W

Find the equivalent circuit of the transformer referred to both primary and secondary sides.

(b) How losses are incorporated in equivalent circuit of a transformer? What assumptions are made in an approximate transformer model? **(15)**

8. (a) Design the circuit using minimum number of op-amps to calculate $Z(t)$. **(15)**

$$Z(t) = \int x(t) \cdot y(t)\, dt + 7$$

where, $x(t)$ and $y(t)$ are input signals.

(b) Show a circuit consisting of diode, resistor, and op-amp that can perform exponential operation. **(10)**

(c) Provide an electronic circuit for the following input (V_{in}) and output (V_{out}) signals, **(10)**

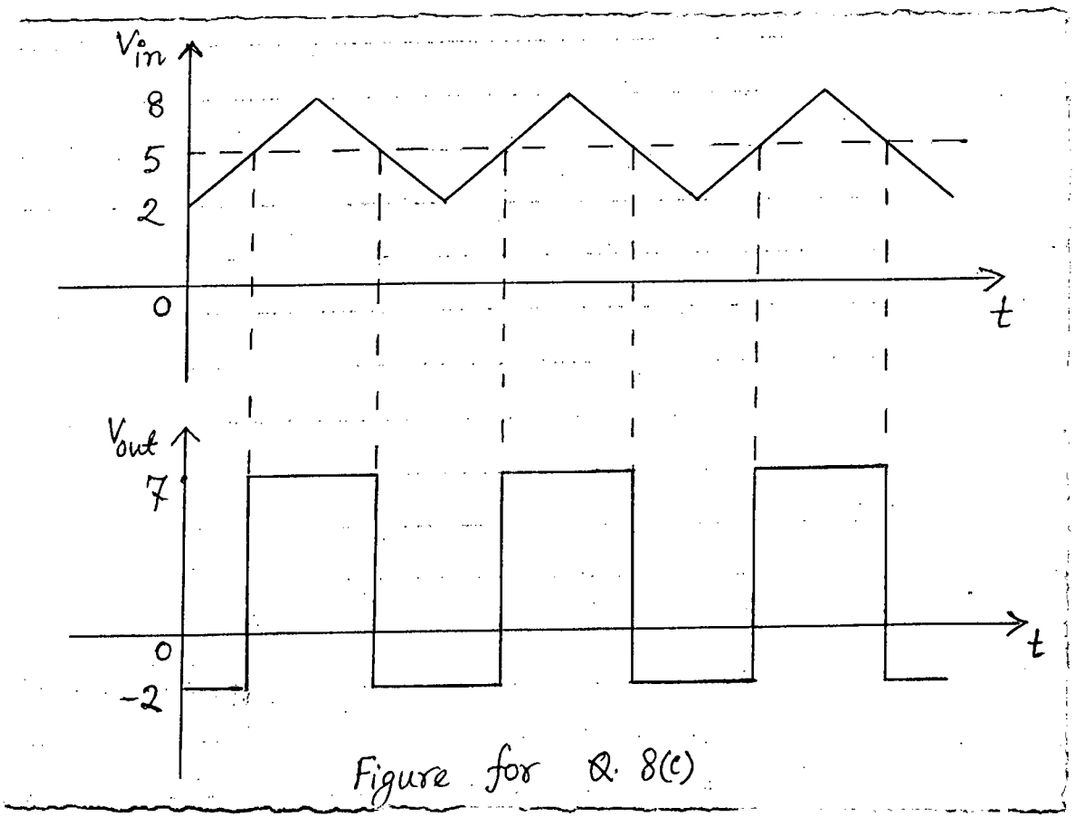


Figure for Q. 8(c)

L-2/T-1/IPE **Date : 06/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2014-2015

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Find the differential equation of all circles passing through the origin and having their centres on the x-axis. **(11)**

   (b) Solve: $(3x^2 - 2xy + 3y^2)dx = 4xydy$ **(12)**

   (c) Solve: $y(6y^2 - x - 1)dx + 2xdy = 0$ **(12)**

2. (a) A tank contains 80 gallons of pure water. A brine solution with 2 pounds of salt per gallon enters at 2 gallons per minute, and the well-stirred mixture leaves at the same rate. Find (i) the amount of salt in the tank at any time, and (ii) the time at which the brine leaving will contain 1 pound of salt per gallon. **(11)**

   (b) Solve: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x + 7x - 2$ **(12)**

   (c) Solve: $x^4\frac{d^3y}{dx^3} + 2x^3\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} + xy = 1$ **(12)**

3. Obtain a general solution in series in powers of x for the following differential equation using the method of Fröbenius: **(35)**

$$x(1-x)\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} - y = 0$$

4 (a) Prove that: $nP_n = (2n-1)xP_{n-1} - (n-1)P_{n-2}$ **(11)**

   (b) Prove that: $xJ_n' = nJ_n - xJ_{n+1}$ **(12)**

   (c) Express $\cos(x \sin \phi)$ as a series in Bessel's function. **(12)**

SECTION – B

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

5. (a) Using the definition of $J_0(t)$, Find $L\{J_0(t)\}$ where $J_0(t) = \frac{1}{\pi}\int_0^{\pi} cos(t\cos\theta)d\theta$ **(10)**

   (b) Show that $\int_0^{\infty} sin\, x^2 dx = \frac{1}{2}\sqrt{\frac{\pi}{2}}$. **(15)**

   (c) Using the convolution theorem, verify that $\int_0^t sin(u)cos(t-u)du = \frac{1}{2}t\sin t$ **(10)**

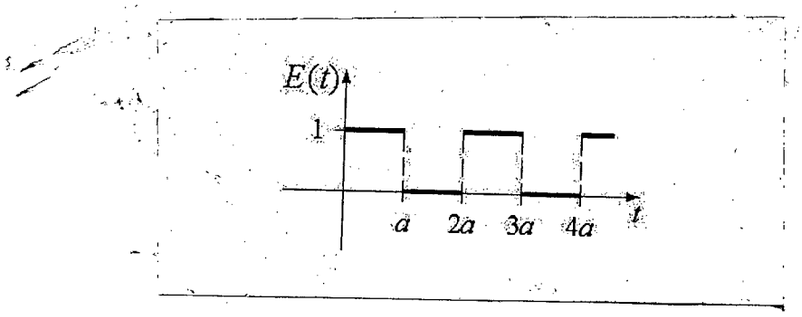
Contd P/2

MATH 291

6. (a) Using Laplace transform solve the given initial value problem **(15)**

$y'' + 4y = 1 - u(t-1),\ y(0) = 0,\ y'(0) = -1$

(b) Solve the differential equation $L\dfrac{di}{dt} + Ri(t) = E(t)$ subject to $i(0) = 0$ with $L = 1$, $R = 1$ and $|E(t)|$ is given by the following square wave function with amplitude 1 and $a = 1$ **(20)**



7. (a) Find (i) the unit tangent vector **T**, (ii) the curvature κ, (iii) the principal normal **N**, (iv) the binormal **B**, and (v) the torsion τ for the space curve

$$x = t - t^3/3,\ y = t^2,\ z = t + t^3/3$$ **(15)**

(b) Prove $\nabla \times (\varphi \mathbf{A}) = (\nabla \varphi) \times \mathbf{A} + \varphi(\nabla \times \mathbf{A})$ **(10)**

(c) If $\mathbf{v} = \boldsymbol{\omega} \times \mathbf{r}$, prove that $\boldsymbol{\omega} = \frac{1}{2}$ curl $\mathbf{v}$, where ω is a constant vector. **(10)**

8. (a) If $\mathbf{A} = (3x^2 + 6y)\boldsymbol{i} - 14yz\boldsymbol{j} + 20xz^2\boldsymbol{k}$, evaluate $\int_C \boldsymbol{A} \cdot d\boldsymbol{r}$ from (0, 0, 0) to (1, 1, 1) along the following paths *C*: **(10)**

(i) $x = t,\ y = t^2,\ z = t^3$

(ii) The straight lines from (0, 0, 0) to (1, 0, 0) then to (1, 1, 0) and then to (1, 1, 1)

(b) If $\boldsymbol{F} = 4xz\boldsymbol{i} - y^2\boldsymbol{j} + yz\boldsymbol{k}$, evaluate $\iint_S \boldsymbol{F}.\boldsymbol{n}dS$

where S is the surface of the cube bounded by $x = 0,\ x = 1,\ y = 0,\ y = 1,\ z = 0,\ z = 1$. **(10)**

(c) Verify Stokes' Theorem for the vector field $\boldsymbol{F}(x, y, z) = 2z\boldsymbol{i} + 3x\boldsymbol{j} + 5y\boldsymbol{k}$, taking to be the portion of the paraboloid $z = 4 - x^2 - y^2$ for which $z \geq 0$ with upward orientation, and *C* to be the positively oriented circle $x^2 + y^2 = 4$ that forms the boundary of S in the *xy* – plane. **(15)**
