

Con. 5764-10.

GT-7782

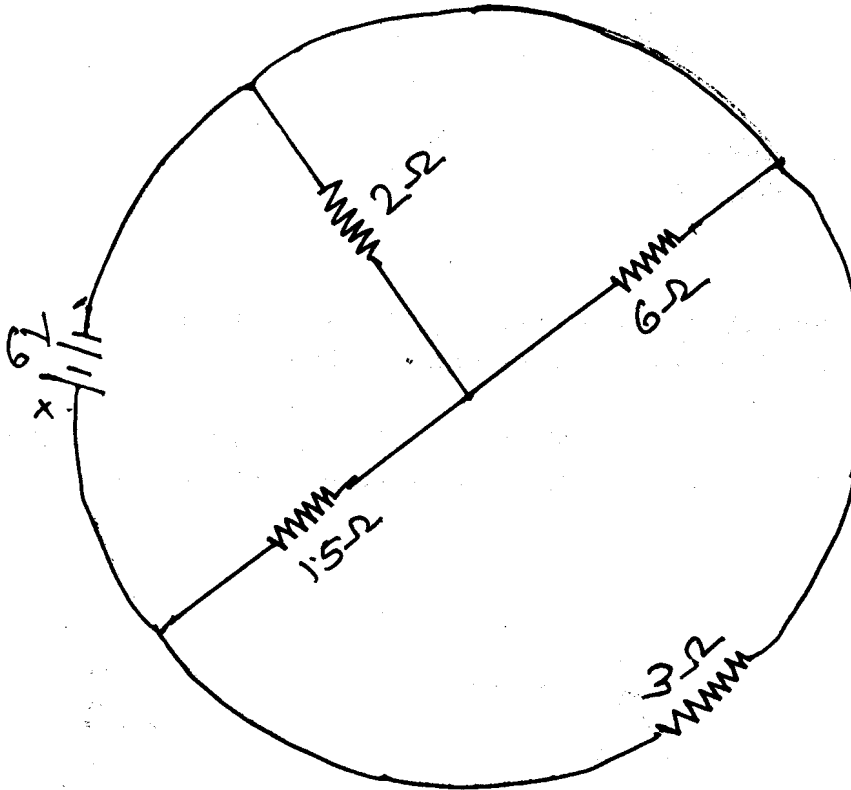
(3 Hours)

[Total Marks : 100

N.B. (1) Question No. 1 is **compulsory**.

(2) Attempt any **four** questions out of remaining **six** questions.

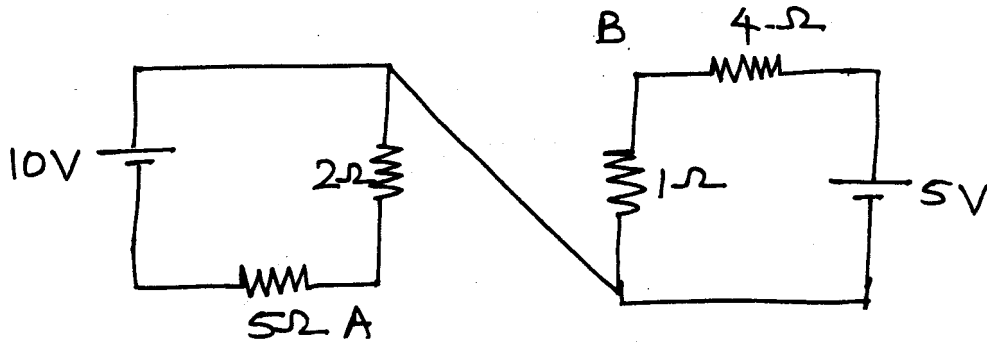
1. (a) What is the total current supplied by the battery to the circuit shown ? 5



- (b) What is back emf and state its significance wrt DC motor. 5
- (c) What are the losses in transformer ? Explain why rating of transformer in KVA and not in kW ? 5
- (d) What is power factor ? What is its significance ? State one method to improve it ? 5

2. (a) Obtain Thevenin's equivalent circuit across A and B.

8



(b) Draw experimental set-up to plot Input-Output characteristics of CE configuration of BJT and draw and explain output characteristics.

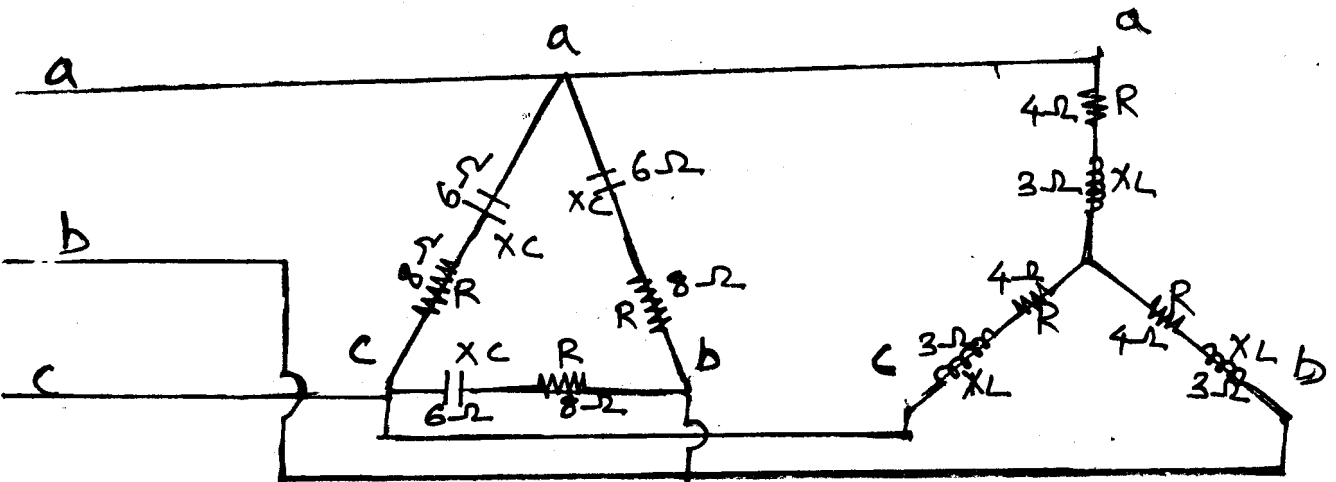
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(c) In RLC series circuit the voltage across resistor, inductor and capacitor are 10 V, 15 V and 10 V respectively. What is power factor of the circuit ?

4

3. (a)

12

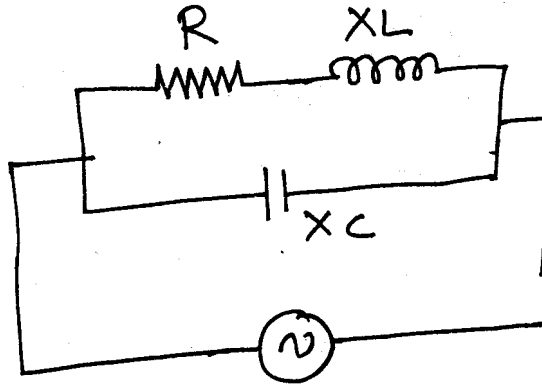


If 3- ϕ 400 V, 50 Hz is supplied to the circuit. Calculate line currents, phase currents, power factor, active power and reactive power.

(b) Explain full wave rectifier circuit using centre tap transformer. Find the expression for rms and average load current, TUF and rectifier efficiency.

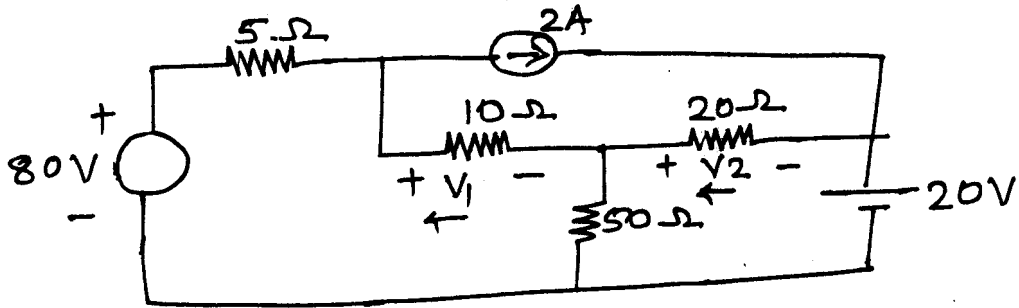
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4. (a) Develop the approximate equivalent circuit of a transformer. How it helps in deciding the Regulation of transformer. 12
- (b) Derive the condition for resonance in the circuit given below. Find equation for impedance. (Find Resonance frequency equation) 8



5. (a) A voltage of $200 \angle 25^\circ$ Volt is applied to a circuit composed of 2 parallel branches, if the branch currents are $10 \angle 45^\circ$ and $20 \angle -30^\circ$ determine the kVA, kVAR, kW in each branch. Also calculate the P. F. of the combined load. 10
- (b) Draw schematic diagram of DC shunt motor and explain its characteristics and applications. 10
6. (a) A 5 kVA 200/400 V, 50Hz, single phase transformer gave the following test results. 12
- | | | | |
|-----------------------|-------|-------|-------|
| O.C. test (L.V. side) | 200 V | 0.7 A | 60W |
| S.C. test (H.V. side) | 22 V | 16 A | 120 W |
- (i) Draw the equivalent circuit of the transformer referred to L.V. side and insert all parameter values.
- (ii) Efficiency and regulation at 0.9 P.F. (lead) if operating at rated load.
- (iii) Currents at which efficiency is maximum, also find load kVA at max η (efficiency).
- (b) A 3-phase 10 kVA load has P.F. of 0.342. The power is measured by two watt-meter method. Find the reading of each wattmeter when (i) P.F. is leading (ii) P.F. is lagging. 6
- (c) Define R.M.S. value. 2

7. (a) By using Nodal analysis find V_1 and V_2 .



- (b) Explain the production of rotating magnetic field by graphical approach.
- (c) Define phase sequence and explain its significance.



- N.B. :** (1) Question No. 1 is compulsory.
 (2) From remaining six questions attempt any four.
 (3) **Figures** to the right indicate full marks.
 (4) **All** questions carry equal marks.
 (5) At.wts : Ca=40, H=1, C=12, O=16, Mg=24, Na=23, Cl=35.5, S=32.

Q1) Attempt any five from the following. 15

- a) Explain Flash point and Fire point with its significance.
- b) What are the merits of Phase rule?
- c) Distinguish between conventional and non-conventional energy sources.
- d) Find the acid value of a used oil sample whose 7ml required 3.8ml of N/50 KOH during titration. (density of oil= 0.88). State whether the oil is suitable for lubrication or not.
- e) Explain the principle of EDTA method.
- f) Explain the following terms with their significance:
 - i) Biological oxygen demand
 - ii) Chemical oxygen demand
- g) What is Shape memory effect? Name a few shape memory alloy types.

Q2)a) Describe the method for production of bio-gas from waste. Give its advantages and composition. 6

- b) Explain polymer fracture in different types of polymer materials. 5
- c) Hardness of 4,500 liters of water was removed completely by zeolite softener. This zeolite required 30 liters of 100gm/lit of NaCl to regenerate. Calculate the hardness of water. 4

Q3) a) Write short notes on any two of the following: 6

- i) Nanomaterial-Graphite
 - ii) Liquid Crystal polymers
 - iii) Reverse Osmosis
- b) Calculate the quantity of lime and soda required for softening 50,000 liters of water containing the following salts per liter:
 Ca(HCO₃)₂=8.1mg, Mg(HCO₃)₂=7.5, CaSO₄=13.6mg, MgSO₄=12mg,
 MgCl₂=2mg, NaCl= 4.7mg.

c) Write a note on Blended oils. 4

Q4) a) Write the synthesis, properties and uses of the following:

(i) Buna-S (ii) PE

b) Discuss the application of phase rule to one component system.

c) Explain Vulcanization of rubber.

Q5) a) Explain the following types of lubrication:

i) Boundary lubrication (ii) Extreme pressure lubrication

b) What is activated sludge? Explain the method with a proper flow sheet diagram.

What are its advantages?

c) Explain the solar heating system using flat plate collector

Q6) a) Explain the following additives used for compounding of plastics:

i) Plasticizers (ii) Resins (iii) catalysts

b) Explain the hot lime soda method for softening of water with the help of a neat diagram. What are advantages and disadvantages of lime soda process?

c) Explain the effect of the following elements on alloy steels:

i) Chromium (ii) manganese (iii) Nickel (iv) Cobalt

Q7) a) Write short notes on:

i) Nano cones (ii) Application of nano materials in environmental technologies

b) 1gm of CaCO_3 was dissolved in 1 liter of distilled water, 50ml of this solution required 45ml of EDTA solution for titration. 50ml of hard water required 25ml of EDTA for titration. The same sample of water after boiling consumed 15ml of EDTA for titration. Calculate the hardness of water.

c) Explain in details the injection moulding method for fabrication of plastics

- N.B. :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions from the remaining questions.
 (3) Assume **suitable** data and symbols if **required**.
 (4) **Figures** on the **right** indicates **full marks**.

Qu.1 Attempt any five ; (15)

- a) Calculate the lattice parameter of FCC lattice with molecular weight 60.2 and density 6250 Kg/m^3 .
- b) What is the vortex state of a superconductor?
- c) The mobility of holes is $0.025 \text{ m}^2/\text{V sec}$. What would be the resistivity of p type Silicon if the Hall Coefficient of the sample is $2.25 \times 10^{-5} \text{ m}^3/\text{C}$.
- d) Draw the following.
(100), (220), [101]
- e) Name the various ways by which the sound generated in an auditorium is absorbed.
- f) What will be the young's modulus of quartz plate if 5.5 mm thick quartz plate is used to produce an ultrasonic wave of frequency 0.4999 MHz.? The density of quartz is $2.65 \times 10^3 \text{ Kg/m}^3$.
- g) How will you measure the phase angle between two a.c. signals using Lissajous figures?

Qu.2 a) What type of crystal structure does NaCl have? Explain NaCl unit cell with proper diagram. Calculate the number of atoms per unit cell, atomic radius and atomic packing fraction of NaCl unit cell. (8)

b) Show that for intrinsic semiconductor the Fermi level lies half way between conduction and valence band . Also draw the position of Fermi level for n-type semiconductor at absolute zero and at higher temperatures. (7)

Qu.3 a) What is Magnetostriction effect? Write the construction and working of Magnetostriction oscillator with proper diagram. (8)

b) A sample of a n-type Silicon has a donor density of $10^{20} / \text{m}^3$. It is used in the Hall effect experiment. If the sample of width 4.5 mm is kept in a magnetic field of (0.55T) with current density of 500 A/m^2 . Find ---i) Hall voltage developed in it , ii) Hall coefficient , iii) Hall angle if mobility of electron is $0.17 \text{ m}^2/\text{V sec}$. (7)

Qu.4 a) Calculate the wavelength of X rays reflected the face of FCC crystal with lattice constant of 2.82 nm and if the second order Bragg reflection occurs at a glancing angle of 17.167 deg. (8)

b) What do you understand by the terms critical temperature and critical magnetic field? How does the critical magnetic field vary with the temperature? "A super conductor is perfectly diamagnetic" Explain. (7)

Qu.5 a) A hall of dimension $20 \times 15 \times 10 \text{ m}^3$ has average absorption coefficient 0.1. Find the reverberation time. If a curtain cloth of 100 m^2 is suspended at the centre of the hall with coefficient of absorption 0.66. What will be the change in reverberation time. (8)

b) Draw block diagram of CRO. Describe its various parts along with their functions. (7)

Qu. 6a) What are the types of X rays? Discuss the origin of each type. (5)

b) Differentiate between type-I and type-II Superconductors. (5)

c) With the energy band diagram of an unbiased p-n junction, explain the terms: barrier potential and depletion region. (5)

Qu. 7 a) What is the cavitation effect? Discuss its applications (5)

b) Silicon has the same crystal structure as of Diamond. Its density is $2.33 \times 10^3 \text{ Kg/m}^3$ and atomic weight is 28.9. Calculate lattice constant and atomic radius of it. (5)

c) Explain in brief the conditions necessary for good acoustical design of an auditorium. (5)

Con. 5543-10.

(3 Hours)

[Total Marks : 100

- N.B. :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** from remaining **six** questions.
 (3) Figures to the **right** indicate **full** marks.
 (4) Assume the **suitable** data if needed with **justification**.

1. (a) Express $(1 + 7i)(2 - i)^{-2}$ in the form of $r(\cos \theta + i \sin \theta)$ and prove that its fourth power is a real negative number. 5

(b) If $u = z \tan^{-1} \frac{y}{x}$ find the value of $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}$ 5

(c) Find $\nabla \cdot \vec{F}$ & $\nabla \times \vec{F}$ where $\vec{F} = \frac{1}{(x^2 + y^2)}(x\hat{i} - y\hat{j})$ 5

(d) Test the convergence of the series $\sum \frac{\sqrt{n}}{\sqrt{n^2+1}} x^n$ 5

2.(a) Prove that $\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots$
 Hence expand $\log(1 + x^2)$ in powers of x 8

(b) If $z = f(x, y), x = u \cosh v, y = u \sinh v$, prove that $\left(\frac{\partial z}{\partial u}\right)^2 - \frac{1}{u^2} \left(\frac{\partial z}{\partial v}\right)^2 = \left(\frac{\partial z}{\partial x}\right)^2 - \left(\frac{\partial z}{\partial y}\right)^2$ 6

(c) Show that for real values of a and b , $e^{2a \cot^{-1} b} \left[\frac{b-1}{b+1} \right]^{-a} = 1$ 6

3.(a) State Euler's theorem for a function of 3 variables and hence verify the same for $u = \log \left(\frac{xy+yz+zx}{x^2+y^2+z^2} \right)$ 8

(b) Determine $y_n(0)$ if $y = \frac{x^3}{x^2-1}$ 6

(c) Find the constants a, b, c if the normal to the surface $ax^2 + yz + bxz^3 = c$ at $P(1,2,1)$ is parallel to the normal to the surface $y^2 + xz = 61$ at $Q(10,1,6)$. 6

4.(a) Find the cube roots of unity. If w is a complex cube root of unity, prove that

(i) $1+w+w^2=0$

(ii) $\frac{1}{1+2w} + \frac{1}{2+w} - \frac{1}{1+w} = 0$

8

(b) Use Rolle's Theorem to prove that the equation $ax^2 + bx = \frac{a}{3} + \frac{b}{3}$ has a root between 0 & 1.

6

(c) Find $xu_x + yu_y + zu_z$ for $u = \cos \frac{xy + yz}{x^2 + y^2 + z^2} + \sin(\sqrt{x} + \sqrt{y} + \sqrt{z})$

6

5.(a) If $\frac{x^2}{a^2+u} + \frac{y^2}{b^2+u} + \frac{z^2}{c^2+u} = 1$,

prove that $(\frac{\partial u}{\partial x})^2 + (\frac{\partial u}{\partial y})^2 + (\frac{\partial u}{\partial z})^2 = 2(x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z})$

8

(b) Find a, b, c given that $\lim_{x \rightarrow 0} \frac{ae^x - be^{-x} - cx}{x - \sin x} = 4$

6

(c) Prove that $\sinh^{-1}(\tan \theta) = \log \left(\tan \left(\frac{\theta}{2} + \frac{\pi}{4} \right) \right)$.

6

6.(a) if $y^{\frac{1}{m}} + y^{\frac{-1}{m}} = 2x$,

Prove that $(x^2 - 1)y_{n+2} + x(2n + 1)y_{n+1} + (n^2 - m^2)y_n = 0$

8

(b) The diameter and altitude of a can in shape of right circular cylinder are measured as 4cm & 6cm respectively. The possible error in each measurement is 0.1cm. Find approximately the maximum possible error in the value computed for the volume & lateral surface.

6

(c) If $x + iy = c \cot(u + iv)$, show that $\frac{x}{\sin 2u} = \frac{-y}{\sinh 2v} = \frac{c}{\cosh 2v - \cos 2u}$

6

7.(a) Find the stationary values of $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$

8

(b) If $a = \cos 3\alpha + i \sin 3\alpha, b = \cos 3\beta + i \sin 3\beta, c = \cos 3\gamma + i \sin 3\gamma$ then prove that

$$\sqrt[3]{\frac{ab}{c}} + \sqrt[3]{\frac{c}{ab}} = 2 \cos(\alpha + \beta - \gamma)$$

6

(c) if $\vec{r} = a \cos t \hat{i} + a \sin t \hat{j} + at \tan \alpha \hat{k}$, then prove that

(i) $[\dot{\vec{r}} \ \ddot{\vec{r}} \ \dddot{\vec{r}}] = a^3 \tan \alpha$

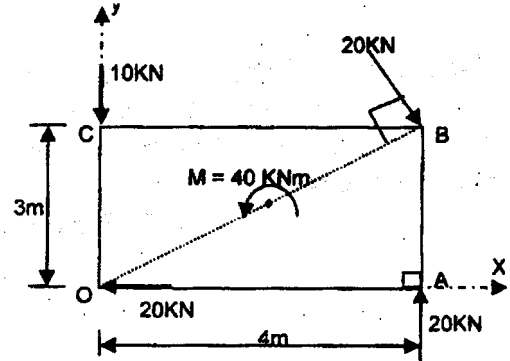
(ii) $|\dot{\vec{r}} \times \ddot{\vec{r}}| = a^2 \sec \alpha$

6

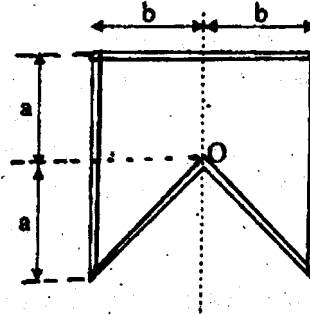
- N.B. :** (1) Question No. 1 is compulsory.
 (2) Attempt any four questions out of remaining six.
 (3) Assume suitable data if necessary stating them clearly.
 (4) Take $g = 9.81 \text{ m/s}^2$.
 (5) Draw suitable sketches where necessary.

Qn 1. Answer any Four

1A). Find the resultant of the force system acting on a body OABC, shown in figure. Also find the points where the resultant will cut the x and y axis. What is the distance of resultant from O? (05 Marks)



1B). Determine the ratio a/b for which centroid will be located at point 'o' for a wire bent as shown in Fig. (05 Marks)

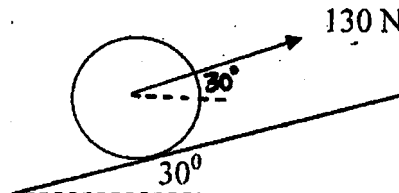


1C). The velocity of a particle travelling in a straight line is given by $v = 6t - 3t^2 \text{ m/s}$. Where t is in seconds. If $s = 0$ when $t = 0$, determine the particle's deceleration and position when $t = 3\text{s}$. How far has the particle travelled during the 3 second time interval and what is its average speed? (05 Marks)

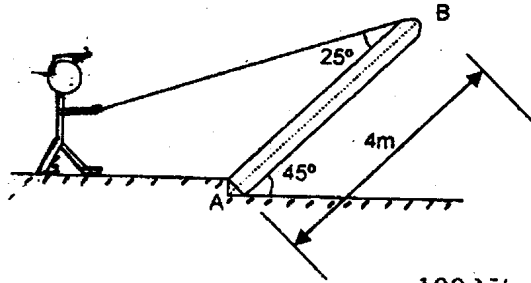
1D). A boy throws a ball vertically downwards from a height of 1.5m. He wants the ball to rebound from floor and just touch the ceiling of room which is at a height of 4m from ground. If coefficient of restitution e is 0.8, find the initial velocity with which the ball should be thrown. (05 Marks)

1E). A 5 Kg mass drops 2m upon a spring whose modulus is 10N/mm. What will be the speed of the block when the spring is deformed 100mm? (05 Marks)

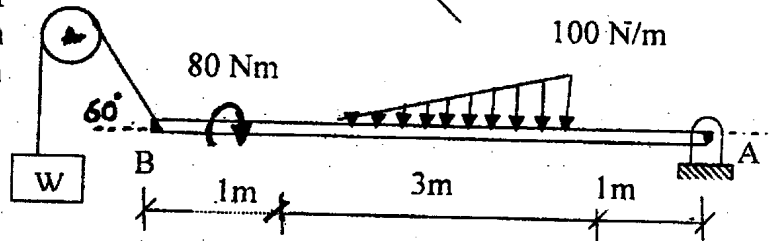
1F). Find the work done in rolling a 20Kg wheel a distance 1.5m up a plane inclined 30° with the horizontal as shown in figure. Assume coefficient of friction as 0.25. (05 Marks)



2A). A man raises a 12kg joist of length 4m by pulling the rope. Find the tension in the rope and the reaction at A. (08 Marks)



2B). Determine minimum weight of block required to keep the beam in horizontal equilibrium. Assume rough pulley with coefficient of friction as 0.2. (12 Marks)

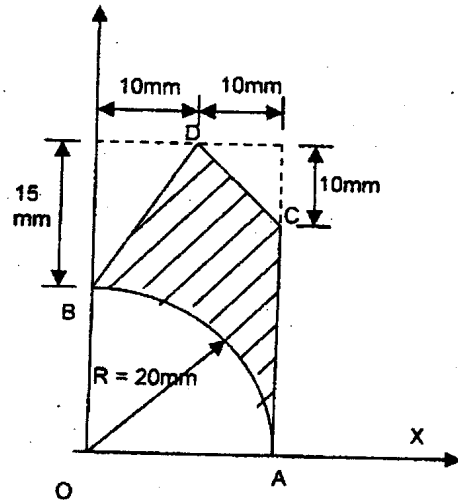


3A). State Varignon's Theorem. (02 Marks)

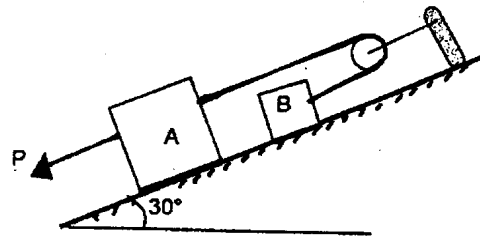
3B). State the assumptions made in the analysis of truss. (02 marks)

3C). State Work Energy Principle & Law of conservation of Momentum principle. (04 marks)

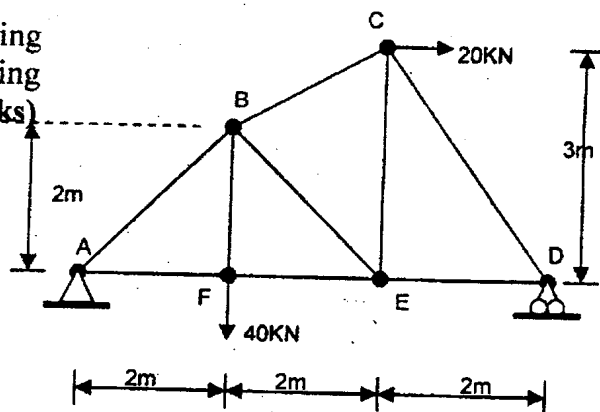
3D). Find centroid of plane area & also MI about centroidal axis. (12 Marks)



4A). Determine the force 'P' to cause motion to impend. Take masses of blocks A and B as 8kg and 4kg respectively and the coefficient of sliding friction as 0.3. The force 'P' and rope are parallel to the inclined plane. Assume frictionless pulley. (08 marks)

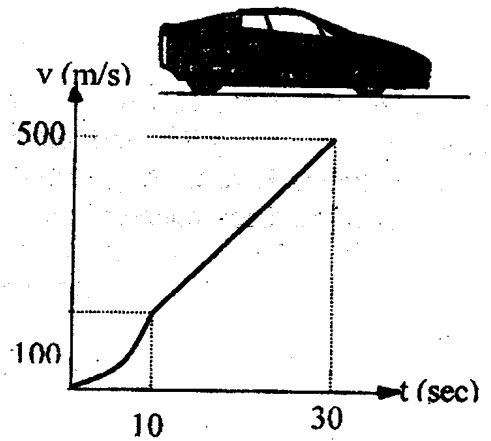


4B). Find Forces in truss members BF, BE using method of section and other members using method of joints. (12 Marks)

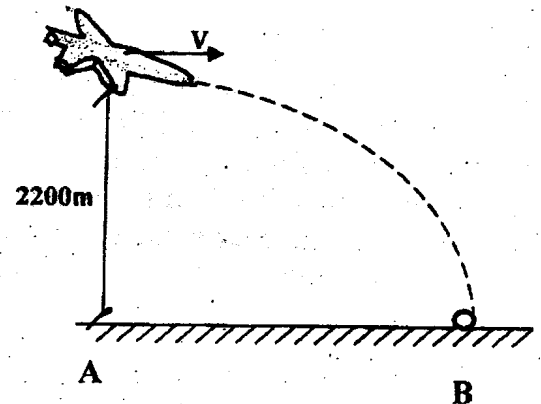


5A). The acceleration of the particle is defined by the relation $a = 25 - 3x^2 \text{ mm/s}^2$. The particle starts with no initial velocity at the position $x = 0$. (a) Determine the velocity when $x = 2 \text{ mm}$ (b) the position when velocity is again zero (c) position where the velocity is maximum and the corresponding maximum velocity. (08 marks)

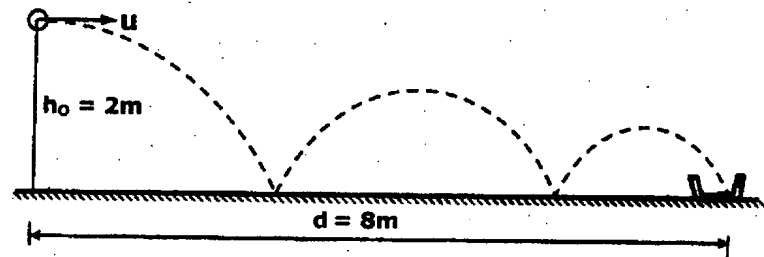
5B) A car moves along a straight road such that its velocity is described by the graph shown in figure. For the first 10 seconds the velocity variation is parabolic and between 10 seconds to 30 seconds the variation is linear. Construct the s-t and a-t graphs for the time period $0 \leq t \leq 30 \text{ s}$. (12 marks)



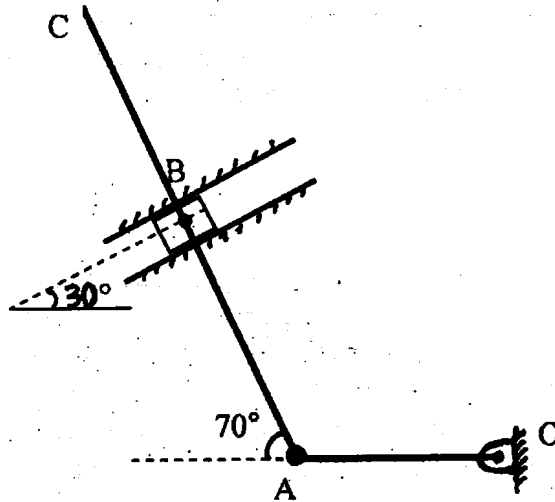
6A). An aeroplane is flying in horizontal direction with a velocity of 540 km/hr and at a height of 2200 m . When it is vertically above the point A on the ground, a body is dropped from it. The body strikes the ground at point B. Calculate the distance AB (ignore air resistance). Also find velocity at B and time taken to reach B. (08 marks)



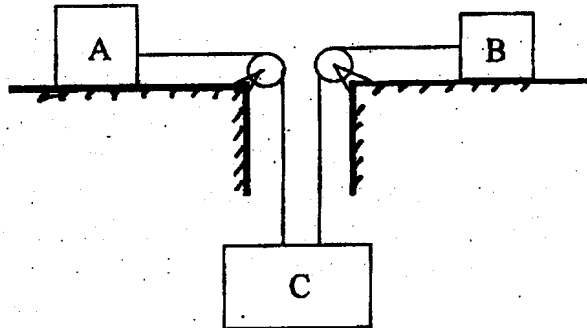
6B). A small steel ball is to be projected horizontally such that it bounces twice on the surface and lands into a cup placed at a distance of 8 m as shown. If the coefficient of restitution for each impact is 0.8 , determine the velocity of projection 'u' of the ball. (12 marks)



7A) Locate the instantaneous centre of rotation for the link ABC and determine Velocity of Points B & C. Angular velocity of rod OA is 15 rad/sec counter clock wise. Length of OA is 200 mm , AB is 400 mm and BC is 150 mm . (08 marks)



7B) Masses A (5kg), B (10kg), C (20kg) are connected as shown in the figure by inextensible cord passing over massless and frictionless pulleys. The coefficient of friction for masses A and B with ground is 0.2. If the system is released from rest, find the acceleration of the blocks and tension in the cords. (12 marks)



Con. 6231-10. FE/Sem-I / Computer Prog. - I
(3 Hours)

[Total Marks : 100

- N.B. : (1) Question No. 1 is compulsory.
 (2) Attempt any four questions out of remaining six questions.
 (3) Figures to the right indicates full marks.

20

1. Find o/p of the following programs (5 marks each)

```
(a) void main ()
{
  int a=1,b=2,c=3,d=4.75,x;
  x=++a + b++ * ++c%d++;
  cout<<a<<" "<<b<<"," "<<c<<" "<<d<<" "<<x<<endl;
}
```

```
(b) Void main ()
{
  int x=1;
  cout<<x<<(x=x+2)<< (x<<2),,endl;
  x<<2;
  cout<<++x<<x++<<++x<<endl;
}
```

```
(c) int x;
void f1()
{
  ++x;
}
void main()
{
  int x=10;
  f1();
  x=x+10;
  cout<<x<<" "<<::x<<endl;
}
```

```
(d) class Test
{
public:
  Test()
  {
    cout<<"constructor"<<endl;
  }
  ~Test()
  {
    cout<<"destructor"<<endl;
  }
}
void main()
{
  Test t1;
  Test t2, t3;
  Test t4;
}
```

10

2. (a) Write a program to print following pattern :-

```

1
21A
321AB
4321ABC
54321ABCD
```

(b) $x=1! + 3! + 5! + (2*n-1)!$

10

3. (a) What is recursion ? Write a recursive function to find n^{th} Fibonacci term. Use this function to generate n terms of the Fibonacci series. 10
- (b) What is function overloading ? Overload function add to add two integers, two float and two arrays. 10
4. (a) What is operator overloading ? Overload operators +, +=, ++ on complex number. ++ should increment real and imaginary parts by 1. 10
- (b) Find o/p
void f()
{
extern int n3;
static int n1;
int n2=20;
n1=n1+10;
n2=n1+n2;
n3=n1+n2;
cout<<n1<<" "<<n2<<" "<<n3<<endl
}
int n3;
void main()
{
register int i;
for(i=1; i <=3; i++)f1();
}
- (c) Write a program to count blank spaces, digits, vowels and consonants in the string. 5
5. (a) Write a program to create singly linked list of 10 student nodes. The student node contain roll no and percentage. Read information and print this information in the linked list. 10
- (b) Write a program using pointer to allocate memory for 10 integers. Read and print these integers. Find average of these integers. 10
6. (a) What is function overriding. Give example. 10
- (b) Explain Inheritance visibility. 5
- (c) Create class Circular with data member radius and member functions to read radius, print radius and calculate radius. Derive class cylinder from class circle. Class Cylinder should have data member height and inherited radius from circle and member functions to read height and radius and calculate area. 5
7. (a) Explain virtual function with example. 5
- (b) Explain pure virtual function with example. 5
- (c) Write pure virtual function convert to convert liters to milliliters, grams to kilograms, dollar to rupee. Assume 1 dollar is 45 rupees. 10