Con. 5957-11.   **MP–2446**

(2 Hours)   [**Total Marks : 75**

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** to the **right** indicate the **full** marks.

Q.1   Answer any five questions:
    a) Draw the following planes (121), (100), (111)   (3)
    b) State any three applications of superconductivity   (3)
    c) How Lissajous figures are used to determine phase difference? (3)
    d) What are ultrasonic waves? State magnetostriction effect.   (3)
    e) State Sabine's formula.   (3)
    f) Calculate atomic packing factor for FCC crystal structure?   (3)
    g) Show the position of Fermi level in intrinsic semiconductor, p-type   (3)
        semiconductor and n-type semiconductor.

Q.2   a) Explain Diamond crystal structure with proper diagram. Calculate the   (8)
        number of atoms per unit cell, atomic radius and atomic packing factor
        for diamond unit cell.
    b) What is cavitation effect? Find the natural frequency of vibration of   (7)
        quartz plate of thickness 2 mm. Given: Young's modulus for quartz is 8×10^{10} N/m^2 and density 2650 Kg/m^3. Calculate the change in thickness
        required if the same plate is to be used to produce ultrasonic waves of 3
        MHz.

Q.3   a) Explain reverberation and reverberation time. Explain various methods   (8)
        for design of good acoustics.
    b) What are lattice parameters? Aluminium has density 2.7 gm/cm^3. It has   (7)
        atomic weight 27 and lattice parameter is 4.05 A^0. Determine the type of
        crystal structure followed by Aluminium and calculate the atomic radius.
        Given Avogadro's number $N_A = 6.023 \times 10^{23}$ /gm mole.

Q.4   a) What is superconductivity and critical temperature? Describe type I and   (8)
        type II superconductor.
    b) Define mobility of charge carrier. Find resistivity of germanium at 300   (7)
        ^{0}K. Given density of carriers is 2.5×10^{19} /m^2. Mobility of electron is 0.39
        m^2/V-Sec and mobility of hole is 0.19 m^2/V-Sec. Charge of electron is 1.6
        $\times 10^{19}$ C.

[**TURN OVER**

Q.5   a)   State Hall effect and what is the significance of hall effect?   (8)
n-type Ge sample has donor concentration 10^{21} atoms /m^3. What hall
voltage would you expect if current 1×10^{-3}A and if 0.5 T magnetic field is
applied across 2 mm thick sample.

    b)   What is piezoelectric effect? Explain with neat labeled diagram the   (7)
construction and working of Piezoelectric oscillator.

Q.6   a)   State and explain terms in Bragg's law of X-ray diffraction. Calculate the   (8)
glancing angle on cube (100) of rock salt having lattice constant 2.814 A^0
corresponding to first order diffraction maximum for X- rays of
wavelength 1.541 A^0.

    b)   Explain construction and working of CRO.   (7)

Q.7   Solve/explain any three :

    a)   A class room has dimension $20 \times 15 \times 10 \ m^3$, the reverberation time is 3
sec. Calculate total absorption of its surfaces and average absorption
coefficient.   (5)

    b)   Liquid crystal and different phases of liquid crystal   (5)
    c)   Point defects in crystal   (5)
    d)   Meissner effect   (5)

(2 Hours)   [Total Marks : 75

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

(2) From Q. No. 2 to Q. No. 7 answer any **four** questions,

(3) **Atomic Weights. :** C-12, O-16, H-1, N-14, S-32, Cl-35·5, Ca-40, Mg-24, Na-23, Al-27, K-39.

(4) Answer to questions should be **grouped** and written **together**.

Q.No.1   Answer any three from the following;   5x3=15

a) Classify the following impurities in to temporary, permanent and non-hardness causing impurities.

$Ca(HCO_3)_2$, $MgSO_4$, $CaCl_2$, CO_2, HCl, $Mg(HCO_3)_2$, $CaSO_4$ and $NaCl$.

How many grams of $CaCl_2$ dissolved per litre gives 150 ppm of hardness?

b) 1.3g of a gear box oil is taken for acid value determination. It required 0.8ml of 0.001N KOH for neutralization. Calculate the acid value and mention whether the oil is suitable to be used further or not.

c) Give the main physical changes that take place at the nano scale with its applications.

d) What is degree of polymerization? Give its significance. A homo polymer has mol.wt.= 56,000. Its monomer mol.wt is =28. Calculate its degree of polymerization.

e) Define COD and BOD. Give its significance.

f) What is reverse osmosis? Give its applications.

g) Distinguish between conventional and non-conventional energy sources.

Q.No.2 a) Outline the chemical reactions involved in the Lime-soda method of softening water. 6

b) A blended oil weighing 12.3 g was treated with 45ml of 0.5 N KOH and refluxed for 1.5 hrs. The blank titration reading was 45ml of 0.5 N HCl. The back titration reading was 20.2 ml of 0.5 N HCl. Calculate the saponification value.If the oil used for blending is castor oil having saponification value= 188, calculate the percentage blend. 4

c) With a neat diagram explain Solar photovoltaics. 5

Q.No.3 a) Distinguish between thermoplastics and thermosettings. 5

b) 15,000 litres of hard water was passed through a zeolite softener. The exhausted zeolite required 120 litres of NaCl having 30 g / litre of NaCl. Calculate the hardness of water. 5

c) What is glass transition temperature? What is its significance? 5

Q.No.4 a) Explain the application of phase rule to one component system. 5

b) 20 ml of standard hard water containing 1.2 g $CaCO_3$ per litre required 35 ml of EDTA. 50 ml of hard water sample required 30 ml of the same EDTA. 100 ml of hard water sample after boiling required 25 ml of the same EDTA. Calculate the various hardnesses. 5

c) With a neat diagram explain working of Lithium ion batteries.Give its applications. 5

Q.No.5 a) What are CNTs? What are its types? Give their applications. 5

b) What are plain carbon steels? How are they classified on the basis of the carbon content? Give their draw backs. 5

c) Calculate the quantity of lime(90% pure) and soda (95% pure) required for softening 50,000 litres of water containing the following impurities. 5
$Ca(HCO_3)_2$-81 mg/l , $MgCl_2$-95 mg/l, $CaSO_4$-68 mg/l, SiO_2-50 mg/l,$Mg(HCO_3)_2$-146 mg/l, H_2SO_4-49 mg/l.

Q.No.6 a) What is fabrication? What are the various types? With a neat diagram explain any one of them. 6

b) List any five characteristics of a good lubricant with justification. 5

c) Advanced polymeric materials like, conducting polymers, liquid crystal polymers, supramolecules and polymer composites have gained increasing importance in the recent years. Explain what are these, what are their main structural features with one example each. 4

Q.No.7 a) What is vulcanization? How does it improve the properties of rubber? 5

b) What are shape memory alloys? How do they work? Give their applications. 5

c) With a neat flowchart explain the waste water treatment. 5

Con. 5840-11. MP-3355

(3 Hours) [Total Marks : 100]

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

(2) Attempt any **four** questions from the remaining questions.

(3) **Figures** to the **right** indicate **full marks**.

1. (a) If arg $(z + 1) = \frac{\pi}{6}$ and arg $(z - 1) = \frac{2\pi}{3}$, find z, a complex number. 5

(b) Prove that $\tanh^{-1}(\sin\theta) = \cosh^{-1}(\sec\theta)$. 5

(c) Prove that the real part of $\left(1 + i\sqrt{3}\right)^{\left(1 + i\sqrt{3}\right)}$ is $2e^{-\pi/\sqrt{3}} \cos\left(\frac{\pi}{3} + \sqrt{3}\cdot\log 2\right)$. 5

(d) Test the convergence of $\frac{x}{1\cdot2} + \frac{x^2}{3\cdot4} + \frac{x^3}{5\cdot6} + \frac{x^4}{7\cdot8} + \ldots\ldots(x > 0, x \neq 1)$. 5

2. (a) Prove that $\frac{a + ib}{1 + c} = \frac{1 + iz}{1 - iz}$, if $a^2 + b^2 + c^2 = 1$ and $b + ic = (1 + a)z$. 6

(b) Find the roots $\alpha, \alpha^2, \alpha^3, \alpha^4$ of the equation $x^5 - 1 = 0$ and show that $(1 - \alpha)(1 - \alpha^2)(1 - \alpha^3)(1 - \alpha^4) = 5$ 6

(c) Prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$, if $u = f(e^{y-z}, e^{z-x}, e^{x-y})$. 8

3. (a) Prove that arg $z_1 -$ arg $z_2 = \frac{\pi}{2}$, if $|z_1 + z_2| = |z_1 - z_2|$, z_1, z_2 being complex numbers. 6

(b) Prove that $\alpha^n + \beta^n = 2\cos n\theta \operatorname{cosec}^n\theta$, if α, β are the roots of the equation $z^2\sin^2\theta - z\sin 2\theta + 1 = 0$ 6

(c) Show that $\tan^{-1} i\left(\frac{x - a}{x + a}\right) = \frac{i}{2}\log\frac{x}{a}$. 8

4. (a) Prove that $x^2 y_{n+2} + (2n + 1)xy_{n+1} + 2n^2 y_n = 0$, if $\cos^{-1}(y/b) = \log\left(\frac{x}{n}\right)^n$. 6

(b) Show that $\frac{\partial^2 z}{\partial x^2} = a^2\frac{\partial^2 z}{\partial y^2}$, if $z = \tan(y + ax) + (y - ax)^{3/2}$. 6

(c) Prove that $2x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y} = 4x$, if $f(xy^2, z - 2x) = 0$. 8

5. (a) Separate into real and imaginary parts $\cos t^{-1}\left(\frac{3i}{4}\right)$. 6

5. (a) Separate into real and imaginary parts $\cos^{-1}\left(\dfrac{3i}{4}\right)$.   6

(b) Prove that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} + z\dfrac{\partial u}{\partial z} = 0$, if $u = f\left(\dfrac{x}{y}, \dfrac{y}{z}, \dfrac{z}{x}\right)$.   6

(c) Examine the function $f(x, y) = y^2 + 4xy + 3x^2 + x^3$ for extreme values.   8

6. (a) Find x, if $\bar{a} = x\,i + 12j - k$, $\bar{b} = 2i + 2j + k$, $\bar{c} = i + k$ are coplanar. Also find unit vector in the direction of vector $\bar{a}$.   6

(b) Prove that $\log \sec x = \dfrac{1}{2}x^2 + \dfrac{1}{12}x^4 + \dfrac{1}{45}x^6 + \ldots\ldots$ 6

(c) Evaluate $\displaystyle\lim_{x \to 0} \dfrac{e^x \sin x - x - x^2}{x^2 + x \log (1-x)}$.   8

7. (a) Prove that, $\dfrac{\partial f}{\partial y} \cdot \dfrac{\partial \phi}{\partial z} \cdot \dfrac{dz}{dx} = \dfrac{\partial f}{\partial x} \cdot \dfrac{\partial \phi}{\partial y}$, if $f(x,y) = 0$ and $\phi(y,z) = 0$.   6

(b) Find $(1.04)^{3.01}$, by using the theory of approximation.   6

(c) Prove that $\left[\,\bar{b} \times \bar{c} \quad \bar{a} \times \bar{c} \quad \bar{a} \times \bar{b}\,\right] = \left[\,\bar{a}\ \bar{b}\ \bar{c}\,\right]^2$ 8

20/12/2011   FE Sem-I (Rev)
FE BEE All Branch

(3 Hours)   [Total Marks : 100

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

1. (a) What are the losses in the transformer ? Explain why the rating of transformer **20** in KVA not in kW.
   (b) Derive the relation between power in Delta and Star system.
   (c) A lamp rated 110 Volt, 60 W is connected with another lamp rated 110 Volt, 100 W across 220 volt mains. Calculate the resistance that should be joined in parallel with the first lamp so that both the lamps may take their rated power.
   (d) Explain the effect of temperature on resistance of different material.

2. (a) Explain full wave rectifier circuit using centre tap transformer. Find the expression **10** for RMS and average load current, TUF, rectifier efficiency.
   (b) The voltage of 150 V applied between A and B produces a current of 32 A. For **10** the circuit shown in **figure**. Find the value of R and p.f. of the circuit.
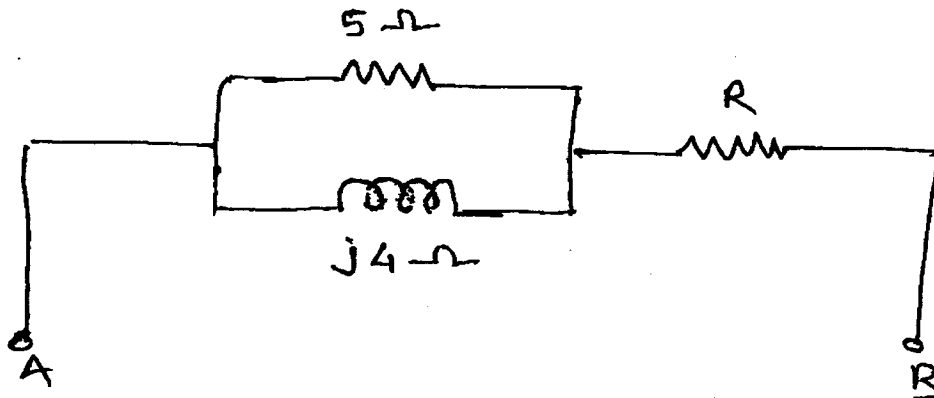
3. (a) Explain two wattmeter method power measurements in 3 ϕ star-connected **10** balanced load.
   (b) Find the current across 4 Ω by superposition theorem. **10**
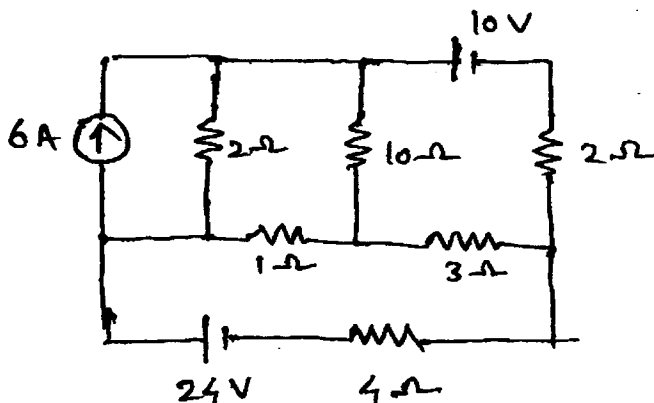
[**TURN OVER**

4. (a) Draw and explain input and output characteristics of CE transistor.   **10**

    (b) 3 ϕ, 220 V, 50 Hz, 11·2 kW Induction Motor has full load efficiency of 88% and **10** draws a line current of 38 Amp. under full load, when connected to 3 ϕ, 220 V supply find the reading on Two wattmeter connected in the circuit to measure the input to the motor. Determine also p.f. at which motor is operating.

5. (a) An R-L-C series circuit has a current that lags behind applied voltage by 45°. **10** The voltage across the inductance has maximum value equal to twice the maximum value of voltage across capacitance. The voltage across inductance is 300 sin (1000 t) and R = 20 Ω. Find the values of inductance and capacitance.

    (b) Explain double field revolving theory of single phase Induction Motor.   **10**

6. (a) 5 KVA, 200/400 V, 50 Hz 1ϕ transformer give following results.   **10**

O. C.	200 V	0·7 A	60 W
S. C.	22 V	16 A	120 W

      (i) Draw equivalent circuit reffered to primary and insert all the parameters.
      (ii) Efficiency at 0·9 p.f. at full load.

    (b) Draw the resonance graph for the following :—   **10**
      (i) XL   (ii) R   (iii) Z   (iv) cos ϕ (v) I

7. (a) Using Norton's theorem, find the current flowing through 100 Ω.   **10**
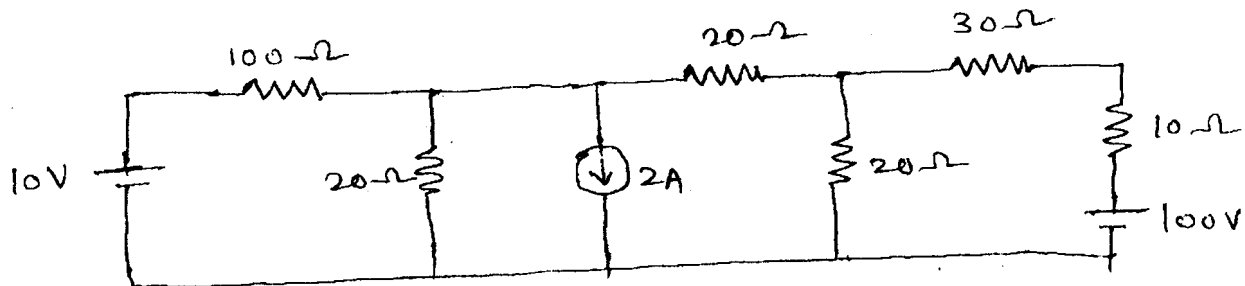
    (b) Write short notes on the following (any **two**) :—   **10**
      (i) Shaded Pole Motor
      (ii) Three Phase Induction Motor
      (iii) Classification and Application of D. C. Motor.
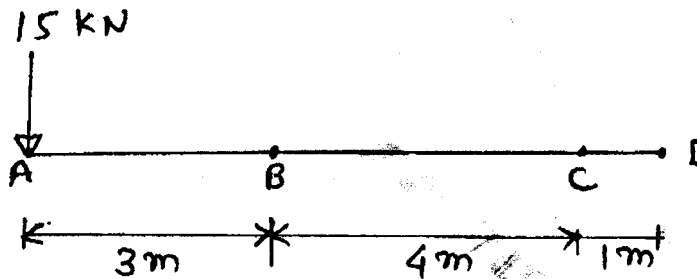
(3 Hours)　　　　　　　　　　　　　　[**Total Marks : 100**

N.B. (1) Question No. **1** is **compulsory**.
　　　(2) Attempt any **four** questions from remaining **six** questions.
　　　(3) Assume **suitable** data if **necessary** and mention the same **clearly**.
　　　(4) Take $g = 9 \cdot 81$ m/sec².

1. Solve any **four** of the following :—
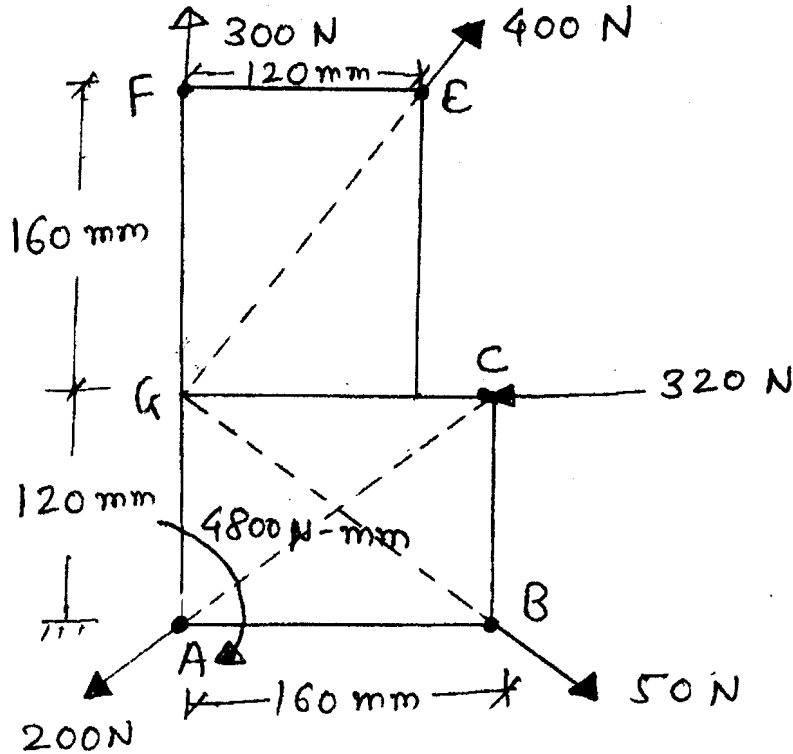　　(a) Resolve 15 kN force acting at 'A' into two parallel components at B and C.　　**5**

15 KN

　　(b) Derive an expression for centrifugal tension in flat belt drive.　　**5**
　　(c) Find 'P' required to accelerate the block shown in **figure** below at 2·5 m/sec².　　**5**
　　　　Take μ = 0·3.

　　(d) A particle moves in X – Y plane and its position is given by $\bar{r}$ = (3t)i + (4t – 3t²)j.　　**5**
　　　　Where $\bar{r}$ is the position vector of the particle measured in meters at time 't'
　　　　seconds. Find the radius of curvature of its path and normal and tangent
　　　　components of acceleration when if crosses X-axis again.
　　(e) Write short notes on following :—　　**5**
　　　　(i)　Classification of truss
　　　　(ii)　Assumptions made in the analysis of perfect truss.

2. (a) Find the resultant of coplaner force system given below and locate the same on **10** AB with consideration of applied moment of 4800 N-mm.
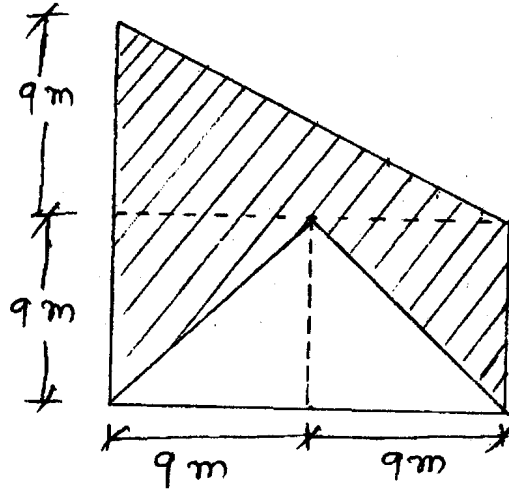

300 N

F

← 120 mm →

E

400 N

160 mm

G

C

320 N

120 mm

4800 N-mm

B

A

← 160 mm →

50 N

200N

(b) If the link CD is rotating at 5 rad/sec. anticlockwise, determine the angular velocity **10** of link AB at the instant shown.
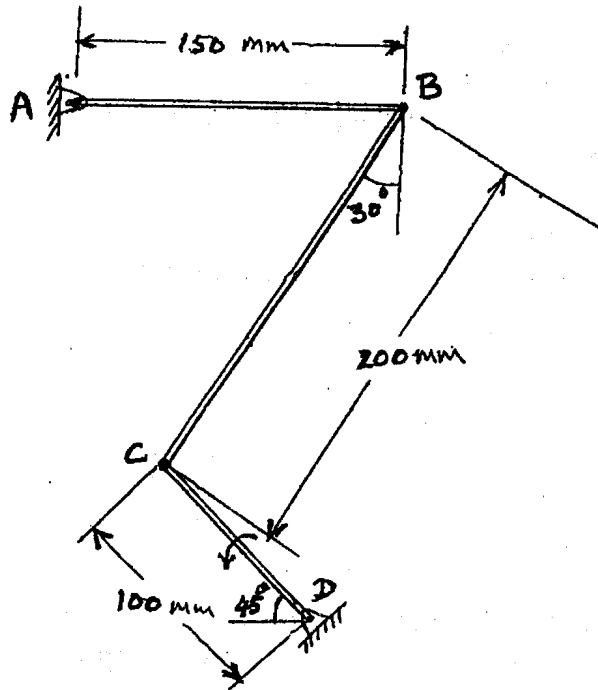

3. (a) Locate the centroid of the shaded area as shown in **figure**. Also determine area **10** moment of inertia of shaded area about its centroidal X-axis.

(b) **Figure** shows acceleration-time diagram for rectilinear motion. Construct velocity- **10** time and displacement-time diagrams for the motion assuming that the motion starts with initial velocity of 5 m/sec from starting point.
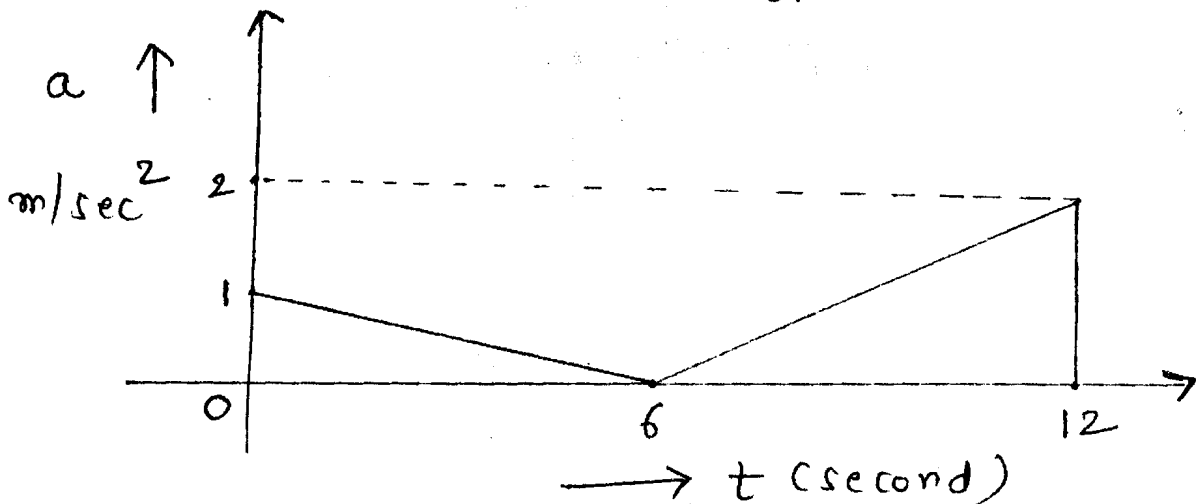
4. (a) What should be the value of 'θ' so that the motion of block 'A' impend down the **10** plane ? The coefficient of friction 'μ' for all the surfaces is 1/3.
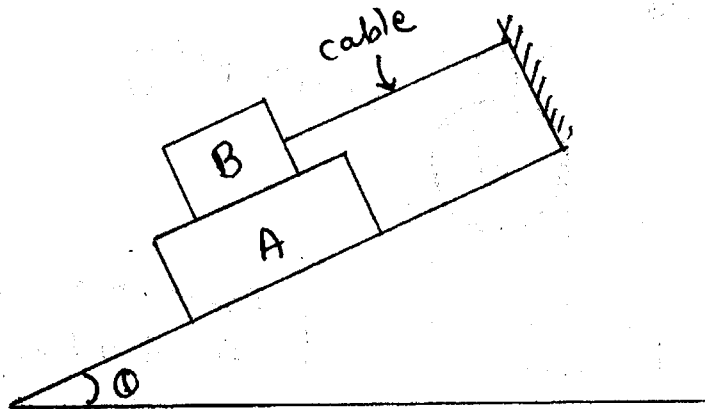

mass of block A = 40 kg
mass of block B = 13·5 kg

(b) Two smooth spheres A and B having a mass of 2 kg and 4 kg respectively Collide **10** with initial velocities as shown in **figure**. If the coefficient of restitution for the spheres is e = 0·8, determine the velocities of each sphere after collision and their directions.
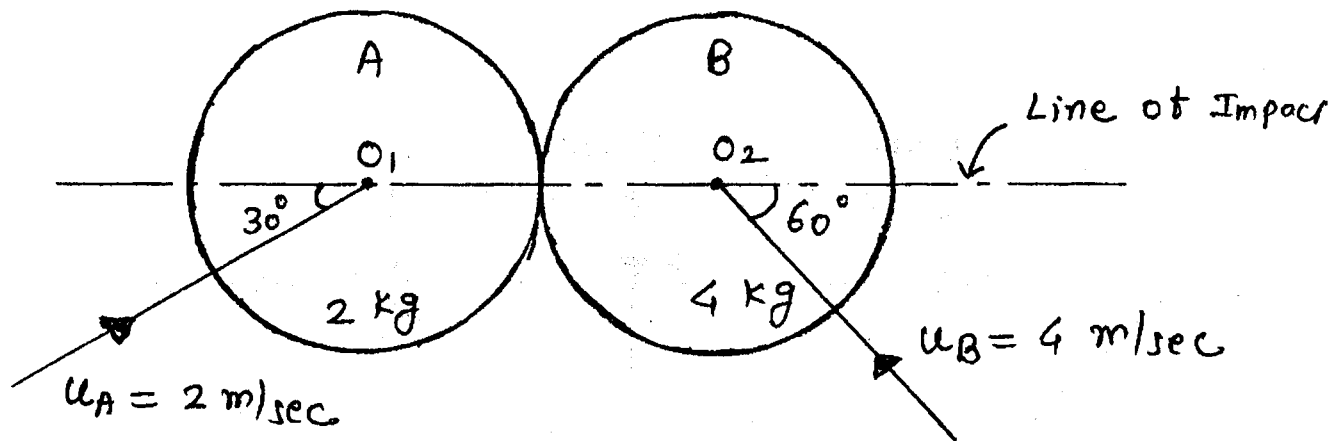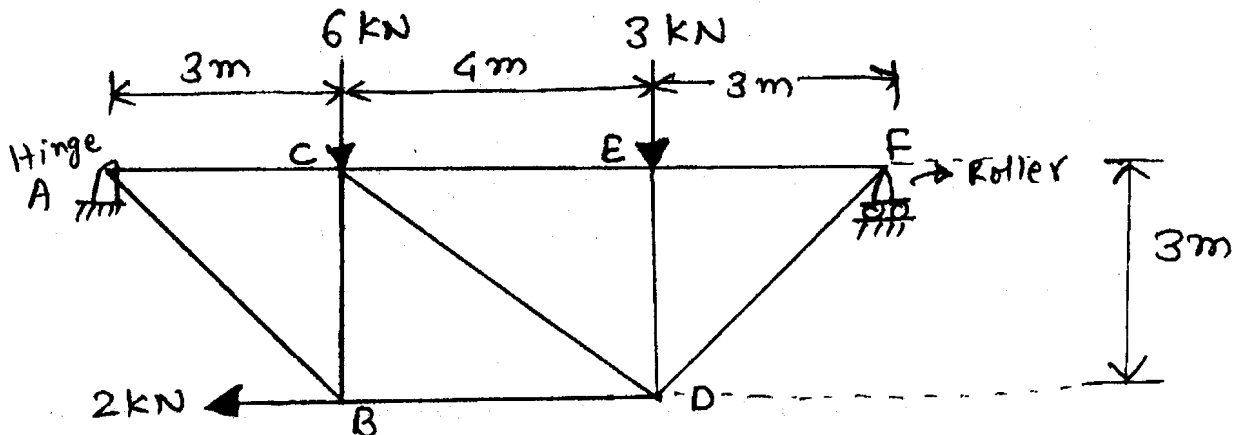

5. (a) Find analytically the support reaction at B and load P for the beam as shown in **10** **figure** if reaction at support 'A' is zero.

[TURN OVER
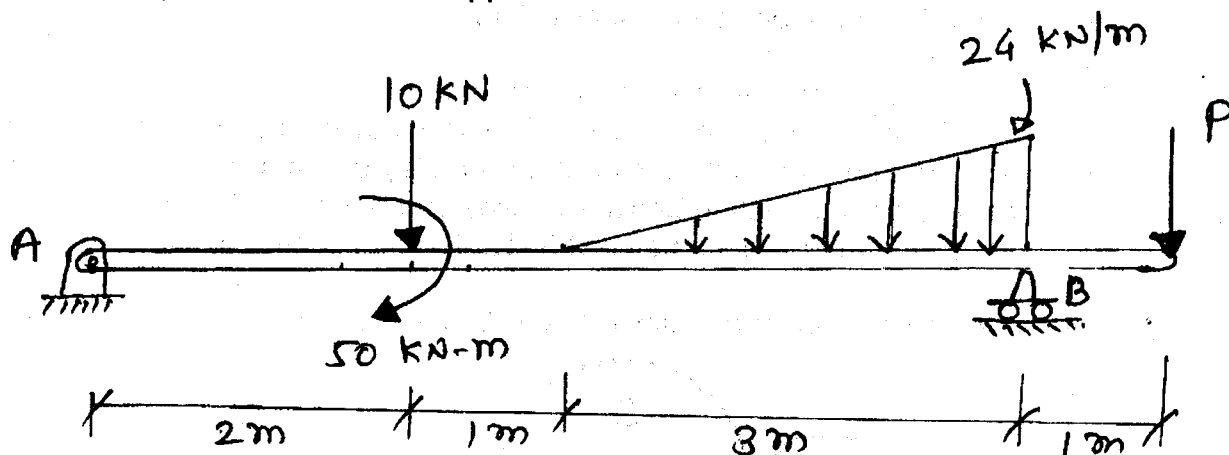
(b) Determine the weight 'W' required to bring the system in the following **figure** to stop in 5 second if at the instant as shown, 500 N block is moving down at 3 m/sec. The pulley is frictionless.　　**10**
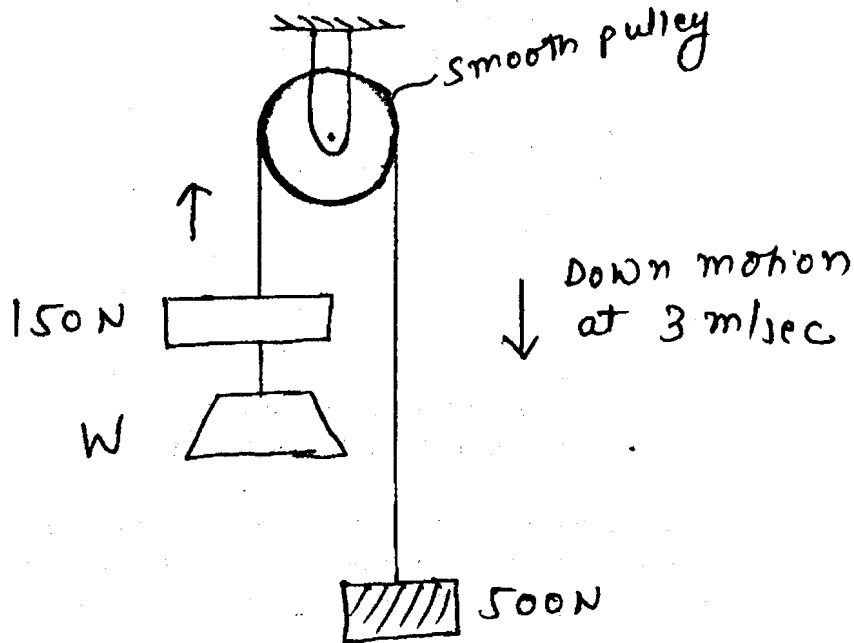

6. (a)

A Truss is loaded and supported as shown find —
- (i) Reactions at A and F　　**3**
- (ii) Forces in all members by method of joint　　**9**
- (iii) Verify the forces in members CE, CD and BD by method of section.　　**3**

(b) Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between pulley and belt is 0·25 and angle of lap is 160° and maximum tension in belt is 2·5 kN. Neglect centrifugal tension.　　**5**

7. (a) Determine the reaction at point of contact 1, 2 and 3. Assume smooth surfaces. **10**
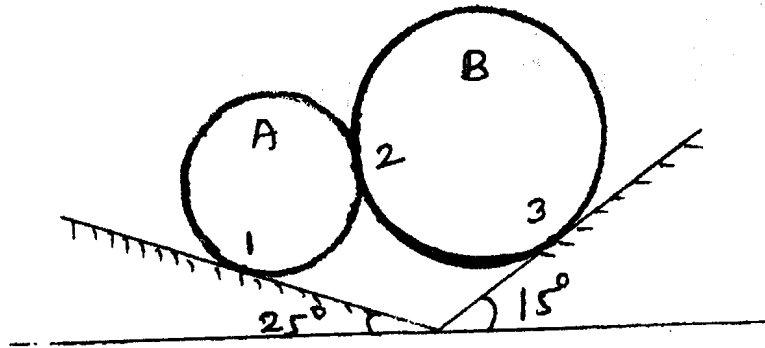
$m_A = 1$ kg $m_B = 4$ kg
$R_A = 1$ cm $R_B = 4$ cm

10

(b) Explain the following terms in short :—
   (i) Radius of gyration
   (ii) Work-energy principle
   (iii) Types of Impact
   (iv) Theorm of parallel axis
   (v) Angle of repose.

(3 Hours)　　　　　　　　　　[Total Marks : 100

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

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

N.B : 1) Question 1 is compulsory

2)Attempt any four questions out of six questions

1.a) What are the features of object oriented programming?　　　　　　　　　(10)

b) Find the output of the following:　　　　　　　　　　　　　　　　　　(10)

i) main()
```
{
    int c[ ]={2.8,3.4,4,6.7,5};
    int j,*p=c,*q=c;
    for(j=0;j<5;j++)
    {
        cout<<*c;
    }
    for(j=0;j<5;j++)
    {
        cout<<*p;
        ++p;
    }
}
```

ii) main()
```
{
    int i=-1,j=-1,k=0,l=2,m;
    m=i++&&j++&&k++||l++;
    cout<<i<<j<<k<<l<<m;
}
```

iii) main()
```
{   int c=- -2;
    cout<<"c="<<c;
}
```

2a) Write a program to generate the following pattern:　　　　　　　　　　(10)
```
    1
   121
  12321
 1234321
  12321
   121
    1
```

b) i) Explain call by value and call by reference with the help of example.　　(5)

ii) Write a program to print prime numbers from 1 to 200.　　　　　　　(5)

3. a) Write a program to sort an array in ascending order.　　　　　　　　(10)

b) What is operator overloading? Declare a class Distance with feet and inches. Overload binary (+,-) and unary(++,--).　　　　　　　　　　　　　　　　　　　　(10)

4. a) What is recursion? Write a program to reverse a number using recursive function.　(10)

b) Write a program to implement multilevel inheritance.　　　　　　　　　(10)

[TURN OVER

Con. 5901-MP-2458-11. 2

5. a) Declare a structure product that will describe the following information- name , weight and price of the product. Develop a program that will store information of 25 products using structure. Also display names in the descending order of price. (10)

b) Differentiate between: (10)
   1) Constructor and Destructor
   2) Break and continue
   3) Function overloading and function overriding

6. a) Write a program to perform matrix multiplication. (10)
   b) Write a program to implement string copy with the help of pointers. (10)

7. Write short notes on the following : (Attempt any four) (20)
   a) Friend function
   b) Virtual Base class
   c) Static data member and function
   d) Access Specifiers
   e) Virtual functions

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