

- N.B. (1) Question No. 1 is **compulsory**.
(2) Out of **remaining** questions attempt any **four**.

1. (a) (i) Explain inline function. 10
(ii) Explain why break and continue statement is used in program.
(iii) Explain basic difference between structure and union with suitable example.
(iv) What is a constructor ? Explain in brief.
(v) What will be the output of following program code ?

```
# include <iostream.h>
void main ( )
{
    for (int i = 0; i < 10; i++);
        cout << "Hello World" << endl;
    cout << "i = " << i;
}
```

- (b) What is object oriented programming ? Explain the features of object oriented programming. 5
(c) Explain data types in C++ in respect to their keyword, memory requirement and range. 5

2. (a) Write a C++ program for the Pascal triangle. 10

```
1
11
121
1331
14641
```

- (b) Explain storage classes with suitable example. 10
3. (a) Explain bitwise operators in C++. 5
(b) Write a recursive program for calculating factorial of a given number n. 5
(c) Write a program to read two matrices and perform multiplication on them. Display the resultant matrix. 5
(d) Differentiate between While and Do-while. 5

4. (a) Explain call-by value and call-by reference with example. 10
(b) Define a structure Employer with following variables :— 10
(i) Employee code
(ii) Employee name
(iii) Employee salary
(iv) Employee designation.

Write a program to read the structure for 10 employees and display record in sorted order of employee code.

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5. (a) What is operator overloading ? Overload operator += on complex number. 10
(b) What is virtual function ? What is the need of virtual function ? 5
(c) What is abstract class ? Give one example. 5
6. (a) What is inheritance ? Explain types of inheritance. 5
(b) Explain logical operators. Write C++ program to demonstrate the same. 10
(c) What is dynamic binding in C++ ? Write a program implementing the concept of dynamic binding. 5
7. Write short notes on :— 20
(a) This pointer
(b) Function overloading
(c) Data abstraction and Data encapsulation
(d) Access specifiers
(e) Friend function.
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FE | sem - I (Old)

4/12/12

A.M. I

P4-11-Exam Oct-12-2016

Con. 8987-12.

(3 Hours)

KR-3690

[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) Find all the values of $(1-i)^{2/3}$. 3
- (b) Find the n^{th} derivative of $y = \sin^2 x \cos^3 x$. 3
- (c) Prove that $\hat{i} \times (\hat{a} \times \hat{i}) + \hat{j} \times (\hat{a} \times \hat{j}) + \hat{k} \times (\hat{a} \times \hat{k}) = 2\hat{a}$. 3
- (d) Using Maclaurin's series find the expansion of $\log(1 + e^x)$ (at least four terms). 3
- (e) If $u = \tan^{-1}\left(\frac{y}{x}\right)$ prove that $u_{xx} + u_{yy} = 0$. 4
- (f) Find the minimum value of $f(x, y) = 3x + 4y$ on the circle $x^2 + y^2 = 1$, using the method of Lagrange's Multipliers. 4

2. (a) If $p = \cos\theta + i\sin\theta$; $q = \cos\phi + i\sin\phi$ 6
 show that $\frac{p-q}{p+q} = i \tan\left(\frac{\theta-\phi}{2}\right)$.
- (b) If $\sin(A + i\beta) = x + iy$, then 6
 Prove that (i) $\frac{x^2}{\cosh^2\beta} + \frac{y^2}{\sinh^2\beta} = 1$
 (ii) $x^2 \operatorname{cosec}^2 A - y^2 \sec^2 A = 1$.
- (c) State and prove Euler's Theorem on homogenous function of two variables 'x' and 'y' - 8

If $u = \operatorname{cosec}^{-1}\left[\left(\frac{x^{1/2} + y^{1/2}}{x^{1/3} + y^{1/3}}\right)^{1/2}\right]$ then prove that

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{\tan u}{12} \left[\frac{13}{12} + \frac{\tan^2 u}{12} \right]$$

3. (a) State Rolle's Theorem and verify the theorem for $f(x) = e^x(\sin x - \cos x)$ 6
 in $\left[\frac{\pi}{4}, \frac{5\pi}{4}\right]$.
- (b) A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 5$ where 't' is the time. 6
 find the components of its velocity and acceleration at $t = 1$, in the direction of $\hat{i} - \hat{j} + 3\hat{k}$.

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- (c) (i) Prove that $e^x \sin x = x + x^2 + \frac{x^3}{3} + \dots$ 8
- (ii) Expand $2x^3 + 7x^2 + x - 1$ in powers of $(x - 2)$. (upto 4 terms)
(Mention the name of the series in each case)
4. (a) Find the roots common to - 6
 $x^4 + 1 = 0$ and $x^6 - i = 0$
- (b) Test for convergence of the series $\frac{x}{2} + \left(\frac{2}{3}\right)^4 x^2 + \left(\frac{3}{4}\right)^9 x^3 + \dots$ 6
- (c) If $y = \log(x + \sqrt{x^2 + 1})$ prove that 8
 $y_{2n}(0) = 0$ and $y_{2n+1}(0) = (-1)^n 1^2 3^2 5^2 \dots (2n - 1)^2$
5. (a) If $y = (\sinh^{-1} x)^2$, then prove that 6
 $(1 + x^2)y_{n+2} + (2n + 1)xy_{n+1} - (n + 1)^2 y_n = 0$.
- (b) Evaluate $\text{Lt}_{x \rightarrow 0} \left[\frac{a^x + b^x + c^x}{3} \right]^{1/x}$ 6
- (c) Prove that $\vec{F} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$ is solenoidal and 8
determine constants a, b and c if \vec{F} is irrotational.
6. (a) If $u = f(x^n - y^n, y^n - z^n, z^n - x^n)$, prove that $\frac{1}{x^{n-1}} u_x + \frac{1}{y^{n-1}} u_y + \frac{1}{z^{n-1}} u_z = 0$ 6
- (b) Find the directional derivative of $\phi = x^4 + y^4 + z^4$ at point A (1, -2, 1) in the direction 6
of AB where B is (2, 6, -1)
- (c) If $\cosh x = \sec \theta$ prove that - 8
(i) $x = \log(\sec \theta + \tan \theta)$
(ii) $\tanh\left(\frac{x}{2}\right) = \tan \frac{\theta}{2}$.
7. (a) If $u = x \log xy$ and $x^3 + y^3 + 3axy = 1$; find $\frac{du}{dx}$. 6
- (b) Find the stationary values of $(\cos x)(\cos y)\{\cos(x + y)\}$. 6
- (c) Show that $\tan^{-1} i \left(\frac{x-a}{x+a} \right) = \frac{i}{2} \log\left(\frac{x}{a}\right)$. 8

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(OLD COURSE)

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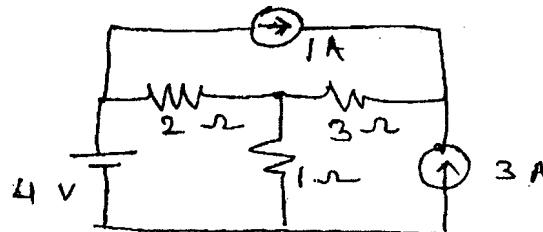
(3 Hours)

[Total Marks : 100

- N.B. :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions from Question Nos. 2 to 7.
 (3) Assume suitable **data** whenever **necessary**.
 (4) **Figures** to the **right** indicate **full** marks.

1. (a) State and explain Ohm's Law. 3
- (b) State Superposition Theorem. 3
- (c) Define RMS Value. 2
- (d) Explain quality factor in series resonance circuit. 3
- (e) State Relationship between Line Voltage, Phase Voltage, Line current and Phase current for balanced star and delta connected system. 2
- (f) What is all day efficiency of transformer. 3
- (g) Define slip in Induction Motor. 2
- (h) Differentiate between half wave and full wave rectifier (any two points.) 2

2. (a) Find current through 1Ω resistance for the network Shown below using Nodal Analysis. 6

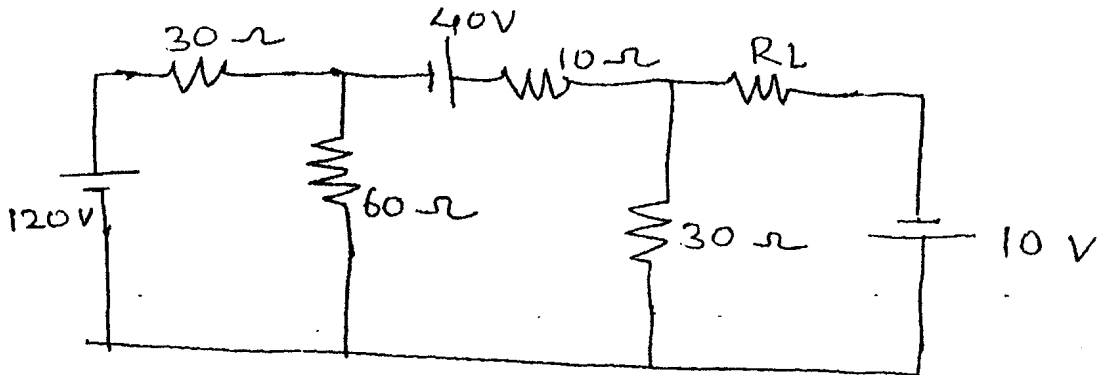


- (b) A current of 5 A flows through pure resistance in series with coil when supplied at 250 V, 50 Hz. If the voltage across the resistance is 125 V and across the coil is 200 V. Calculate value of pure resistance, resistance and inductance of the coil. 6
- (c) Explain Vector diagram of Transformer on Load for (i) Resistive Load, (ii) Inductive Load. 8

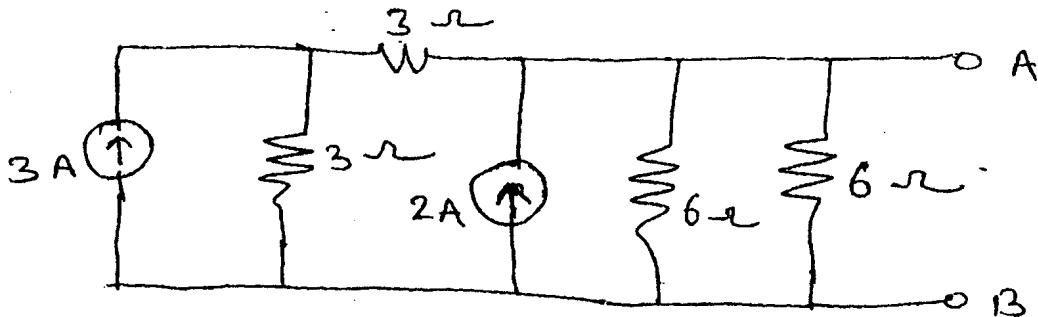
3. (a) Each phase of star connected load consists of Resistance of 100Ω in parallel with capacitance of $31.8 \mu\text{F}$. Calculate Line current, power factor, active power and Total volt amperé, If voltage is 400 V at 50 Hz. 8
- (b) A 20 kVA transformer has Iron loss of 450 watts and full load copper loss of 900 W. Find efficiency at Full load, 0.8 p.f. Lagging. 4
- (c) Explain double field Revolving Theory in 1 – Phase induction motor. 8

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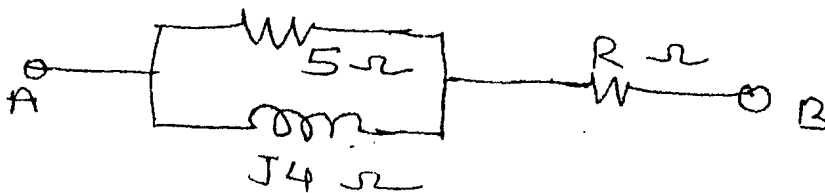
4. (a) Draw Thevenin's Equivalent circuit as seen by Load R_L for circuit shown below. 7



- (b) An alternating current is given by $i = 141.4 \sin 314 t$ 4
 Find : (i) Peak value (ii) Frequency (iii) Time period, (iv) Instantaneous value when time is 3 ms.
- (c) A 3- ϕ motor load has a power factor of 0.397 Lagging. The power is measured by 2-wattmeter method and is 30 kW. Find readings of each wattmeter. 4
- (d) Explain Full Wave Rectifier using centre tap Transformer with neat circuit diagram and input and output waveforms. 5
5. (a) Using source transformation, reduce given network in to single voltage source 7
 in series with single resistance across A B.



- (b) The voltage of 150 V applied between terminals A and B produces a current of 32 A. Find the value of R and circuit p.f. 5

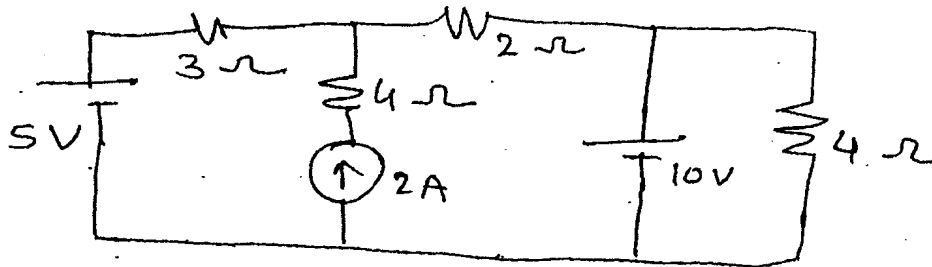


- (c) The result of open circuit and shortcircuit test on 5 kVA, 500 / 250 V, 50 Hz, 1 - ϕ transformer are as follows :— 8

O. C. Test (H. V. side)	500 V	1 A	50 W
S. C. Test (L. V. side)	15 V	6 A	21.6 W.

Find equivalent circuit parameters and insert them on equivalent circuit.

6. (a) Using superposition theorem find current through $2\ \Omega$ resistance for circuit shown below. 7



- (b) R-L-C series circuit consists of resistance of $10\ \Omega$, Inductance of 0.2 Henry and capacitance of $40\ \mu\text{F}$ is supplied with $100\ \text{V}$ supply at variable frequency. Find — 7

- Resonant Frequency
- Current at resonance
- Power
- Voltage across R, L and C
- Q factor
- Half power points.

- (c) Explain how two wattmeter method can be used to measure power factor in 3-phase circuit. 6

7. (a) Define form factor and peak factor. 2
- (b) The voltage and current in ac circuit are given by $v(t) = 34 \sin 377 t$ volt and $i(t) = 2 \sin (377 t - 60^\circ)$. Find Impedance and p.f. 3
- (c) Derive condition for maximum efficiency. 5
- (d) Explain classification of D. C. motor using circuit diagram. 5
- (e) Explain Input and output characteristics of transistor CE configuration. 5

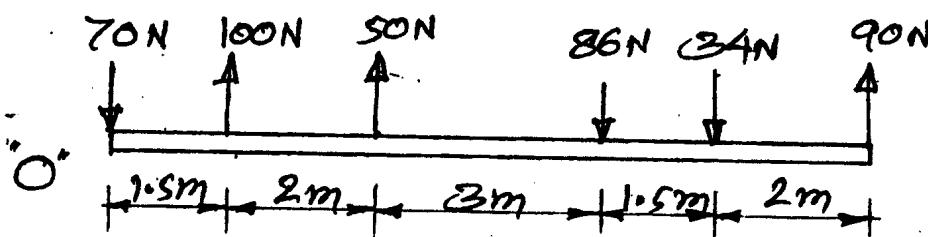
(OLD COURSE)

(3 Hours)

[Total Marks : 100

- N.B. : (1) Question No. 1 is compulsory. Solve any four questions from Question Nos. 2 to 7.
 (2) Assume suitable data, if necessary and state it.
 (3) Draw suitable sketches wherever necessary.
 (4) Take $g = 9.81 \text{ m/s}^2$.

1. (a) Find the resultant force of a following parallel force system, and locate it with reference to point O. 4



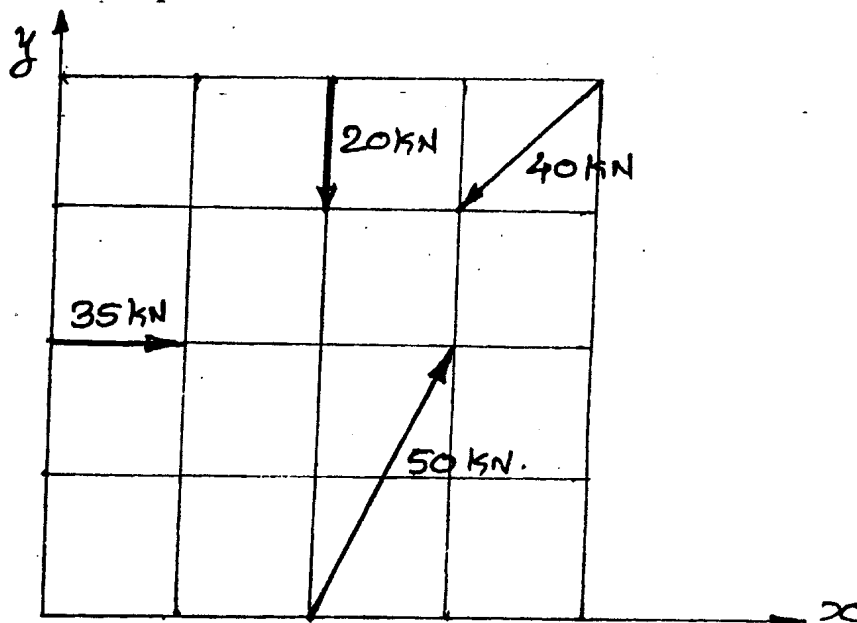
- (b) State conditions for zero force members in a truss. Explain how to check perfectness of truss. 4

- (c) Find the H.P. transmitted by a belt running over a pulley of 80 cm diameter at 150 r.p.m. Take $\mu = 0.25$ and angle of lap = 160° . Tight side tension is 200 N. 4

- (d) The position of a particle which moves along a straight line is given by $x = t^3 - 6t^2 - 15t + 40$ where x is in meters and t is in seconds. Find the time at which the velocity will be zero. Also find the position and distance travelled by the particle at that time. 4

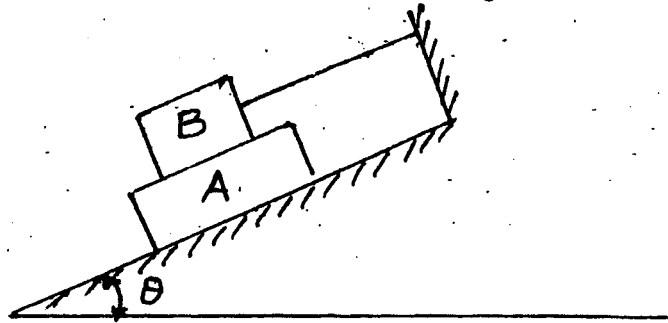
- (e) A ball drops from certain height. After rebounding twice it reaches a height half that of the initial height from which it was dropped. Find the coefficient of restitution. 4

2. (a) Find resultant of the following force system. Also find its x and y intercepts. Take side of each square as 1 m. 8

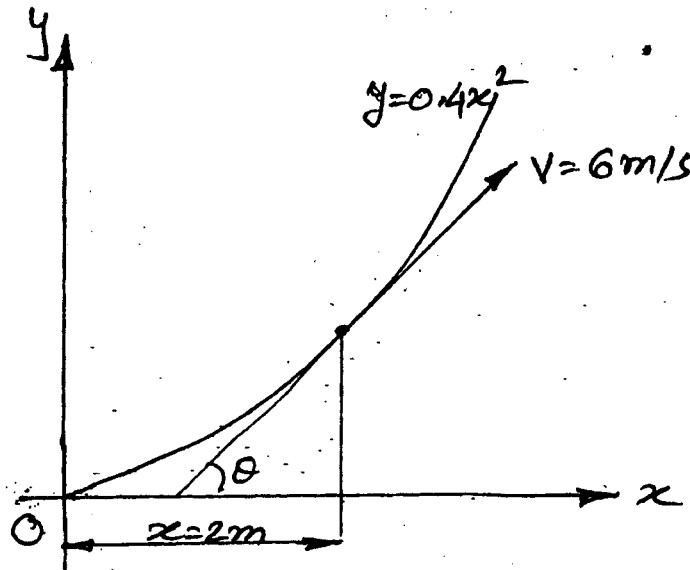


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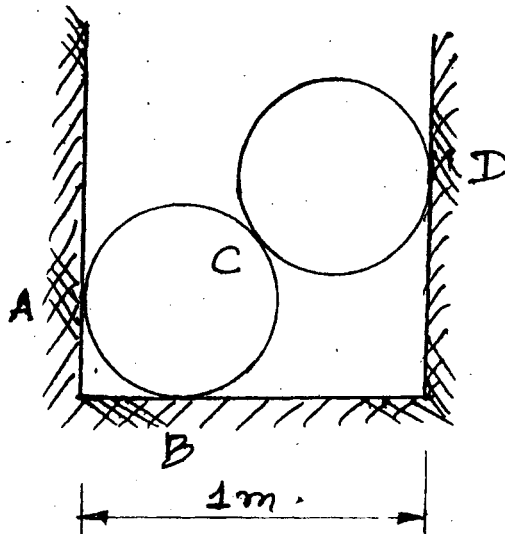
- (b) Find θ so that motion of block A impends down the plane. Take $\mu = 0.33$ for all surfaces. Mass of A = 40 kg and mass of B = 14 kg. 6



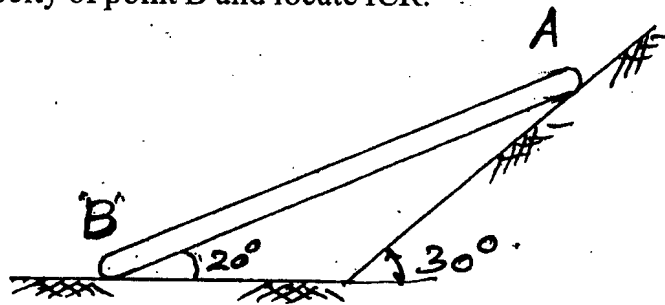
- (c) A point moves along a curved path $y = 0.4x^2$. At $x = 2$ m its speed is 6 m/sec ; increasing at the rate of 3 m/sec^2 . At this instant, find :— 6
 (i) velocity component along x and y axis and
 (ii) its total acceleration.



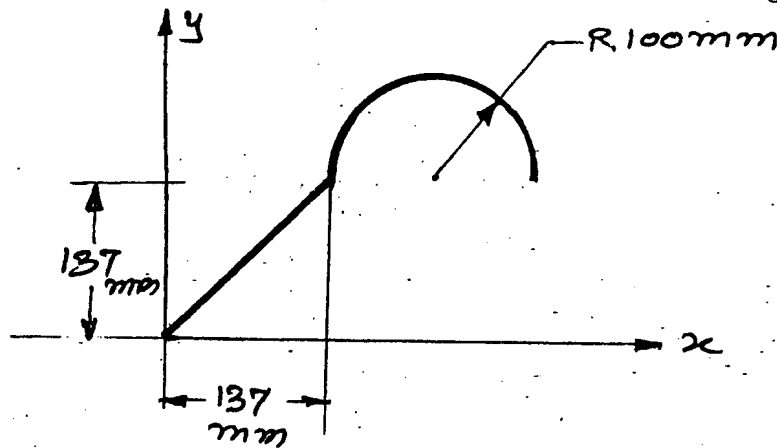
3. (a) Two spheres of 50 N each and 0.6 m diameter are placed in a cup of 1 m diameter, as shown in the figure. Find reactions at points of contact A, B, C and D. 8



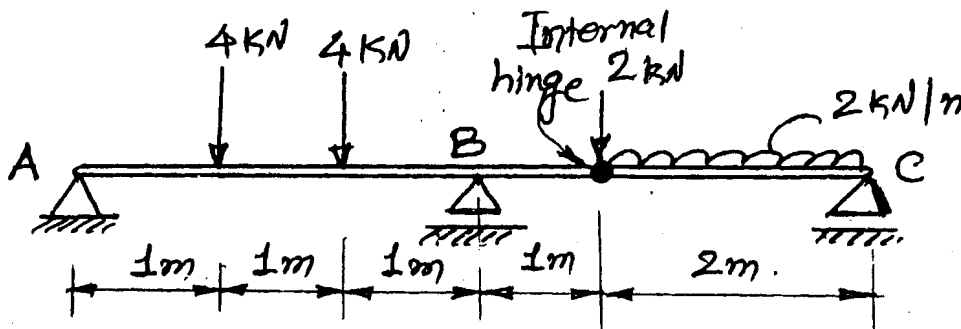
- (b) A particle travels on a curved path, Path travelled is defined by $s = 0.5 t^3 + 3 t$ in meters. If the total acceleration is 10 m/s^2 at $t = 2 \text{ sec}$; find the radius of curvature. 6
- (c) A rod AB of length 3 m is kept on Smooth planes as shown in the figure. Velocity of A is 5 m/s along the inclined plane. Find velocity of point B and locate ICR. 6



4. (a) Find the centroid of the bent up wire ABCD, as shown in the figure. 4



- ✓ (b) Find Reactions for the beam loaded and supported as shown in the figure. 8

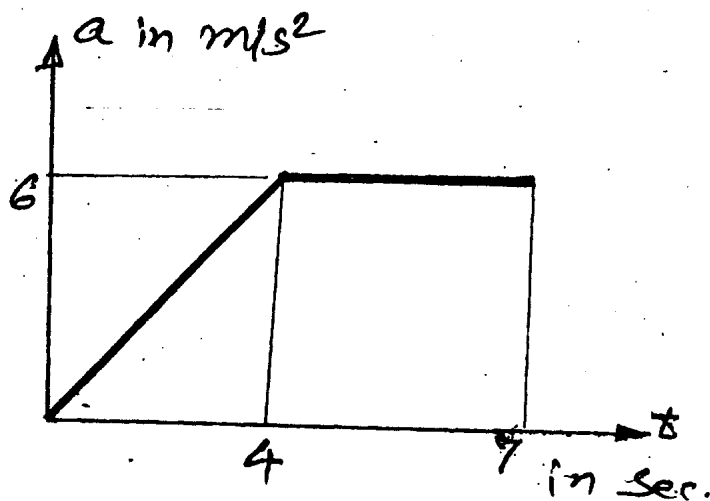


B and C are roller support

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- (c) The a-t curve for a particle having rectilinear motion is as shown in the figure. Draw v-t and s-t diagrams. At $t = 0, v = 8 \text{ m/s}$.

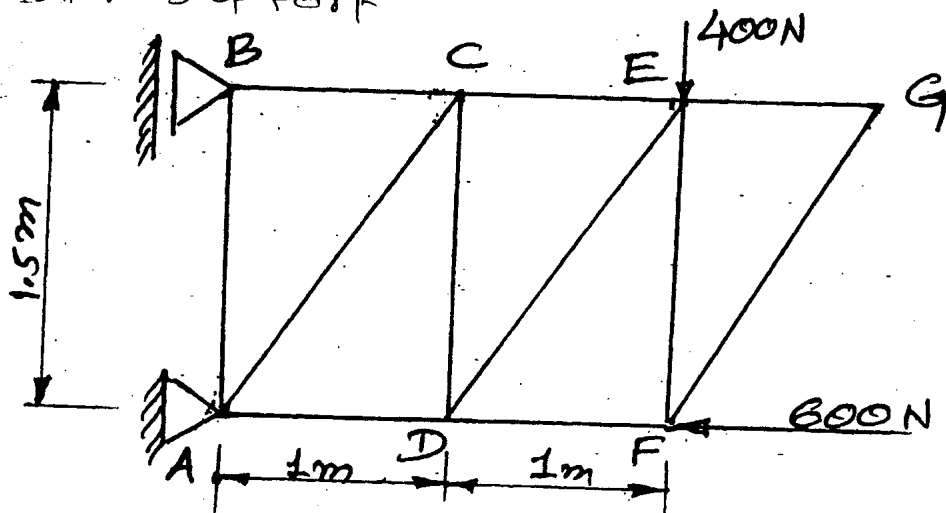
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5. (a) Find forces in the numbers BC, AC, CD, CE, DE and EF for the truss a shown in figure below :—

6

B is roller support

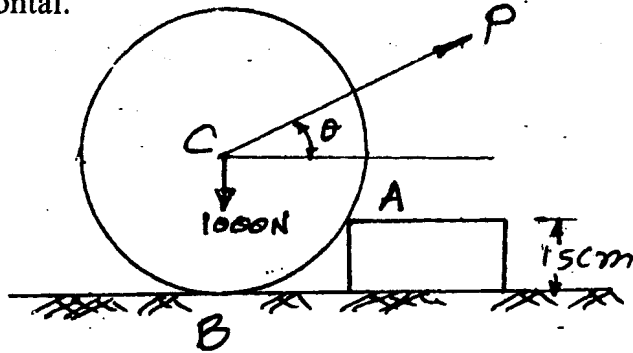


- (b) A flat belt 8 mm thick and 160 mm wide drives a pulley of 1200 mm in diameter at 180 rpm. Angle of contact is 180° ; and coefficient of friction is 0.3. The specific weight of the belt is 14 N/m. If the stress in the belt is not to exceed 1.5 MN/m^2 , determine the power transmitted.
- (c) A vertical lift of total mass 750 kg acquires an upward velocity of 3 m/s over a distance of 4 m moving with constant acceleration starting from rest. Calculate tension in the cable.

8

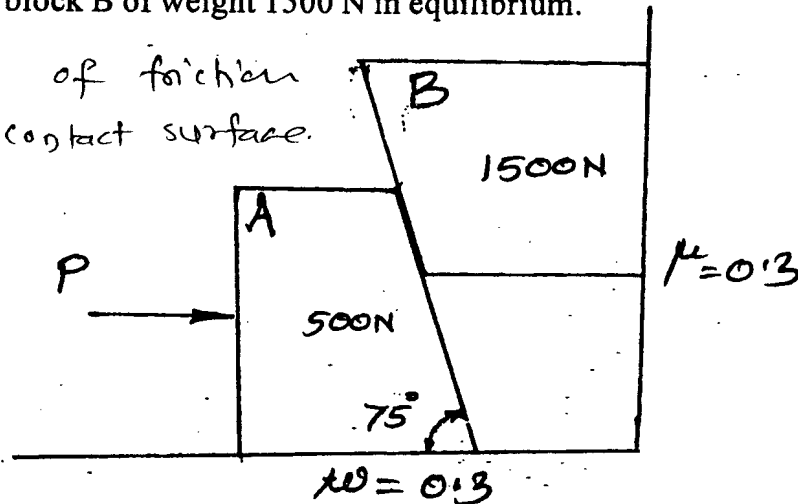
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6. (a) A uniform wheel of 60 cm diameter, weighing 1000 N rests against a rectangular step 15 cm high. Find the least force required, acting through the centre of the wheel, will just turn the wheel over the step. Also find angle θ which the force will make with horizontal.



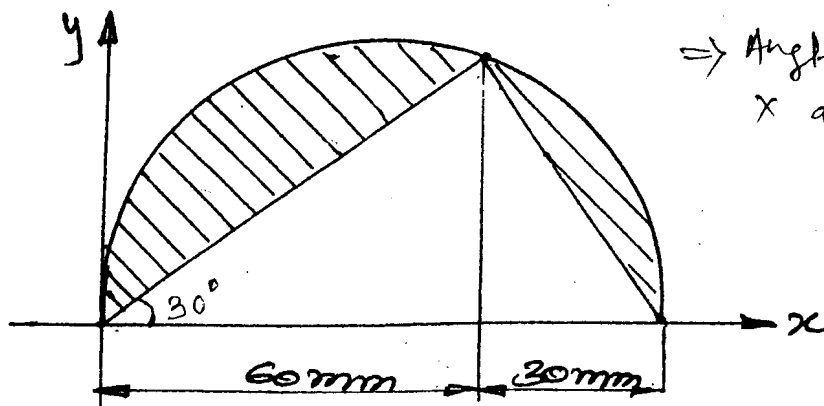
- (b) Find the minimum horizontal force P to be applied to block A, weighing 500 N so as to keep block B of weight 1500 N in equilibrium.

Coefficient of friction at all contact surface is 0.3



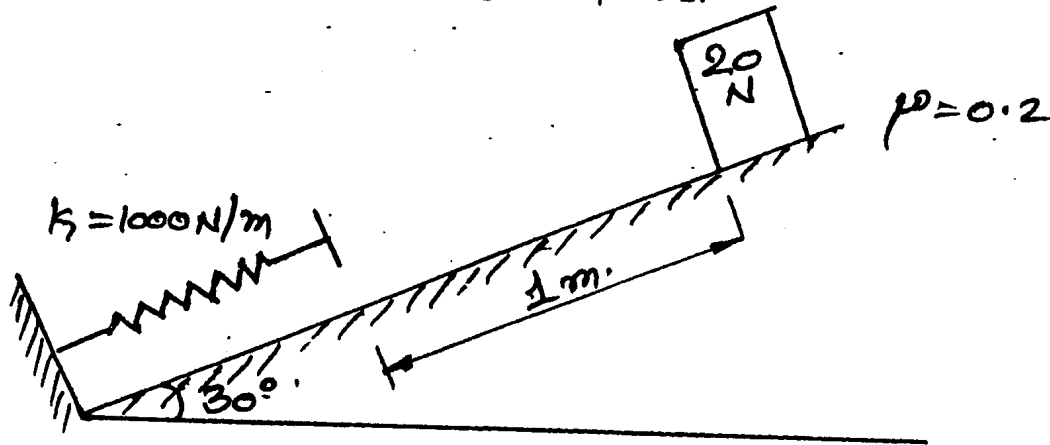
- (c) Rotation of a fly wheel is governed by the relation $\alpha = 20t - t^2$ in rad/sec². How many revolutions will it make before it comes to rest? Assume at $t = 0, \omega = 0$.

7. (a) Locate the centroid of shaded position of lamina shown below. Take diameter of semi circle as 90 mm.



\Rightarrow Angle at origin with x axis is 30 degree

- (b) A 20N block is released from rest. Determine maximum compression of the spring. Also determine the distance moved by the block when the energy is released from the compressed spring. Take $\mu = 0.2$. 8



- (c) A pile hammer weighing 25 kN drops from a height of 2 m on a pile of 5 kN. The pile penetrates 200 mm. Find the resistance to penetration, assuming it to be uniform. 6

- N. B. :**
- (1) Question No. 1 is compulsory.
 - (2) Attempt any **four** questions from remaining **six** questions.
 - (3) Use **suitable** data whenever is **required**.
 - (4) **Figures** to the **right** indicates **full** marks.
 - (5) Illustrate your answer with **sketches** whenever **necessary**.

1. Attempt any **five** out of **seven** questions :— 15
 - (a) Draw the following (101) , $(\bar{1}\bar{2}\bar{3})$ and $[2\ 3\ 1]$.
 - (b) The first order Bragg's reflection is observed at 28° in a certain crystal when X-rays of 0.32 nm are used. Find the interplanar spacing.
 - (c) What is Hall effect? Write any two application.
 - (d) Define Mobility of charge carrier and state its SI Units.
 - (e) State the Meissner effect in superconductors.
 - (f) State Sabine's formula and explain the terms used in it.
 - (g) Explain cavitations effect.

2. (a) Draw the Unit Cell of NaCl. Calculate the number of molecules per unit cell, packing efficiency, co-ordination number and nearest neighbours distance in terms of radii of Na and Cl ions. 8
 - (b) What is Fermi Energy? Show that for intrinsic semi conductors the Fermi level lies half way between conduction and valence band. 7
3. (a) What is superconductivity? Describe type - I and type - II superconductors. Prove that super conductors are perfect diamagnet. 8
 - (b) Explain construction and working of Electrostatic lens. 7
4. (a) What are liquid crystals? Explain its different phases. 5
 - (b) Calculate the conductivity of Ge specimen if the donor impurity added to Ge is $1.2 \times 10^{23}\text{ atoms/m}^3$. Given mobility of electron is $3800\text{ cm}^2/\text{V-sec}$. 5
 - (c) A classroom has dimensions $20 \times 15 \times 5\text{ m}^3$. The reverberation time is 3.5 second . 5
Calculate the average absorption coefficient and total absorption.

5. (a) Explain the procedure to determine miller indices of a crystal plane which intercepts the three axis. With one example. 5
- (b) What are the diffusion and drift currents in semiconductors ? Explain. 5
- (c) Velocity of ultrasonic waves in mild steel is 5.9×10^3 m/sec. The velocity of ultrasonic waves in brass measured by ultrasonic gauge meter which was calibrated for mild steel was found to be 4.3×10^3 m/sec. If the thickness of brass plate measured by ultrasonic gauge meter is 15 cm. What is its real thickness ? 5
6. (a) What are X-rays ? Differentiate between continuous and characteristic X-rays. 5
- (b) What are high T_c superconductors ? Give four applications of superconductors. 5
- (c) Find the depth of sea water from ship on sea surface. If the time interval of 2 seconds is required to receive the signal back. Given that the temperature of sea water is 20°C and salinity is 10 gm/lit. 5
7. (a) Estimate the ratio of vacancies at :— 5
- (i) -119°C and
- (ii) 80°C . Where average energy to create vacancy is 1.8 eV.
- (b) State acoustic requirements of a good auditorium. 5
- (c) What are Lissajous figures ? Explain how they are used to measure Unknown frequency. 5
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- N.B. :** (1) Question No. 1 is compulsory.
(2) Attempt any **four** questions from remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) **All** questions carry **equal** marks.
(5) **Atomic weights** : H = 1, C = 12, N = 14, O = 16, Na = 23, Mg = 24, Ca = 40, S = 32, Cl = 35.5, Fe = 58.8, K = 39, Al = 27. -

1. Attempt any **five** from the following :- 15
- (a) What is reverse osmosis ? Give its applications.
 - (b) Distinguish between thermoplastic and thermosetting polymers.
 - (c) Define cloud and pour point of lubricant and mention its significance.
 - (d) Differentiate between conventional and non-conventional energy sources.
 - (e) How plain carbon steel is classified on the basis of its carbon contents ?
 - (f) Explain fullerenes with structure and applications.
 - (g) 9 ml of oil is taken from gear box and it requires 1.5 ml of 0.04 N KOH. Find the acid value of oil and state whether it can be used further. (Density of oil is 0.81 gm/lit).
2. (a) Calculate the lime (95% pure) and soda (90% pure) required for softening of 10^5 6
liters of water containing the following constituents :-
 $\text{Ca}(\text{HCO}_3)_2 = 81 \text{ mg/L}$, $\text{Mg}(\text{HCO}_3)_2 = 98 \text{ mg/L}$,
 $\text{CaSO}_4 = 68 \text{ mg/L}$, $\text{Mg Cl}_2 = 95 \text{ mg/L}$,
 $\text{Mg}(\text{NO}_3)_2 = 14.8 \text{ mg/L}$, $\text{H}_2\text{SO}_4 = 14.7 \text{ mg/L}$.
- (b) Give preparation, properties and uses of Urea formaldehyde. 5
 - (c) Describe the working of solar heating system using flat plate collector. 4
3. (a) What is meant by fabrication of plastics ? Explain injection moulding with the help of neat diagram. 6
- (b) When solid lubricants are used ? Explain structure, properties and applications of Graphite as lubricant. 5
 - (c) What are carbon nano tubes ? Give types and applications of carbon nano tubes. 4
4. (a) Standard hard water contains 15 gm CaCO_3 in one liter of water. 20 ml of this solution required 25 ml EDTA. 100 ml of sample water required 15 ml of EDTA. This sample water was boiled, cooled and filtered and 100 ml of boiled water required 10 ml of EDTA. Calculate temporary, permanent and total hardness of the water sample. 4
- (b) Explain water system and draw a neat phase diagram. 5
 - (c) Define lubrication. Explain the mechanism of boundary film lubrication. 6

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5. (a) What are stainless steels ? Explain the special effects of the following metals on properties of alloy steels :- 6
(i) Chromium
(ii) Nickle
(iii) Cobalt
(iv) Tungsten.
- (b) Explain the process of melting and glass transition temperature of polymer. Write the factors affecting its value. 4
- (c) Explain the ion exchange process for softening of hard water. Give its advantages and disadvantages. 5
6. (a) Explain activated sludge process of treatment of sewage with the help of flow chart. 5
- (b) What is fuel cell ? Explain the principle and working of Hydrogen-Oxygen fuel cell. 4
- (c) Write a note on :- 6
(i) Nanocones
(ii) Hackelites.
7. (a) What is vulcanization ? How does it improve the properties of natural rubber ? 6
(b) Define BOD and COD and write their significance. 5
(c) State and explain the following terms :- 4
(i) Phases
(ii) Components, with reference to phase rule.
