

[Time: Three Hours]

[Marks: 80]

Please check whether you have got the right question paper.

- N.B:
1. Question No.1 is compulsory.
 2. Answer any three from the remaining.
 3. Figures to the right indicate marks.

- Q.1. a. Separate into real part and imaginary of $\cos^{-1}\left(\frac{3i}{4}\right)$ 03
- b. Show that the matrix A is unitary where $A = \begin{bmatrix} \alpha + i\gamma & \beta + i\delta \\ \beta + i\delta & \alpha + i\gamma \end{bmatrix}$ is unitary if $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = 1$ 03
- c. If $z = \tan(y + ax) + (y - ax)^{3/2}$ then show that $\frac{\partial^2 z}{\partial x^2} = a^2 \frac{\partial^2 z}{\partial y^2}$ 03
- d. If $x = uv$ $y = \frac{u}{v}$ Prove that $JJ' = 1$ 03
- e. Find the n^{th} derivative of $\frac{x^3}{(x+1)(x-2)}$ 04
- f. Using the matrix $A = \begin{bmatrix} -1 & 2 \\ -1 & 1 \end{bmatrix}$ decode the message matrix $C = \begin{bmatrix} 4 & 11 & 12 & -2 \\ -4 & 4 & 9 & -2 \end{bmatrix}$ 04
- Q.2. a. If $\sin^4 \theta \cos^3 \theta = a \cos \theta + b \cos 3\theta + c \cos 5\theta + d \cos 7\theta$ then find a, b, c, d. 06
- b. Using Newton Raphson method Solve $3x - \cos x - 1 = 0$ Correct to 3 decimal places. 06
- c. Find the stationary points of the function $x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$ & also find maximum and minimum values of the function. 08
- Q.3. a. Show that $x \operatorname{cosec} x = 1 + \frac{x^2}{6} + \frac{7}{360} x^4 + \dots$ 06
- b. Reduce matrix to PAQ normal form and find 2 non Singular matrices P & Q 06
- $$\begin{bmatrix} 1 & 2 & -1 & 2 \\ 2 & 5 & -2 & 3 \\ 1 & 2 & 1 & 2 \end{bmatrix}$$
- c. If $y = \cos(m \sin^{-1} x)$ Prove that $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} + (m^2 - n^2)y_n = 0$ 08

Q.P. Code : 24851

Q.4. a. State and prove Euler's theorem for three Variables.

b. Show that all the roots of $(x + 1)^6 + (x - 1)^6 = 0$ are given by $-\text{icot} \frac{(2k+1)\pi}{12}$ where $k= 0,1,2,3,4,5$

06
06

c. Show that the equations

$$-2x + y + z = a$$

$$x - 2y + z = b$$

$$x + y - 2z = c$$

08

have no solutions unless $a + b + c = 0$ in which case they have infinitely many solutions. Find these Solutions when $a = 1$ $b = 1$ $c = -2$

Q.5. a. If $z = f(x, y)$ $x = r \cos \theta$

$y = r \sin \theta$ Prove that

$$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2} \left(\frac{\partial z}{\partial \theta}\right)^2$$

06

b. If $\cos hx = \sec \theta$ Prove that

i) $x = \log(\sec \theta + \tan \theta)$

ii) $\theta = \frac{\pi}{2} - 2 \tan^{-1}(e^{-x})$

06

c. Solve by Gauss Jacobi Iteration method

$$5x - y + z = 10$$

$$2x + 4y = 12$$

$$x + y + 5z = -1$$

08

Q.6. a. Prove that

$$\cos^{-1}[\tan h(\log x)] = \pi - 2 \left(x - \frac{x^3}{3} + \frac{x^5}{5} - \dots \right)$$

06

b. If $y = e^{2x} \sin \frac{x}{2} \cos \frac{x}{2} \sin 3x$ Find y_n

06

c. (i) Evaluate $\lim_{x \rightarrow 0} (\cot x)^{\sin x}$

04

(ii) Prove that $\log \left[\frac{\sin(x+iy)}{\sin(x-iy)} \right] = 2i \tan^{-1}(\cot x \tan hy)$

04

Correction for QP code 24851

1. b. $A = \begin{bmatrix} \alpha + i\beta & -\beta + i\delta \\ \beta + i\delta & \alpha - i\beta \end{bmatrix}$ is
 corrected A matrix.

Q1. c. No. in equation
 $Z = \dots - ax)^{3/2}$
 Power $\frac{3}{2}$
 term only second



Q. P. Code: 26572

Time: 2 hours

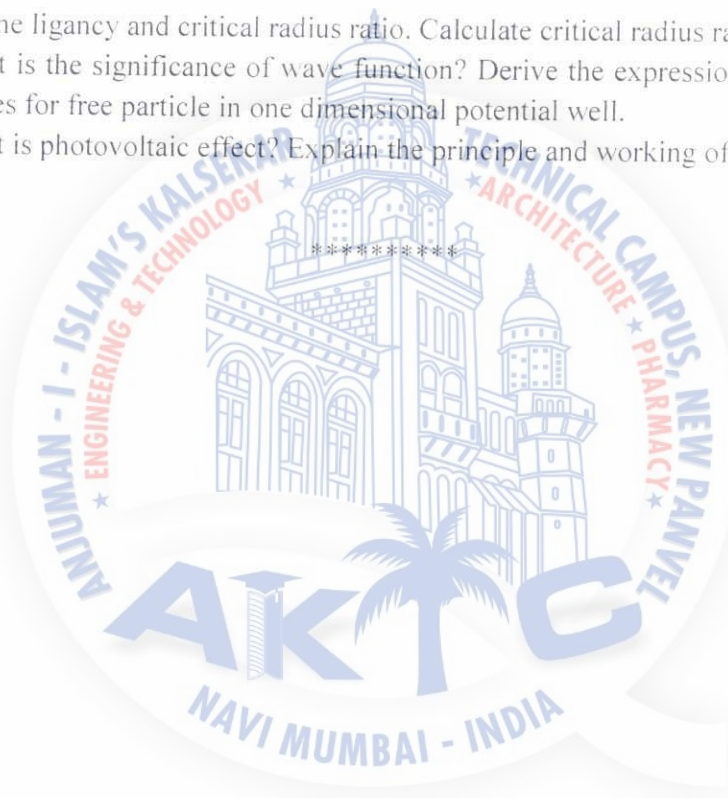
Marks: 60

- N. B. 1) Question no **1** is **compulsory**
2) Attempt any **three** questions from **Q.2 to Q.6**
3) Assume suitable data wherever required
4) Figures on the **right** indicates **marks**

- 1 Attempt **any five** 15
- a 'Crystal act as three dimensional grating for X-rays', explain.
 - b Calculate the frequency and wavelength of photon whose energy is 75eV.
 - c Draw the energy band diagram of p-n junction diode in forward and reverse bias condition.
 - d "Superconductor is a perfect diamagnetic", Explain.
 - e What is reverberation time? How is it important? Write the factors affecting reverberation time.
 - f A quartz crystal of thickness 1.5mm is vibrating with resonance. Calculate it's fundamental frequency if the Young's modulus of quartz crystal is $7.9 \times 10^{10} \text{N/m}^2$ and density is 2650kg/m^3 .
 - g Mobility's of electron and hole in a sample of Ge at room temperature are $0.36 \text{m}^2/\text{V-sec}$ and $0.17 \text{m}^2/\text{V-sec}$ respectively. If electron and hole densities are equal and it is $2.5 \times 10^{13} / \text{cm}^3$, calculate its conductivity.
- 2 a With Heisenberg's uncertainty principle prove that electron cannot survive in nucleus. An electron has a speed of 300m/sec. with uncertainty of 0.01%. Find the accuracy in its position. 4
- b Show that Fermi energy level in intrinsic semiconductor is at the Centre of forbidden energy gap. 4
- What is the probability of an electron being thermally excited to the conduction band in Si at 30°C . The band gap energy is 1.12eV. 7
- 3 a With neat diagram of unit cell, explain the structure of HCP crystal and calculate the no. of ions per unit cell, coordination no. , lattice constant and packing factor of the structure. 8
- b State the Hall effect. Derive the expression for Hall voltage and Hall coefficient with neat diagram. 7

Q. P. Code: 26572

- 4 a What is working principle of Maglev? Explain how it can acquire high speed? 5
b A hall of dimensions $25 \times 18 \times 12 \text{ m}^3$ has an average absorption coefficient 0.2. Find the reverberation time. If a curtain cloth of area 150 m^2 is suspended at the Centre of hall with coefficient of absorption 0.75, What will be the reverberation time? 5
c State the piezoelectric effect. With neat circuit diagram explain the principle and working of piezoelectric oscillator. 5
- 5 a With energy band diagram, explain the variation of Fermi energy level with temperature in extrinsic semiconductor. 5
b Explain with example how to determine crystal structure by Bragg's X-ray spectrometer. 5
c Obtain one dimensional time dependent Schrodinger equation. 5
- 6 a Define ligancy and critical radius ratio. Calculate critical radius ratio for ligancy 6. 5
b What is the significance of wave function? Derive the expression for energy Eigen values for free particle in one dimensional potential well. 5
c What is photovoltaic effect? Explain the principle and working of Solar cell. 5



F E Sem-I - choice based - AC-I

21/12

Q.P. Code :22640

[Time: Two Hours]

[Marks:60]

Please check whether you have got the right question paper.

- N.B:
1. Question.No.1 is compulsory.
 2. Answer any three questions from the remaining five.
 3. All questions carry equal marks.
 4. Atomic weights: Ca= 40, C = 12, O = 16,H =1, Mg =24, S=32, Cl=35.5

Q.1 Attempt **any five** from the following.

15

- a) Distinguish between BOD & COD.
- b) Give the preparation, properties & uses of Kevlar.
- c) Calculate total hardness, in ppm, in given water sample:
 - i) 50ml standard hard water, containing 1mg pure CaCO_3 per ml, consumed 20ml EDTA solution.
 - ii) 50ml water sample consumed 30ml EDTA solution using Erio-Black T indicator.
- d) Define flash point & fire point? Give its significance.
- e) State the number of phases, component for the following equilibrium
 - i) $\text{H}_2\text{O}_{(s)} \rightleftharpoons \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}_2\text{O}_{(g)}$
 - ii) Mixture of Rhombic & monoclinic sulphur.
- f) What are plasticizers? Give its uses & examples.
- g) Write a brief note on CNT's.

Q.2

- a) Calculate the quantity of lime & soda required for softening of 1,00,000 liters of water containing the following impurities in ppm. The purity of lime is 70% & soda is 85%
 $\text{Ca}(\text{HCO}_3)_2 = 30.2$, $\text{Mg}(\text{HCO}_3)_2 = 20.8$, $\text{CaCl}_2 = 28.1$, $\text{MgCl}_2 = 8.78$,
 $\text{CaSO}_4 = 35$, $\text{MgSO}_4 = 6.7$

06

- b) i) Distinguish between thermoplastic & thermosetting resins.
 ii) What are the functions of lubricants?

03

02

- c) What is Decay of concrete? Discuss its prevention.

04

Q.3

- a) Define fabrication. List the methods used. Discuss extrusion moulding in detail.
- b) i) What are the limitations of phase rule?
 ii) Draw a neat, labeled diagram of the Rotary kiln.
- c) 15,000 liters of hard water was passed through a zeolite softener. The exhausted zeolite required 120 liters of NaCl having strength of 30g/l of NaCl. Calculate the hardness of water.

06

03

02

04

Q.P. Code :22640

- Q.4 a) What is activated sludge? How is the process carried out for treatment of waste water? Explain with a flow sheet diagram. 06
- b) i) 20ml of lubricating oil was dissolved in alcohol. The solution was titrated against 0.1N KOH solution. At the end point the burette reading was found to be 2.5ml. calculate the acid value of the oil (density of oil = 0.86 g/ml) 03
ii) Distinguish between the dry & wet process for manufacturing of Portland cement. 02
- c) List the uses of polymers in medicine & surgery. 04
- Q.5 a) Write notes on (any two) 06
i) Glass transition temperature
ii) Conducting polymers
iii) Vulcanization
- b) i) Discuss the treatment of water using bleaching powder. 03
ii) Explain the mechanism of Extreme pressure lubrication 02
- c) What is reduced phase rule? Draw the phase diagram of the Ag-Pb system with proper labelling. 04
- Q.6 a) What are the conditions for use of solid lubricants? Discuss the structure & uses of Graphite. 06
- b) i) Discuss the Triple point in a one-component system. 03
ii) Explain Reverse Osmosis. 02
- c) Write a note on Fullerenes. 04

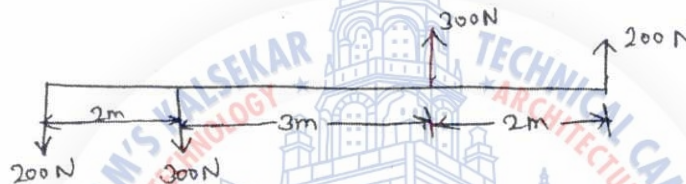
[3 Hours]

[Marks: 80]

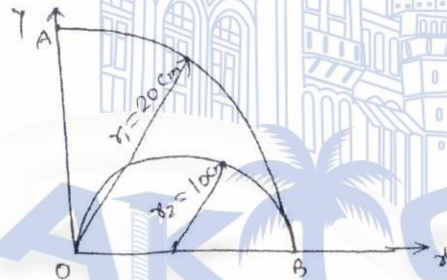
- N.B:
1. Question No. **1** is compulsory.
 2. Attempt any **three** questions out of remaining **five** questions.
 3. Assume **suitable** data if necessary stating them clearly.
 4. Take $g = 9.81 \text{ m/s}^2$.
 5. Draw suitable sketches wherever necessary.

I. Attempt any four :

- (a) State and prove varignon's theorem. 05
- (b) Find the resultant of the force system shown in fig. 05



- (c) Find the co-ordinate of the centroid of the area shown in fig. 05



All dimensions are in cm

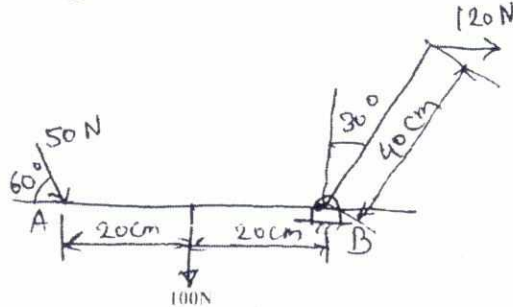
- (d) A force of 500N is acting on a block of 50Kg mass resting on a horizontal surface as shown in fig. Determine the velocity after the block has travelled a distance of 10m. Coeff. of kinetic friction = 0.5 05



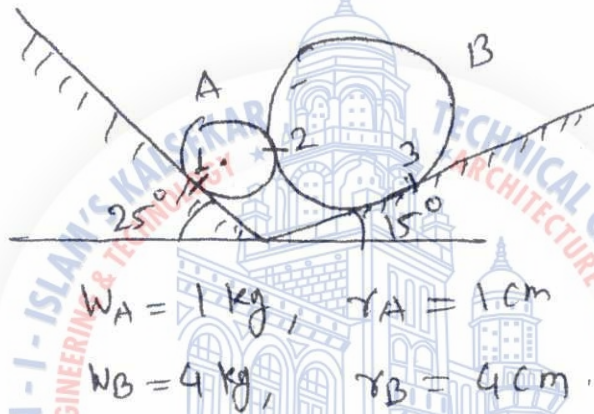
- (e) The position vector of a particle which moves in the X-Y plane is given by $\vec{r} = (3t^3 - 4t^2)\mathbf{i} + (0.5t^3)\mathbf{j}$ m. Calculate velocity and acceleration at $t = 1$ sec. 05

[TURN OVER

2. (a) Find the resultant of the force acting on the bell crank level shown. Also locate its position write hinge B. 08

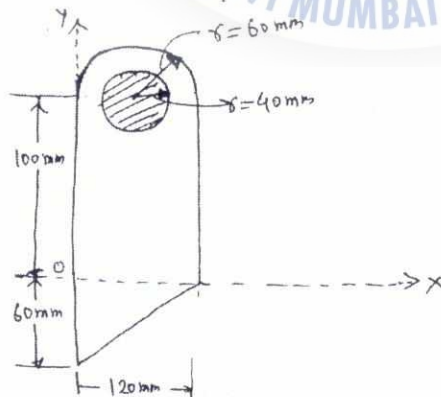


- (b) Determine the reaction at points of constant 1, 2 and 3. Assume smooth surfaces. 05



- (c) Two balls having 20Kg and 30Kg masses are moving towards each other with velocities of 10m/s and 5m/s respectively as shown in fig. If after impact the ball having 30Kg mass is moving with 6m/s velocity to the right then determine the coefficient of restitution between the two balls. 06

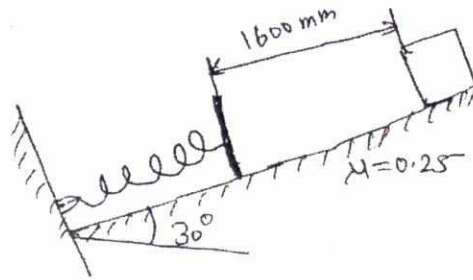
3. (a) Determine the centroid of the plane lamina shaded portion is removed. 08



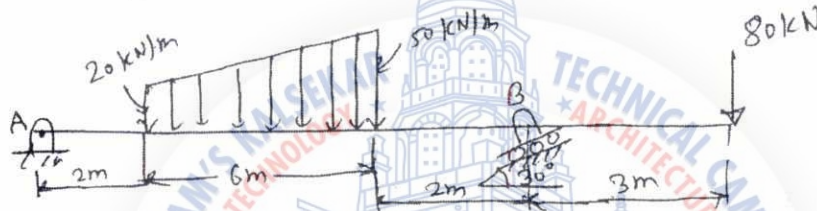
- (b) Explain conditions for equilibrium for forces in spaces. 06

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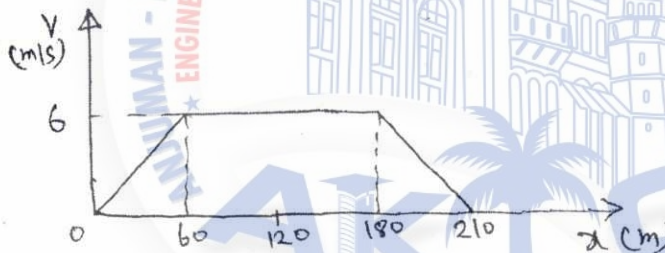
- (c) A 30N block is released from rest. It slides down a rough incline having coefficient of friction 0.25. Determine the maximum compression of the spring. 06



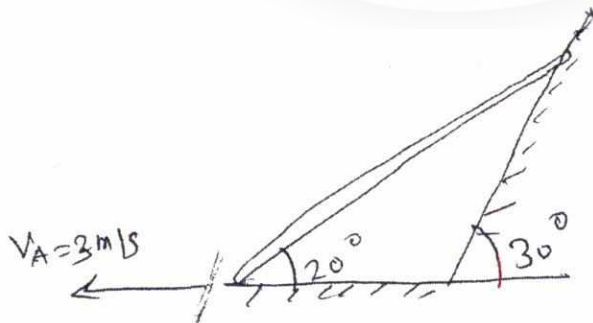
4. (a) Find the support reaction at A and B for the beam loaded as shown in fig. 08



- (b) The V-X graph of a rectilinear moving particle is shown. Find acceleration of the particle at 20 m , 80 m and 200 m . 06

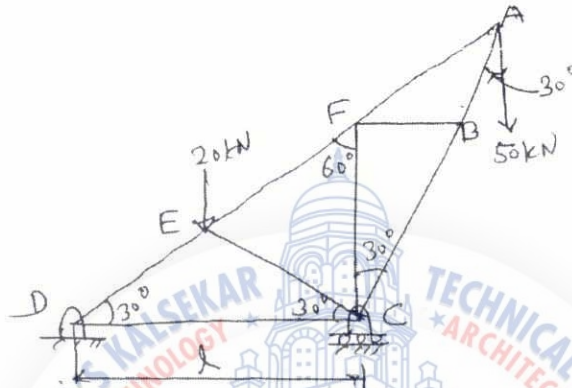


- (c) A bar AB 2 m long slides down the plane as shown. The end A slides on the horizontal floor with a velocity of 3 m/s . Determine the angular velocity of the rod AB and the velocity of end B for the position shown. 06

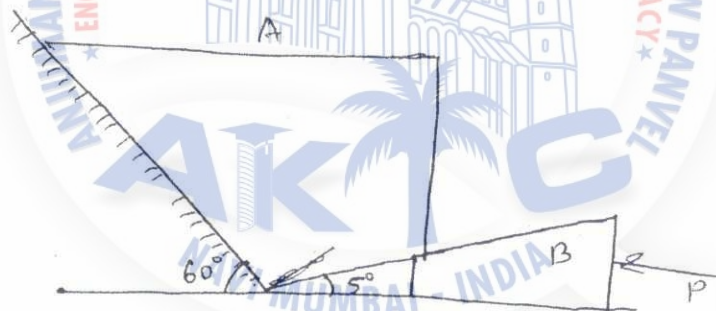


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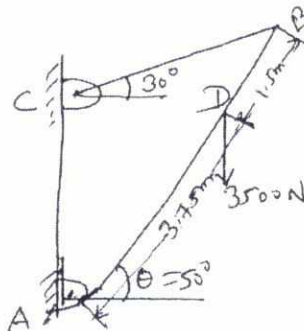
5. (a) Referring to the truss shown in fig. Find 08
- i. Reaction at D and C
 - ii. Zero Force members
 - iii. Forces in members FE & DC by method of section.
 - iv. Forces in other members by method of joints.



- (b) Determine the force P required to move the block A of 5000N weight up the inclined plane, coefficient of friction between all contact surfaces is 0.25. Neglect the weight of the wedge and the wedge angle is 15 degrees. 06



- (c) Determine the tension in a cable BC shown in fig by virtual work method. 06



[TURN OVER

6. (a) A 500N Crate kept on the top of a 15° sloping surface is pushed down the plane with an initial velocity of 20 m/s. If $\mu_s = 0.5$ and $\mu_k = 0.4$, Determine the distance travelled by the block and the time it will take as it comes to rest. **05**
- (b) Derive the equation of the path of a projectile and hence show that the path traced by a projectile is a parabolic curve. **05**
- (c) A particle is moving in X-Y plane and its position is defined by $\vec{r} = \left(\frac{3}{2}t^2\right)\mathbf{i} + \left(\frac{2}{3}t^3\right)\mathbf{j}$. **05**
Find ratio of curvature when $t = 2$ sec.
- (d) A force of 100N acts at a point P(-2, 3, 5) m has its line of action passing through Q (10, 3, 4) m. Calculate moment of this force about origin (0,0,0). **05**



ing towards each other with velocities 10 m/s
after impact the ball having mass 30 kg is
determine the coefficient of restitution between the



Fig. 16.4

Force P

Wedge angle $\theta = 15^\circ$

Q.5



1000 N/m

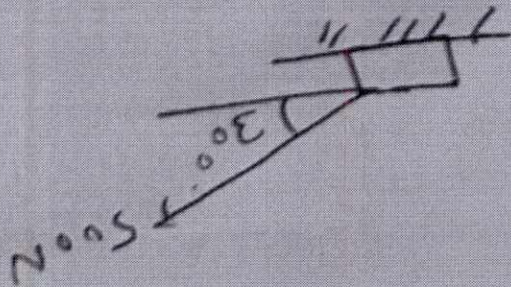
Stress

Q.3 (c)

Q.2 (c)

$$\frac{1}{2}(4+5) \times 1 + \frac{1}{2}(3+4) \times 1 = 2$$

Q.1 (c)

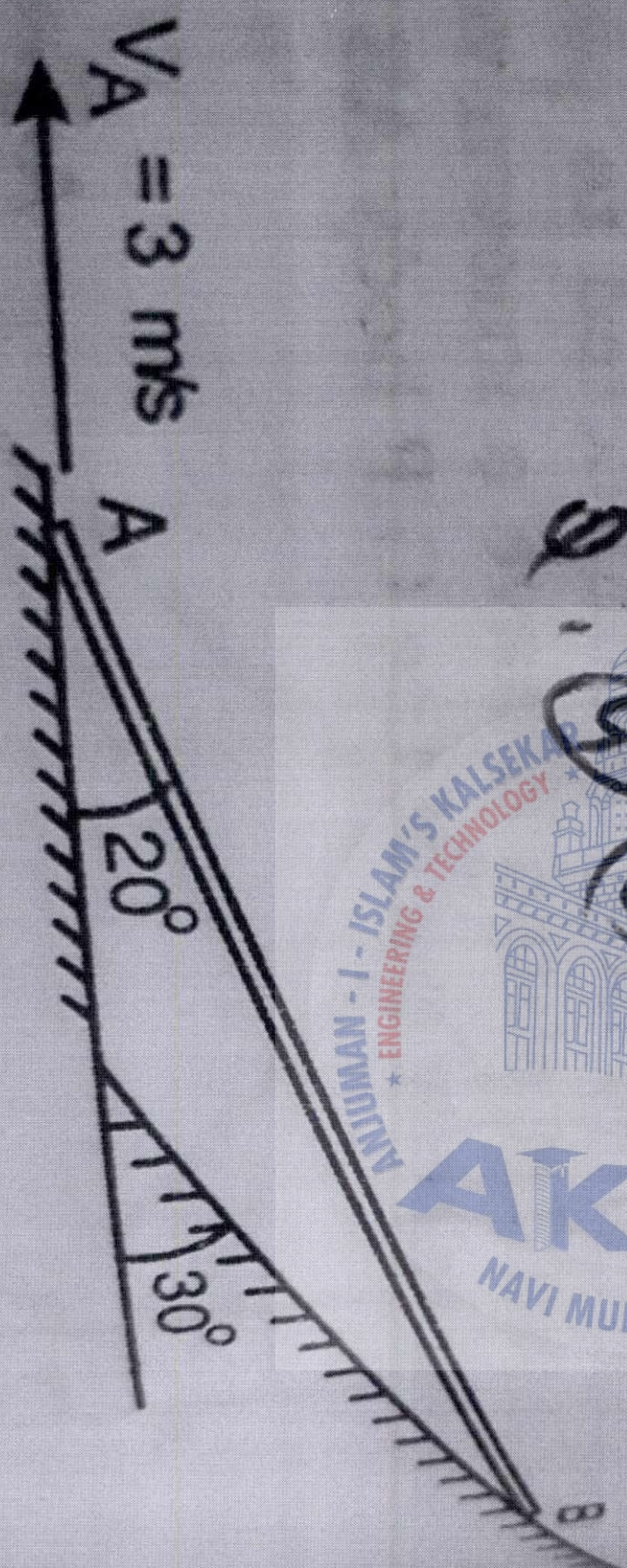


Q.1 (P)

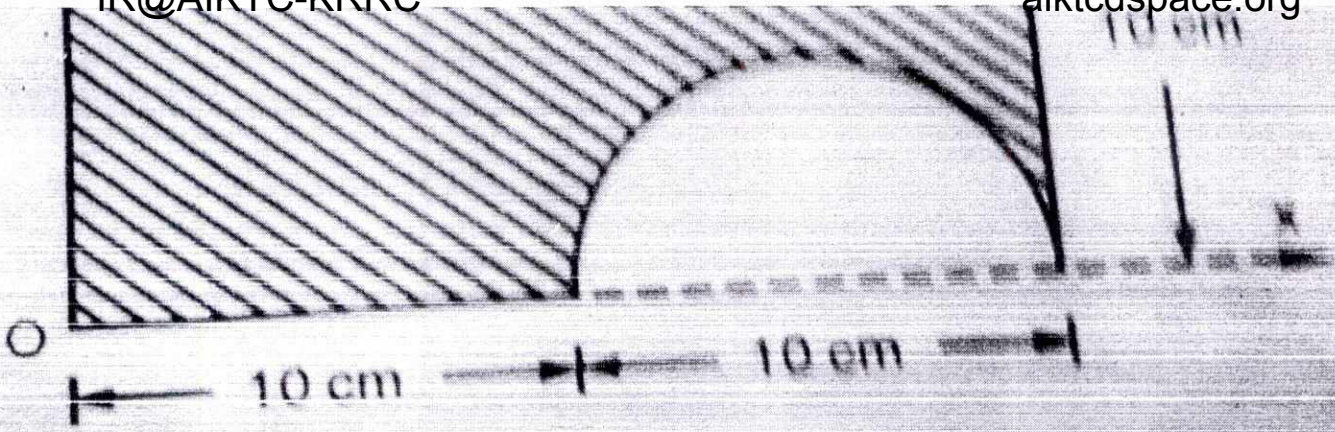
Shaded portion Quarter circle

Engineering Mechanics Statics and Dynamics

Q: (30)

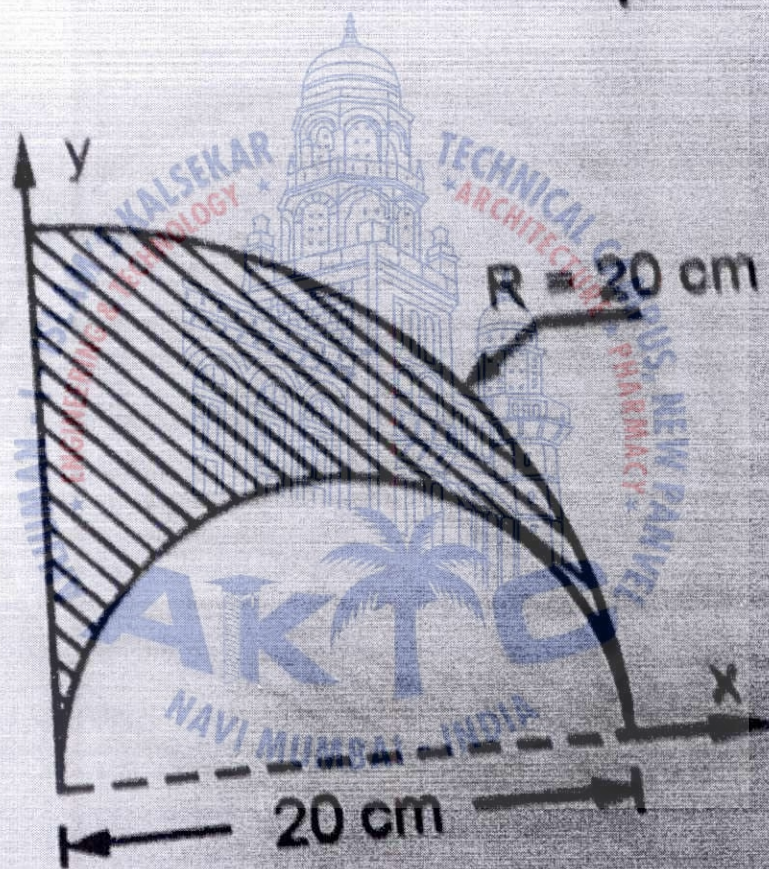


Kinematics
13.5.2



29. Find centroid of the shaded area. (M.U. Dec 13)

(W.C)





459

FE-Sem-I - choice Based - B.E.E

15/12/17

Q.P. Code : 25675

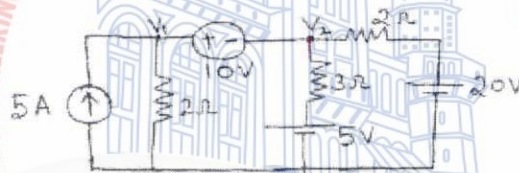
(3 Hours)

[Total Marks : 80

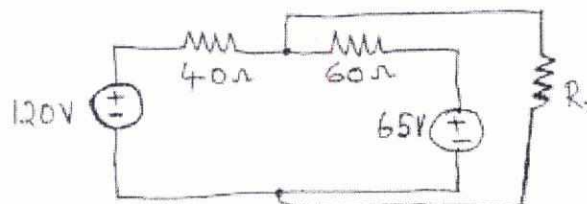
- N.B. :** (1) **Question No.1 is compulsory.**
 (2) Solve **any three** from remaining questions.
 (3) Assume suitable **data** if **necessary.**
 (4) **Figures** to the **right** indicate **full marks.**

1. Answer any Five :

- (a) A voltage $v(t)=282.85 \sin 100\pi t$ is applied to a coil, having resistance of 20Ω in series with inductance of 31.83mH . Find 04
 (i) RMS value of voltage;
 (ii) RMS value of current;
 (iii) power dissipated in the coil and
 (iv) power factor of the coil.
 (b) Derive the relation between line voltage and phase voltage in star connected three phase system. 04
 (c) Find the node voltage V_2 by nodal analysis. 04



- (d) A single phase transformer has a turn ratio (N_1/N_2) of 2:1 and is connected to a resistive load. Find the value of primary current (both magnitude and angle with reference to flux), if the magnetizing current is 1A and the secondary current is 4A. Neglect core losses and leakage reactance. Draw the corresponding phasor diagram. 04
 (e) Find the Norton's equivalent of the given circuit across R_x . 04



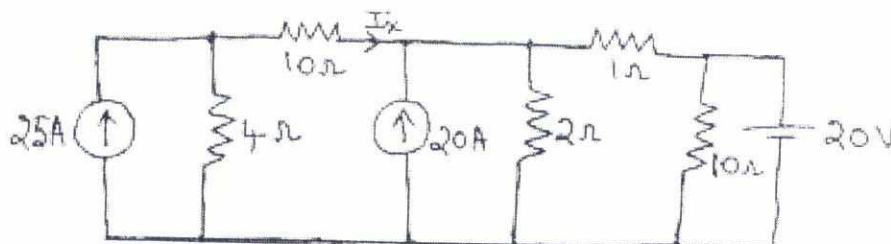
- (f) A coil having a resistance of 20Ω . and an inductance of 0.1H is connected in series with a $50\mu\text{F}$ capacitor. An alternating voltage of 250V is applied to the circuit. At what value of frequency will the current in the circuit be maximum? What is the value of this current? Also find the voltage across the inductor and quality factor. 04

TURN OVER

Q.P. Code : 25675

2

2. (a) With necessary diagrams, prove that three phase power can be measured by only two watt meters. Also prove that reactive power can be measured from the wattmeter readings. 10
- (b) A circuit has $L = 0.2\text{H}$ and inductive resistance 20Ω is connected in parallel with $200\mu\text{F}$ capacitor with variable frequency, 230V supply. Find the resonant frequency and impedance at which the total current taken from the supply is in phase with supply voltage. Draw the phasor diagram and derive the formula used (both impedance and frequency). Also find the value of the supply current and the capacitor current. 10
3. (a) Two impedances $14 + j5\Omega$ and $18 + j10\Omega$ are connected in parallel across 200V , 50Hz , single phase supply. Determine: 10
- Admittance of each branch in polar form;
 - Current in each branch in polar form;
 - power factor of each branch;
 - active power in each branch and
 - reactive power in each branch.
- (b) Derive the emf equation of a single phase transformer. Find the value of the maximum flux in a 25kVA , $3000/240\text{V}$, single phase transformer with 500 turns on the primary. The primary winding is connected to 3000V , 50Hz supply. Find primary and secondary currents. Neglect all voltage drops. 06
- (c) Compare core type and shell type transformer (any four points). 04
4. (a) An alternating voltage is represented by $v(t) = 141.4 \sin(377t)$ V. Derive the RMS value of this voltage. Find 08
- instantaneous value at $t = 3\text{ms}$ and
 - the time taken for the voltage to reach 70.7V for the first time.
- (b) State Superposition theorem. Find I_x using Superposition Theorem without using source transformation technique. 12

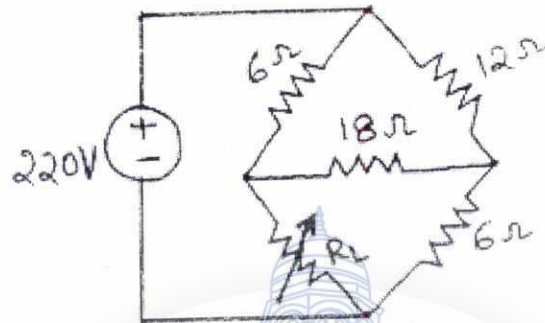


TURN OVER

Q.P. Code : 25675

3

5. (a) State and prove maximum power transfer theorem. Find the value of the resistance R_L using maximum power transfer theorem and find the value of maximum power transferred. 10



- (b) A balanced load of phase impedance 100Ω and power factor 0.8 (lag) is connected in delta to a 400 V, 3-phase supply. Calculate: 10
- phase current and line current;
 - active power and reactive power. If the load is reconnected in star across the same supply, find
 - phase voltage and line voltage;
 - phase current and line current. What will be the wattmeter readings if the power is measured by two wattmeter method (either star or delta).
6. (a) The readings when open circuit and short circuit tests are conducted on a 4kVA, 200/400 V, 50 Hz, single phase transformer are given below. Find the equivalent circuit parameters and draw the equivalent circuit referred to primary. Also find the transformer efficiency and regulation at full load and half load for 0.8 pf lagging. 12

OC test on LV side	200V	0.7 A	70 W
SC test on HV side	15V	10 A	85 W

- (b) With neat diagram explain the main parts of a d.c. machine? Mention the functions of each part. 08

377

Q. P. Code: 27769

Time : 2 hours

Max marks : 60

- N.B.:** i) Question No 1 is compulsory
ii) Attempt any 3 from Q.2 to Q.6
iii) Figures to the right indicate marks.

Q1. Attempt any Five

[15]

- Explain depleting nature of forests: causes, effects and prevention.
- Explain the concept of socio-economic aspects of sustainable development.
- What is meant by 'greenhouse effect' ?
- Write a short note : Environmental Clearance mechanism .
- What are limitations of conventional energy sources ?
- Write a short note on 'water crisis'.
- Explain the concept of 'carbon credit'.

Q2.

- Write a detailed account of 'Chipko movement'. [5]
- What are '3R control measures'? [5]
- Define 'noise pollution'. Which are its sources? What are its health effects? [5]

Q3.

- Explain principle, construction and working of electrostatic precipitator. [5]
- Discuss the case study of cloudburst and landslide at Kedarnath. [5]
- How electricity is generated from wind energy? [5]

Q4

- Discuss the case study of 'London smog'. [5]
- Write in details : Food chain and food web. [5]
- Write a note on : Green buildings – Concept and objectives. [5]

Q5.

- What is land pollution ? Discuss solid waste management. [5]
- Which are renewable energy resources ? Write about their importance. [5]
- Write on : Functions and powers of Central pollution control board. [5]

Q6.

- a) What is nuclear pollution ? Discuss Fukushima disaster. [5]
- b) What is an ecosystem ? Discuss the classification of ecosystems with examples. [5]
- c) Draw a schematic diagram of photovoltaic cell. Explain its principle and working. [5]

