

- N.B.:** (1) Question No. 1 is compulsory.  
 (2) Attempt any **three** questions from Questions Nos. 2 to 6.  
 (3) **Figures to right** indicates full marks.  
 (4) Draw neat **sketches** wherever **necessary**.

1. Attempt any **five** of the following :— 15
  - (a) Why acid-rains are caused ?
  - (b) What are the sources and effects of E-pollution ?
  - (c) How Indoor pollution is caused ?
  - (d) With suitable example explain the concept of food-chain.
  - (e) Which are renewable energy sources ? Why they are important ?
  - (f) What role is played by Ministry of Environment and Forest (MoEF) in conservation of Environment ?
  - (g) What is Appropriate Technology ?
  
2.
  - (a) Explain Socio-Economic aspects of sustainable development. 5
  - (b) With the help of neat diagram, explain working of venturi Scrubber. 5
  - (c) Explain briefly how Photo voltaic cells are useful in harnessing solar energy ? 5
  
3.
  - (a) Explain briefly Industrial waste water treatment. 5
  - (b) What are the powers and functions of Central Pollution Control Board ? 5
  - (c) Explain the concept and objectives of Green Building. 5
  
4.
  - (a) How does Biomass and Energy flow are related in Ecological Pyramid ? 5
  - (b) How electricity can be generated from wind energy ? 5
  - (c) Explain salient features of Environmental Protection Act. 5
  
5.
  - (a) How Resource utilisation as per carrying capacity is important for sustainable development ? 5
  - (b) With suitable diagram of steam power plant, explain how electricity can be obtained from geothermal energy ? 5
  - (c) What is Solid Waste Management ? How Solid Waste Management is done by composting ? 5
  
6.
  - (a) Explain various methods or techniques for managing earthquakes ? 5
  - (b) What are the sources and effects of noise pollution ? 5
  - (c) Explain the relevance of 3R for sustainable development. 5

Con. 8962-12.

(REVISED COURSE)

(3 Hours)

KR-3357

[Total Marks : 80

- N.B. : (1) Question No. 1 is compulsory.  
 (2) Attempt any three questions from the remaining five.  
 (3) Figures to the right indicate full marks.

1. (a) Prove that  $\frac{1}{1 - \frac{1}{1 - \frac{1}{1 - \cosh^2 x}}} = \cosh^2 x$  3

(b) If  $u = \log [\tan x + \tan y]$ , prove that, 3  
 $\sin 2x \frac{\partial u}{\partial x} + \sin 2y \frac{\partial u}{\partial y} = 2.$

(c) If  $u = \frac{x+y}{1-xy}$ ,  $v = \tan^{-1} x + \tan^{-1} y$ , find  $\frac{\partial(u,v)}{\partial(x,y)}$  3

(d) Show that  $\log[1 + \sin x] = x - \frac{x^2}{2} + \frac{x^3}{6} + \dots$  3

(e) Show that every square matrix can be uniquely expressed as  $P + iQ$ , where  $P$  and  $Q$  are Hermitian matrices. 4

(f) Find  $n^{\text{th}}$  order derivative of  $\frac{x^2+4}{(x-1)^2(2x+3)}$  4

2. (a) Show that the roots of the equation  $(x + 1)^6 + (x - 1)^6 = 0$  are given by 6

$$-i \cot \left[ \frac{(2k+1)\pi}{12} \right], k = 0, 1, 2, 3, 4, 5.$$

(b) Reduce the following matrix into normal form and find its rank 6

$$\begin{bmatrix} 2 & -1 & 1 & 1 \\ 1 & 0 & 1 & 2 \\ 3 & 3 & 3 & 1 \\ 1 & 4 & 2 & 0 \\ 0 & -4 & -1 & 2 \end{bmatrix}$$

(c) State and prove the Euler's theorem for a homogeneous function in two variables. 8

Hence find the value of  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$  if  $u = \frac{\sqrt{xy}}{\sqrt{x} + \sqrt{y}}$

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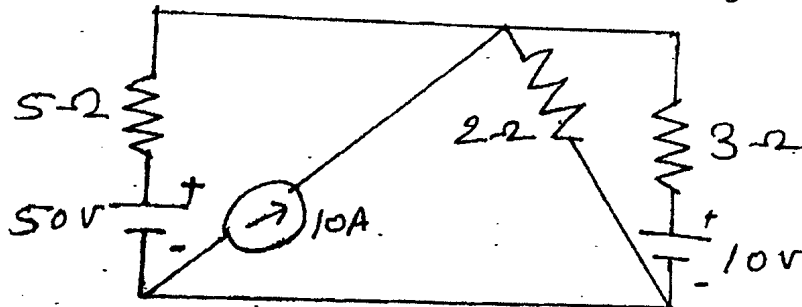
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3. (a) Test for consistency and solve if consistent – 6  
 $x_1 - 2x_2 + x_3 - x_4 = 2$  ;  $x_1 + 2x_2 + 2x_4 = 1$  ;  
 $4x_2 - x_3 + 3x_4 = -1$
- (b) Find all the stationary values of  $x^3 + 3xy - 15x^2 - 15y^2 + 72x$ . 6
- (c) If  $\tan\left(\frac{\pi}{4} + iv\right) = re^{i\theta}$ , show that 8
- (i)  $r = 1$     (ii)  $\tan \theta = \sinh 2v$     (iii)  $\tan hv = \tan \frac{\theta}{2}$ .
4. (a) If  $x = u + e^{-v} \sin u$ ,  $y = v + e^{-u} \cos u$  find  $\frac{\partial u}{\partial y}$ ,  $\frac{\partial v}{\partial x}$  by using Jacobian. 6
- (b) Considering only the principal value, if  $(1 + i \tan \alpha)^{1 + i \tan \beta}$  is real, prove that its value is  $(\sec \alpha)^{\sec^2 \beta}$ . 6
- (c) Solve the system of linear equation by Crout's method 8  
 $x - y + 2z = 2$  ;  $3x + 2y - 3z = 2$  ;  $4x - 4y + 2z = 2$ .
5. (a) Expand  $\cos^7 \theta$  in a series of cosines of multiples of  $\theta$ . 6
- (b) Evaluate  $\lim_{x \rightarrow 0} \left[ \frac{1}{x^2} - \cot^2 x \right]$  6
- (c) If  $y = (\sin^{-1} x)^2$ , obtain  $y_n(0)$ . 8
6. (a) Show that the vectors are linearly dependent and find the relation between them :- 6  
 $X_1 = [1, 2, -1, 0]$ ,  $X_2 = [1, 3, 1, 2]$ ,  $X_3 = [4, 2, 1, 0]$ ,  $X_4 = [6, 1, 0, 1]$
- (b) If  $\frac{x^2}{1+u} + \frac{y^2}{2+u} + \frac{z^2}{3+u} = 1$ , 6  
 Prove that,  

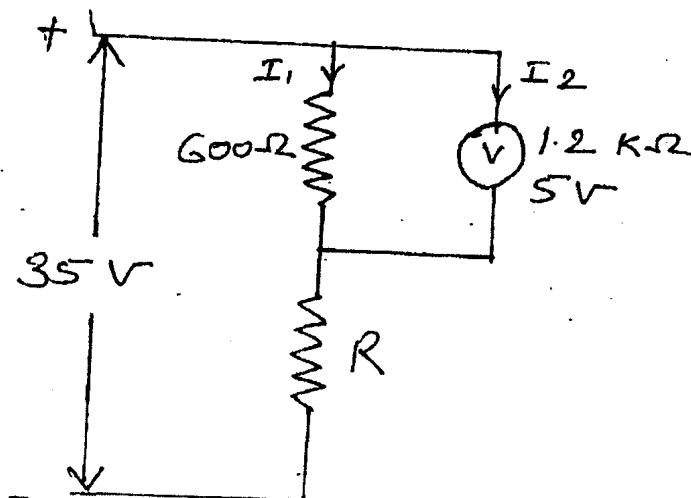
$$\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial y}\right)^2 + \left(\frac{\partial u}{\partial z}\right)^2 = 2 \left[ x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} \right]$$
- (c) Fit a second degree parabolic curve to the following data :- 8
- |   |   |   |   |   |    |    |    |    |   |
|---|---|---|---|---|----|----|----|----|---|
| x | 1 | 2 | 3 | 4 | 5  | 6  | 7  | 8  | 9 |
| y | 2 | 6 | 7 | 8 | 10 | 11 | 11 | 10 | 9 |

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

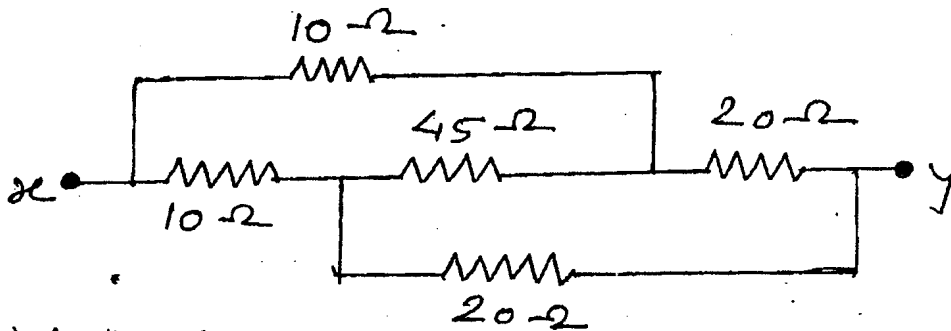
1. (a) Find the current flowing through  $5\Omega$  resistance using source transformation. 3



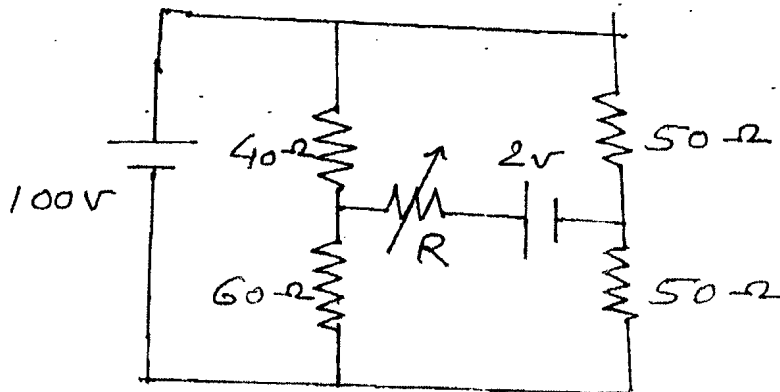
- (b) State and explain maximum power transfer theorem. 3  
 (c) An alternating voltage is given by  $V = 141.4 \sin 314 t$  find- 3  
 (i) Frequency  
 (ii) R.M.S. value  
 (iii) Average value  
 (iv) Instantaneous value of voltage when  $t$  is 3 msec.  
 (d) Define the equation for resonance frequency ( $f_r$ ) in parallel resonance circuit. 2  
 (e) Write down voltage, current and power relation in balanced delta connected load. 3  
 (f) Derive emf equation for single phase transformer. 4  
 (g) Draw complete V-I characteristics of a Diode. 2
2. (a) Determine the value of Resistance  $R$  as shown in **Figure** using KVL and KCL. 6



- (b) A  $100 \Omega$  resistor is connected in series with a choke coil. When a  $400 \text{ V}$ ,  $50 \text{ Hz}$  supply is applied to this combination, the voltage across the resistance and the choke coil are  $200 \text{ V}$  and  $300 \text{ V}$  respectively. Find the power consumed by the choke coil. Also calculate the power factor of choke coil and power factor of the circuit. 8
- (c) Draw phasor diagram of single phase transformer on resistive load (unity power factor) and inductive load (lagging power factor). 6
3. (a) Three similar coils, connected in star, take a total power of  $1.5 \text{ kW}$  at a p.f. of  $0.2$  lagging from a three phase,  $440 \text{ V}$ ,  $50 \text{ Hz}$  supply. Calculate the resistance and inductance of each coil. 8
- (b) A  $230/110 \text{ V}$ , single phase transformer takes an input of  $350 \text{ VA}$  at no load and at rated voltage. The core loss is  $110 \text{ w}$ . Find (i) The iron loss component of no load current (ii) magnetizing component of no load current and (iii) No load power factor. 6
- (c) Define filter and write down types of filters. 2
- (d) Explain input characteristics of common emitter configuration. 4
4. (a) Calculate  $R_{xy}$  for the circuit shown in figure. 7

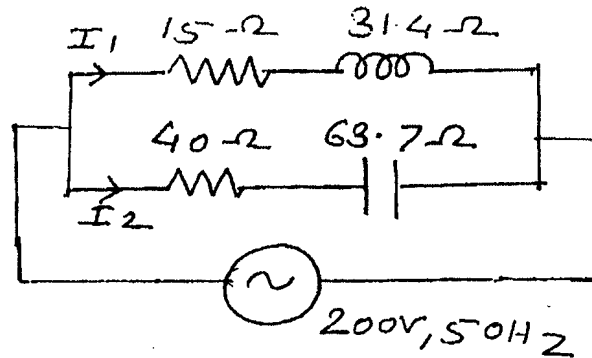


- (b) A voltage of  $150 \text{ V}$ ,  $50 \text{ Hz}$  is applied to a coil of negligible resistance and inductance  $0.2 \text{ H}$ . Write the time equation for voltage and current. 5
- (c) In a balanced three phase circuit, power is measured by two wattmeters, the ratio of two wattmeter readings is  $2 : 1$ . Determine the power factor of the system. 4
- (d) Explain with circuit diagram and waveform working of centre tap full wave rectifier. 4
5. (a) Determine the value of  $R$  for maximum power transfer. Also find magnitude maximum power transferred. 8



- (b) Calculate the branch current  $I_1$  and  $I_2$  for the circuit shown in Figure.

4

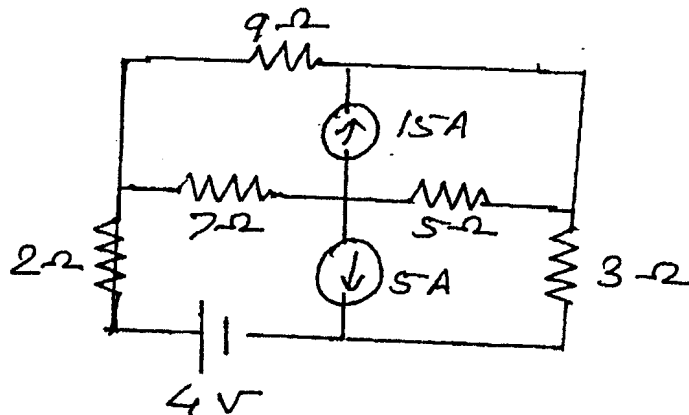


- (c) A 30 kVA, 2400/120 V, 50Hz, transformer has a high-voltage winding resistance of  $0.1 \Omega$  and a leakage reactance of  $0.22 \Omega$ . The low-voltage winding resistance is  $0.035 \Omega$  and the leakage reactance is  $0.012 \Omega$ . Calculate for the transformer—
- Equivalent resistance as referred to both primary and secondary
  - Equivalent reactance as referred to both primary and secondary
  - Equivalent impedance as referred to both primary and secondary
  - Copper loss at full load.

8

6. (a) Find the current through  $3 \Omega$  resistor using superposition theorem.

7



- (b) A resistor and a capacitor are connected in series with a variable inductor. When the circuit is connected to a 230V, 50 Hz supply, the maximum current obtained by varying the inductance is 2A. The voltage across the capacitor is 500 V. Calculate the resistance, inductor and capacitor of the circuit.
- (c) Explain measurement of three phase power using two wattmeter method.

7

6

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Con. 9042-12.

(REVISED COURSE)

(3 Hours)

KR-3411

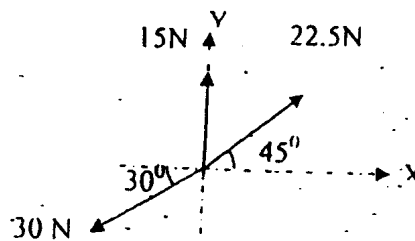
[Total Marks : 80

- Question number 1 is compulsory.
- Attempt any ~~three~~ questions from remaining five questions.
- Figure to the right of the question paper indicate full marks.
- Assume acceleration due gravity value  $g=9.81\text{m/s}^2$
- Assume suitable data wherever necessary
- Answers to sub-questions should be grouped together.

1. Solve

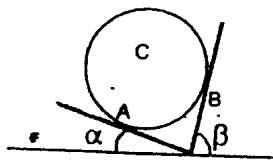
a) Find resultant of the force system.

[04]



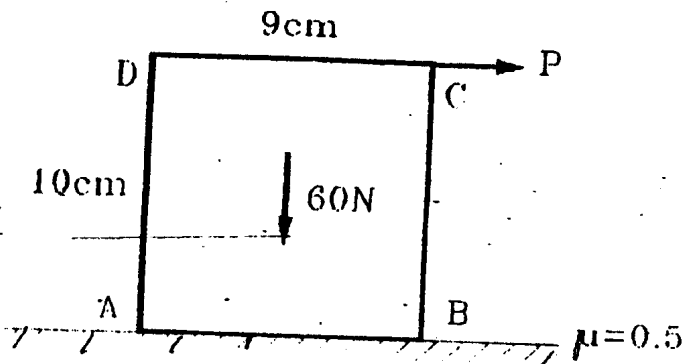
b) A smooth circular cylinder of weight  $W$  and radius  $R$  rests in a V shape groove whose sides are inclined at angles  $\alpha$  and  $\beta$  to the horizontal as shown. Find the reactions  $R_A$  and  $R_B$  at the points of contact.

[04]



$\alpha = 20^\circ$   
 $\beta = 60^\circ$

c) For the block shown in figure, find the minimum value of  $P$ , which will just disturb the equilibrium of the system.



d) A particle moving in the +ve x direction has an acceleration,  $a = 100 - 4v^2 \text{ m/s}^2$ . Determine the time interval and displacement of a particle when speed changes from  $1\text{m/s}$  to  $3\text{m/s}$ .

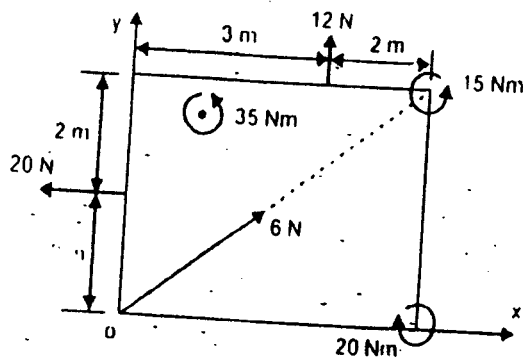
[04]

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- e) A vertical lift of total mass 750kg acquires an upward velocity of 3m/s over a distance of 4m moving with constant acceleration starting from rest. Calculate the tension in the cable. [04]

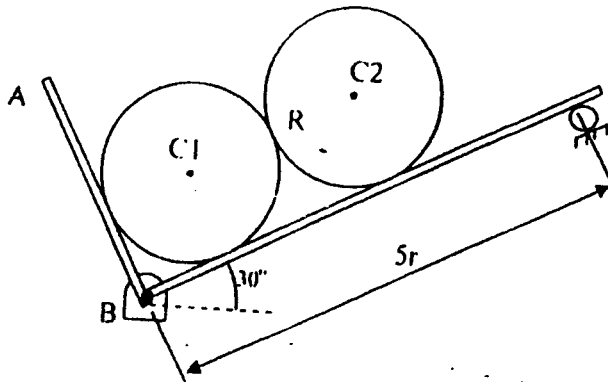
2. Solve

- a) Replace the system of forces and couples by a single force and locate the point on the x-axis through which the line of action of the resultant passes. [6]



Missing length = 2m

- (b) Two identical rollers each of weight 500N and radius  $r$  are kept on a right angle frame ABC having negligible weight. Assuming smooth surfaces, find the reactions induced at all contact surfaces. [8]

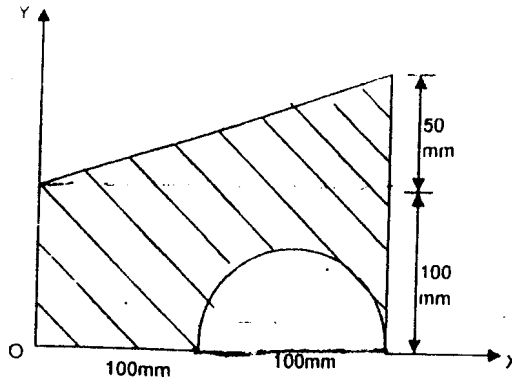


- (c) A body of mass 2kg is projected upwards from the surface of the ground at  $t=0$  with velocity 20m/s. At the same time another body of mass 2 kg is dropped along the same line from a height of 25m. If they collide elastically, find the velocities of body A and B just after collision. [6]

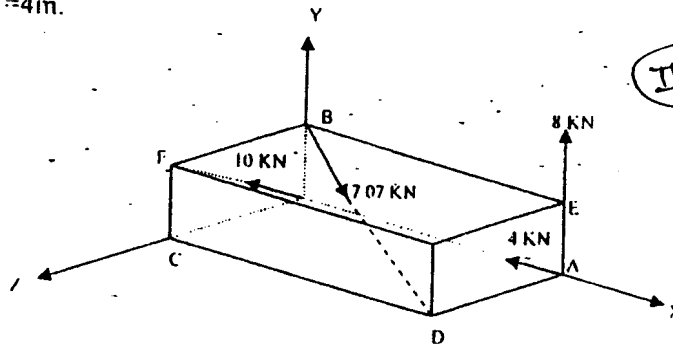
3. Solve

- a) Find centroid of the shaded area. [08]





- b) A rectangular parallelepiped carries 4 forces as shown in the figure. Reduce the force system to a resultant force applied at the origin and a moment around origin.  $OA=5m$ ,  $OB=2m$ ,  $OC=4m$ .



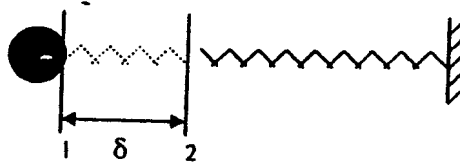
II

[06]

force along BD  
 $B=7.07\text{ kN}$   
 $7.07\text{ kN}$

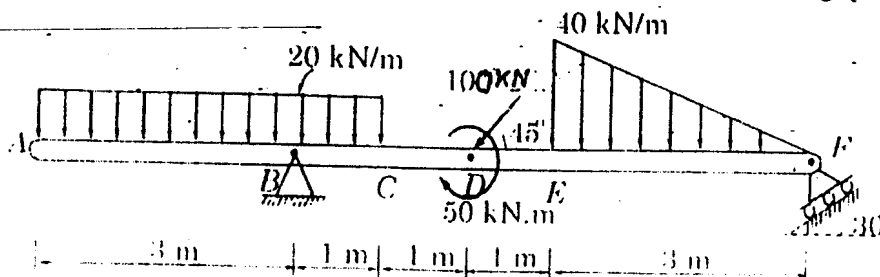
- c) A spring of stiffness  $k$  is placed horizontally and a ball of mass  $m$  strikes the spring with a velocity  $v$ . find the maximum compression of the spring. Take  $m = 5\text{ kg}$ ,  $k = 500\text{ N/m}$ ,  $v = 3\text{ m/s}$ .

[06]



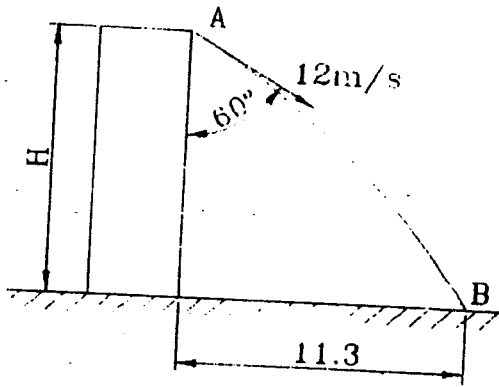
4. Solve

- a. Find the support reactions for the beam loaded and supported as shown in fig. [08]



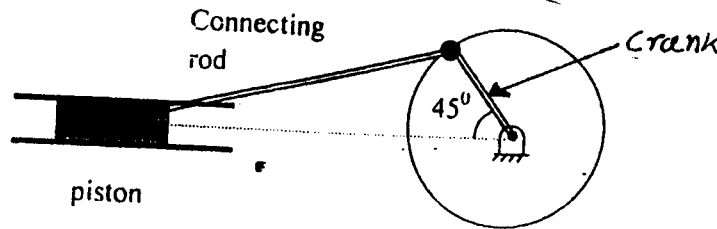
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b) A ball thrown with speed of 12 m/s at an angle of  $60^\circ$  with a building strikes the ground 11.3 m horizontally from the foot of the building as shown. Determine the height of the building [06].



c) In a crank and connecting rod mechanism, the length of crank and the connecting rod are 300mm and 1200mm respectively. The crank is rotating at 180 rpm. Find the velocity of piston, when the crank is at an angle of  $45^\circ$  with the horizontal. [06]

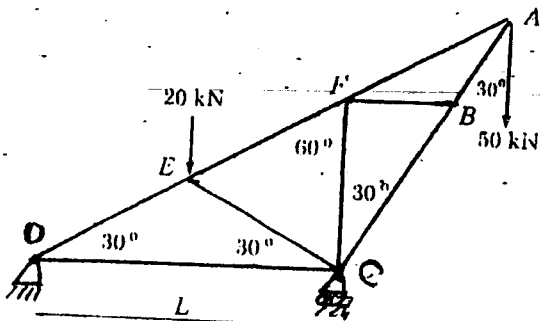
→ Direction of rotation of crank is clockwise



5. Solve

(a) Referring to the truss shown in fig. find

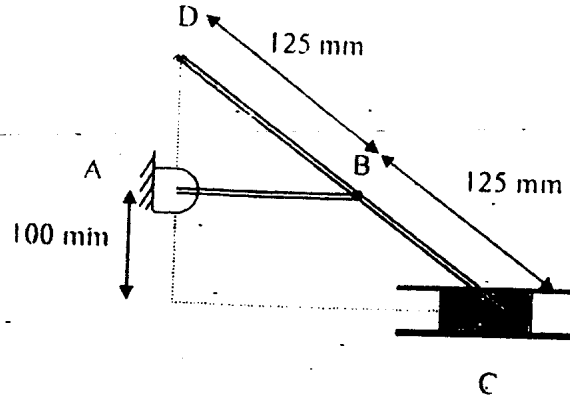
(i) Reactions at D and C (ii) Zero force members (iii) Forces in members  $FE$  and  $DC$  by method of sections and (iv) Forces in other members by method of joints [08]



Hing support is D and Roller support is C

b) A point moves along a path  $y=x^2/3$  with a constant speed of 8m/s. What are the x and y components of its velocity when  $x=3$ ? What is the acceleration of the point at this instant? [06]

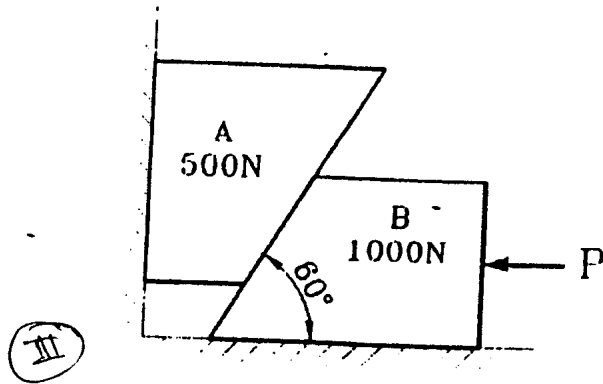
c) At the position shown in figure, the crank AB has Angular velocity of 3rad/sec clockwise. Find the velocity of slider C and the point D at the instant shown. AB=100mm. [06]



6. Solve

a) Force  $\Gamma = 80i + 50j - 60k$  passes through a point A (6, 2, 6). Compute its moment about a point B (8, 1, 4). [04]

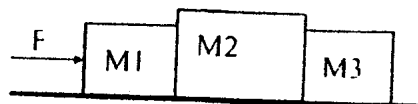
b) Assuming the values for  $\mu=0.25$  at the floor and 0.3 at the wall and 0.2 between the blocks, find the minimum value of horizontal force P applied to the lower block that will hold the system in equilibrium. [8]



*start from rest & moves*

c) The car moves in a straight line such that for a short time its velocity is defined by  $v = (9t^2 + 2t) \text{ m/s}$ . Where t is in seconds. Determine its position and acceleration when  $t = 3 \text{ sec}$ . [04]

d) Three  $m_1, m_2$  &  $m_3$  of masses 1.5Kg, 2Kg & 1Kg respectively are placed on a rough surface with  $\mu = 0.20$ , as shown. If a force F is applied to accelerate the blocks at  $3 \text{ m/s}^2$ , what will be the force that 1.5Kg block exerts on 2Kg block? [04]



Con. 9049-12.

(REVISED COURSE)

KR-3447

(2 Hours)

[Total Marks : 60

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

(2) Attempt any **three** questions from remaining questions No. 2 to 6.(3) Assume **suitable** data wherever **required**.(4) **Figures to the right** indicate marks.

1. Attempt any **five** :- 15
- Explain the term lattice parameters of Cubic crystal.
  - What is the probability of an electron being thermally excited to conduction band in silicon at 20°C. The band gap energy is 1.12eV; Boltzmann constant is  $1.38 \times 10^{-23}$  J/k.
  - Mobility of holes is 0.025 m<sup>2</sup>/V-sec. What would be the resistivity of P-type silicon if the Hall coefficient of the sample is  $2.25 \times 10^{-5}$  m<sup>3</sup>/C ?
  - Define dielectrics, electric dipole and polarizability.
  - Differentiate between soft and hard magnetic materials.
  - Define 'Reverberation time'. Write sabine's formula and explain the terms in it.
  - State the terms : magnetostriction effect; piezo-electric effect.
2. (a) Explain the formation of energy bands in solids. With neat energy band diagrams explain extrinsic semiconductors. 8
- (b) Draw the unit cell of HCP. What is its co-ordination number, atomic radius, and effective number of atoms per unit cell. Also calculate its packing factor. 7
3. (a) What is hysteresis ? Draw a hysteresis loop for ferromagnetic material and explain the various important points on it. What is the technical significance of the area enclosed under it. For a transformer which kind of material will you prefer the one with small hysteresis area or the big one ? 8
- (b) Derive Bragg's law. Calculate the glancing angle on the plane (100) for a crystal of rock salt ( $a = 2.125 \text{ \AA}$ ). Consider the case of 2<sup>nd</sup> order maximum and  $\lambda = 0.592 \text{ \AA}$ . 7
4. (a) Calculate the number of atoms per unit cell of a metal having lattice parameter 2.9 Å and density 7.87 gm/cm<sup>3</sup>. Atomic weight of metal is 55.85, Avogadro number is  $6.023 \times 10^{23}$ /gm-mole. 5
- (b) Prove that the Fermi level lies exactly at the centre of the forbidden energy gap in case of an intrinsic semiconductor. 5
- (c) Explain ionic polarization and obtain polarizability ( $\alpha_i$ ). 5

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2

5. (a) With neat diagram of a unit cell, explain the structure of  $\text{BaTiO}_3$ . 5  
(b) What is Hall effect ? Derive expression for Hall voltage. 5  
(c) Explain the absorption coefficient of a hall. Calculate the change in intensity level when the intensity of sound increases 1000 times its original intensity. 5
6. (a) In what sense real crystals differ from ideal crystals ? Explain the point defects in crystals. 5  
(b) Explain construction and working of a solar cell. 5  
(c) Find the natural frequency of vibration of quartz plate of thickness 2mm. Given Young's modulus of quartz  $Y = 8 \times 10^{10} \text{ N/m}^2$ , density of quartz is  $2650 \text{ kg/m}^3$ . Calculate the change in thickness required if the same plate is used to produce ultrasonic waves of frequency 3MHz. 5

FE (Rev) 29/ Dec 2012  
AM. Chem I

26 : 2nd half-12-(k) JP

Con. 9077-12.

(REVISED COURSE)

KR-3474

(2 Hours)

[ Total Marks : 60

- N.B.:** (1) Question No. 1 is **compulsory**.  
(2) Answer any **three** questions from the remaining **five** questions.  
(3) **Figures** to the **right** indicate marks.  
(4) **All** the questions carry **equal** marks.

(Atomic weight : Ca = 40, H = 1, C = 12, O = 16, Mg = 24, Na = 23,  
Cl = 35.5, S = 32, Si = 28 and Al = 27)

1. Attempt any **five** from the following :—

15

- (a) Distinguish between BOD and COD.  
(b) Write synthesis, properties and applications of Kevlar.  
(c) Define and write significance of Viscosity and Viscosity Index.  
(d) State the limitations of phase rule.  
(e) What is nanomaterial ? Give two properties of nanomaterials which make them different and superior to conventional materials.  
(f) Write synthesis, properties and applications of Buna S.  
(g) Calculate temporary, permanent and total hardness of water sample containing  
 $\text{Mg}(\text{HCO}_3)_2 = 7.3 \text{ ppm}$ ,  $\text{Ca}(\text{HCO}_3)_2 = 16.2 \text{ ppm}$ .  
 $\text{MgCl}_2 = 9.5 \text{ ppm}$   $\text{CaSO}_4 = 13.6 \text{ ppm}$ .

2. (a) Calculate amount of lime (90% pure) and soda (98% pure) for the treatment of 6 million litres of water containing  $\text{Ca}(\text{HCO}_3)_2 = 8.1 \text{ ppm}$ ,  $\text{CaCl}_2 = 33.3 \text{ ppm}$ ,  $\text{HCO}_3^- = 91.5 \text{ ppm}$ ,  $\text{MgCl}_2 = 38 \text{ ppm}$ ,  $\text{Mg}(\text{HCO}_3)_2 = 14.6 \text{ ppm}$ . The coagulant  $\text{Al}_2(\text{SO}_4)_3$  was added at the rate of 17.1 ppm.

(b) Define phase rule and explain terms like phase, component and degree of freedom 5 by giving appropriate examples.

(c) Explain manufacturing process for the portland cement. 4

3. (a) What is lubrication ? Explain fluid film lubrication with the help of diagram. 6

(b) Write synthesis, properties and applications of silicon rubber. 5

(c) Draw neat labelled phase diagram for water system. 4

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**Con. 9077-KR-3474-12.**

**2**

4. (a) What is fabrication technology ? Mention various moulding techniques and explain injection moulding with the help of diagram. 6
- (b) Discuss zeolite process with the help of diagram, chemical reactions and advantages. 5
- (c) Find acid value of vegetable oil whose 5 ml requires 2 ml of N/100 KOH during lubrication (Density of oil is 0.92 g/ml). 4
5. (a) What is SWCNT and MWCNT ? Explain Laser method for the manufacturing of carbon nanotubes. 6
- (b) Write chemical reactions for manufacturing of phenol formaldehyde resin, Explain its applications and properties also. 5
- (c) The hardness of 100,000 litres of water completely removed by passing through zeolite softener, the softener than requires 400 litres of NaCl solution containing 100g/litre NaCl for regeneration. Calculate hardness of water sample. 4
6. (a) Explain activated sludge process with the help of flow sheet diagram. 6
- (b) Write a note on compounding of plastic. 5
- (c) Write a note on blended oil. 4
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