

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-20**

**F. E. Examination - 2009**

**ENGINEERING GRAPHICS - II**

(2003 Course)

**Time : 4 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer **any one** question from each unit.
- (2) Answers to the **two sections** should be drawn on **separate drawing sheet**, use back side of sheet.
- (3) Figures to the right indicate full marks.
- (4) Use of electronic pocket calculator is allowed.
- (5) Assume suitable data, if necessary.
- (6) Retain construction lines; marks are reserved for dimensioning and good presentation.

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**SECTION - I**

**UNIT - I**

**Q.1)** A line AB has its ends A and B, 20 and 60mm in front of VP respectively. The distance between end projectors is 80mm. The line makes 30° to HP with HT 10mm in front of VP. Draw projections and determine :

- (1) Length of Line AB
- (2) Angle made by Line AB with VP
- (3) Locate V'T

**[16]**

**OR**

- Q.2)** A man and a child is standing on the ground, 6 meter from the electric pole, creates the shadow of the man and the child as 1.7 meter and 0.8 meter long respectively. The height of the pole is 8m. Find the height of the man and the child. If the angle between the shadows is  $110^\circ$ . How far the man is standing from the child ? [16]

**UNIT - II**

- Q.3)** A pentagonal plane of sides 30mm is resting on a corner in VP with its surface making an angle of  $40^\circ$  to the VP. The edge opposite to the corner which is resting in VP is inclined at  $35^\circ$  to the HP. Draw the three principal views and find angle made by plane with HP. [17]

**OR**

- Q.4)** A regular hexagonal plate of 35mm side is resting on one of its corner on the ground. The diagonal through that corner is inclined at  $40^\circ$  to HP and  $30^\circ$  to VP. Draw the projection of plate. Determine the inclination of the plate with VP. [17]

**UNIT - III**

- Q.5)** A frustum of a pentagonal pyramid base 50mm side, top 25mm side and axis 75mm long, has its side of base in VP making an angle of  $30^\circ$  to the HP. Draw the projections of the solid when its axis is inclined at  $60^\circ$  to the VP. [17]

**OR**

- Q.6)** A tetrahedron of 75mm long edges having one edge parallel to HP and inclined  $45^\circ$  to VP. While a face containing that edge is vertical. Draw its three views. [17]

**SECTION - II**

**UNIT - IV**

- Q.7)** A cube of 60mm side is kept on HP on one of its faces in such a way that edges on HP are equally inclined to VP. It is cut by an AIP so that true shape of section is a regular hexagon. Draw FV; sectional TV and true shape of section. Determine length of side of hexagon. State the angle made by AIP. [16]

**OR**

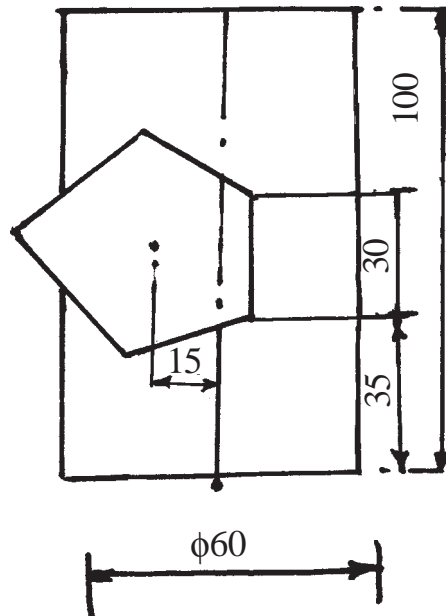
- Q.8)** A cone base 70mm diameter and axis 80mm long, has its axis parallel to the VP and inclined at  $45^\circ$  to the HP. A sectional plane cuts the cone through the mid point of the axis and parallel to HP. Draw the front view sectional top view and an auxiliary top view on a plane parallel to the axis. [16]

**UNIT - V**

- Q.9)** A pentagonal pyramid with side of base 40mm and axis height 70 mm is kept on HP on its base with side of base parallel to VP and closer to VP. A string is wound from the corner of the base which is nearest to observer around the triangular faces and is brought back to same point. Show the shortest path of string in FV and TV. [17]

**OR**

- Q.10)** Draw the development of the lateral surface of the cut cylinder as shown in fig. [17]



Cylinder diameter 60 height 100mm

Regular Pentagon side 30mm

Centre of Pentagon 50mm from base and 15mm offset to right.

## UNIT - VI

**Q.11)** A pentagonal prism side of base 60mm and height 80mm is lying on the HP on one of its pentagonal base such that an edge of the base is parallel to VP and nearer to it. The axis of prism is parallel to VP and perpendicular to HP. The prism is penetrated by horizontal cylinder of dia 60mm the axis of cylinder and prism bisect each other at right angles both in front view and top view. Draw the projections showing the curves of intersection. [17]

**OR**

**Q.12)** A cylinder of diameter 60mm and axis 70mm is kept on HP with axis perpendicular to HP and parallel to VP. Another solid, a square prism with side of base 40mm and axis 100mm intersects the cylinder. The axis of prism is parallel to both HP and VP and 15mm in front of the axis of the cylinder. The axis of prism is 45mm above HP and rectangular faces are equally inclined to HP. Draw the projections showing the curves of intersection. [17]

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-19**

**F. E. Examination - 2009**

**BASIC ELECTRONIC ENGINEERING**

(2003 Course)

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

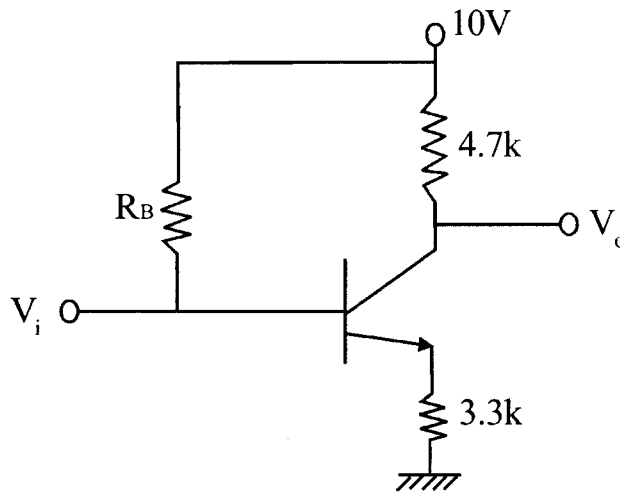
- (1) Answer **any three** questions from each section.
  - (2) Answers to the **two sections** should be written in **separate answer-books**.
  - (3) Black figures to the right indicate full marks.
  - (4) Neat diagrams must be drawn wherever necessary.
  - (5) Use of electronic pocket calculator is allowed.
  - (6) Assume suitable data, if necessary.
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**SECTION - I**

- Q.1) (A)** Explain with neat diagrams and graphs, the ways of biasing a P-N junction diode and variation of the diode current with the voltage across the diode. **[06]**
- (B) A half wave rectifier with  $R_L = 1k\Omega$  is given an input of 10V peak from a step down transformer. Calculate the DC Voltage and Load Current for ideal and silicon diode. **[06]**
- (C) Draw the following characteristics of BJT in Common Emitter Configuration :
- (1) Input Characteristics
  - (2) Output Characteristics
  - (3) Transfer Characteristics **[06]**

**OR**

- Q.2) (A)** For the circuit shown in fig. 1, what will be the value of  $R_B$  to put the transistor just in saturation ? **[06]**



**Fig. 1.**

- (B) Explain the principle of operation of varactor diode along with its characteristics and symbol state its applications. **[06]**
- (C) Draw a neat block diagram of a regulated power supply and state the function of each block. Indicate the waveforms at the output of each block. Give formula for load regulation. **[06]**
- Q.3) (A)** Draw neat circuit diagram of a RC coupled amplifier using BJT as active device. State function of each component. **[08]**
- (B) What is the difference between 78XX and LM 317 regulators? Calculate the component values for LM 317 to get output voltage of 12V, with input of 20V. If output is made variable, calculate the range of output voltage. **[08]**

**OR**

- Q.4) (A)** An amplifier has a signal input voltage  $V_i$  of 0.25V and draws 1 mA from source. The amplifier delivers 8V to a load at 10 mA. Determine the current, voltage and power gains. Also find input resistance of this amplifier. What must be the open circuit voltage of the source  $V_s$  to provide an amplifier input voltage  $V_i$  of 0.25V when the internal resistance of the source is  $50\Omega$ . **[08]**
- (B) Compare series and shunt regulators on the basis of circuit, load current, output voltage and regulation. **[08]**

- Q.5) (A)** Draw the logic diagram to implement the Boolean Expression with minimum number of NAND gates :

$$Y = \overline{(A + \overline{B} + \overline{C})} (A \overline{B} + \overline{A} + \overline{B} + \overline{C}) + C\overline{D} \quad [08]$$

- (B) Implement full adder with basic gates using truth table. Use K-map technique for adder design. [08]

**OR**

- Q.6) (A)** Draw the truth table for one-bit comparator using 2 inputs. Obtain the expression for each output using K-map and realize the same using basic gates. [08]

(B)  $Y = ABC + \overline{B}CD + \overline{A}BC$

- (1) Simplify this equation and realize using basic gates.  
(2) Realize the simplified equation using only NOR Gates. [08]

### **SECTION - II**

- Q.7) (A)** Draw the circuit diagram and explain the working of following : [09]

- (1) Summing Amplifier  
(2) Difference Amplifier

- (B) Draw the circuit diagram of Wien Bridge Oscillator using OP-Amp. Calculate the component values in feedback network to produce sustained oscillations of a time period of 0.1 m/sec. (Assume  $C = 0.01\mu\text{f}$ ) [09]

**OR**

- Q.8) (A)** An OP-Amp is used in following mode with  $R_1 = 1\text{k}\Omega$  and  $R_F = 10\Omega$ ,  $V_i = 10\text{ mV}$  and  $V_{CC} = \pm 12\text{V}$ . Find output voltage in each case :

- (1) Inverting Mode  
(2) Non-inverting Mode

Draw the output waveform if  $V_i$  is sine wave. [09]

- (B) Draw and explain circuit diagram of RC phase shift oscillator. Give equations of frequency of oscillations. [09]

**Q.9) (A)** Draw and explain the principle of operation, applications, advantages and disadvantages of : **[08]**

- (1) Thermistor
- (2) Strain Gauge

**(B)** What are different types of Transducers ? Mention the factors to be considered while selecting a transducer for an application. **[08]**

**OR**

**Q.10)(A)** A thermistor has a characteristics temperature  $\beta$  of 3000k. If its resistance is  $100k\Omega$  at 300k temperature. What will be the resistance at 600k. **[05]**

**(B)** Name five sensors used for temperature measurement giving their range of temperature. **[04]**

**(C)** Name the different pressure sensors and explain working of each in brief. **[07]**

**Q.11)(A)** Draw and explain the block diagram of an IC 555 timer. **[08]**

**(B)** Draw functional block diagram of CRO and explain its working. **[08]**

**OR**

**Q.12)(A)** Draw and explain the block diagram of Public Address System. What are the important requirements to be satisfied by a good P.A. system. **[08]**

**(B)** State various Front Panel Control and dual trace CRO and explain function of at least 6 controls. **[08]**



Total No. of Questions : 12]

[Total No. of Printed Pages : 11

[3661]-18

F. E. Examination - 2009  
ENGINEERING MECHANICS  
(2003 Course)

Time : 3 Hours]

[Max. Marks : 100

Instructions :

- (1) Solve Q. No. 1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6 from section I and Q.7 or Q.8, Q.9 or Q.10 and Q.11 or Q.12 from section II.
- (2) Answers to the two sections should be written in separate answer-books.
- (3) Black figures to the rights indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of electronic pocket calculator is allowed.
- (6) Assume suitable data, if necessary.

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SECTION - I

Q.1) (A) Illustrate with neat sketches different types of Force Systems. [04]

(B) Three forces are applied to the bracket as shown in figure 1.1. Determine and show the equilibrant force for  $\alpha = 40^\circ$  if the angle between two 30N forces always remain  $50^\circ$ . [06]

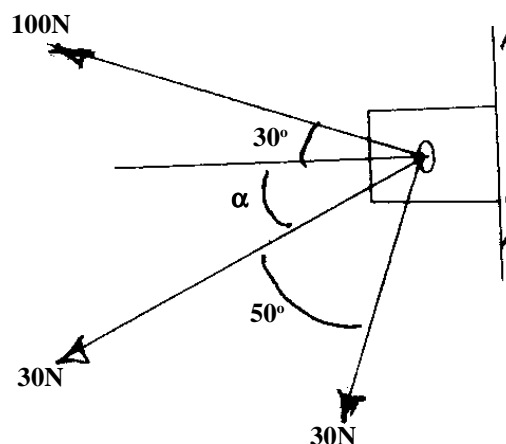


Fig. 1.1

- (C) A homogeneous wire AB is bent into the shape shown in figure 1.2. Determine the centroid of bent up wire. The radius of circle is 200 mm. [08]

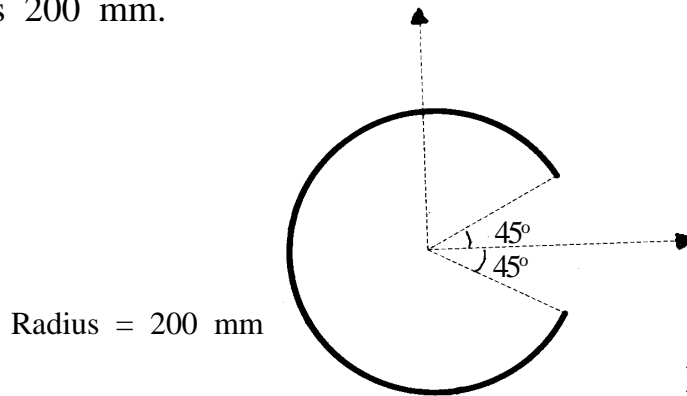


Fig. 1.2

OR

- Q.2) (A) State and explain Varignon's Principle. [04]  
 (B) Determine reactions at support 'A' and 'B' for the bracket ACB supporting 330N force as shown in figure 2.1. [06]

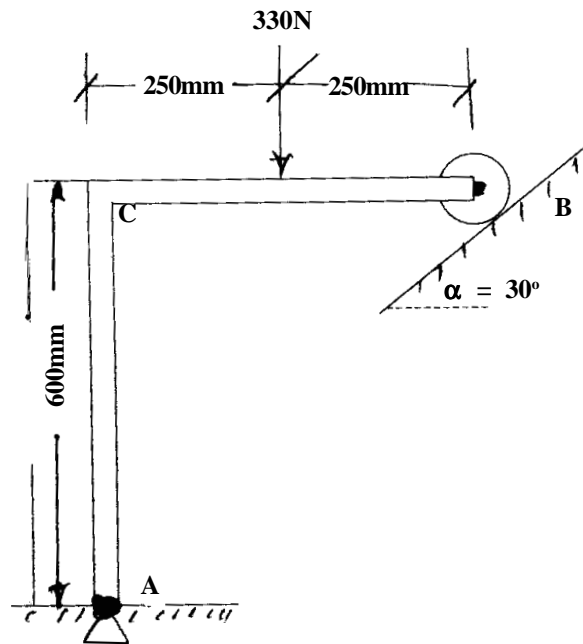


Fig. 2.1

(C) A force 'P' applied at 'B' and a block attached at 'C' maintain cable ABCD in the position shown. Knowing that 'P' has magnitude of 1320N determine :

- (1) Reaction at 'A'
- (2) Mass 'm' of the block
- (3) Tension in each portion of the cable. (Refer figure 2.2) [08]

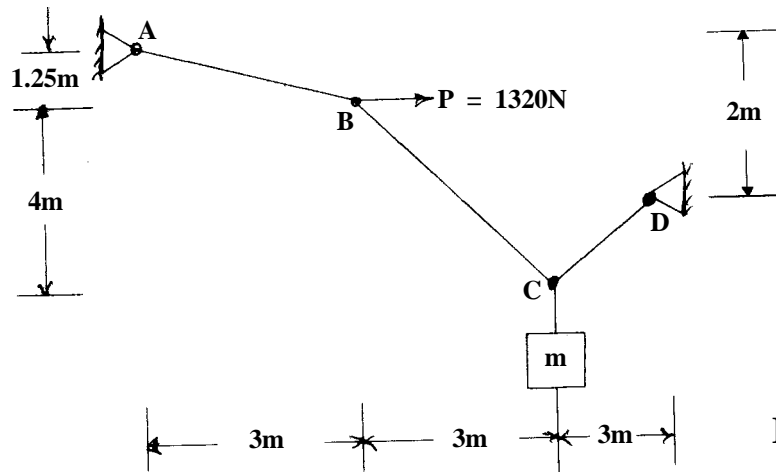


Fig. 2.2

Q.3) (A) Determine the forces in the members AB, BF, EF and CD of the truss shown in figure 3.1. Also state whether the members are tension or compression. [08]

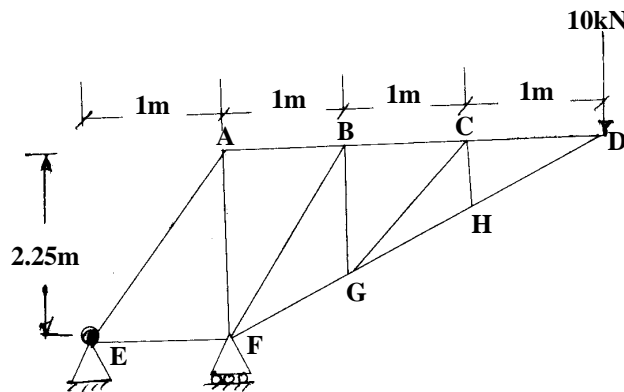


Fig. 3.1

- (B) For the cantilever, determine range of values of force 'P' for which the magnitude of the fixing moment at 'A' does not exceed 5000 N/m. (Refer figure 3.2) [08]

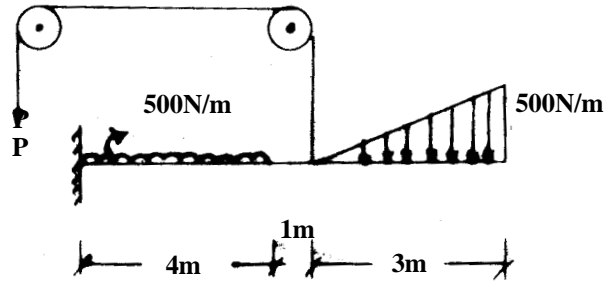


Fig. 3.2

OR

- Q.4) (A) Referring to figure 4.1, calculate the force 'P' required to just raise the block 'B' of weight 1000N. The wedge may be assumed of negligible weight. Assume coefficient of friction between block and wedge 0.3 and at all other surfaces 0.2. [08]

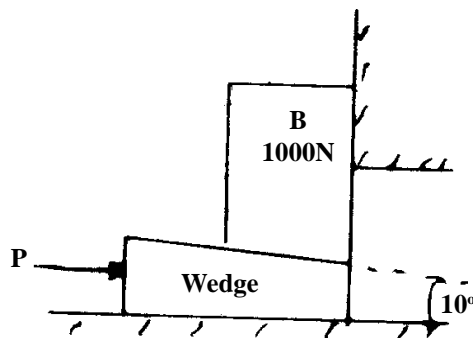


Fig. 4.1

- (B) Determine the components of the reactions at 'A' and 'D' when a force of 24kN directed vertically downward is applied at 'B'. (Refer figure 4.2) [08]

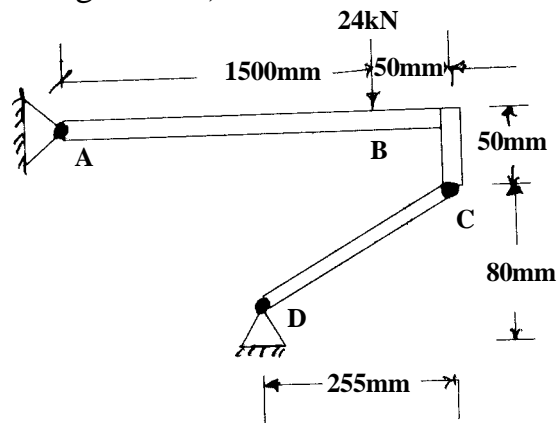
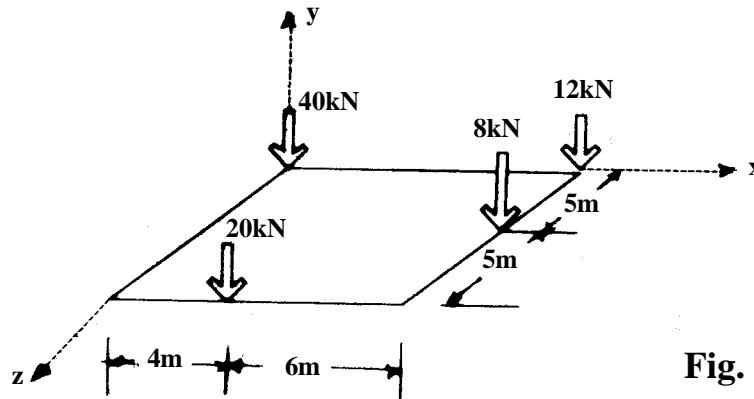


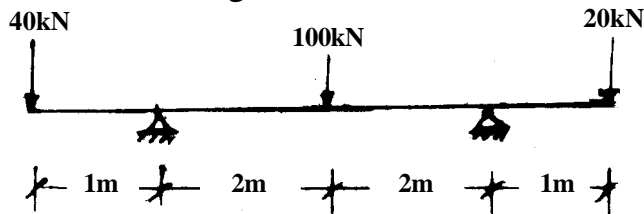
Fig. 4.2

- Q.5) (A)** A square foundation mat supports the four column loads as shown in figure 5.1. Determine the magnitude and point of application of the resultant of the four loads. [08]



**Fig. 5.1**

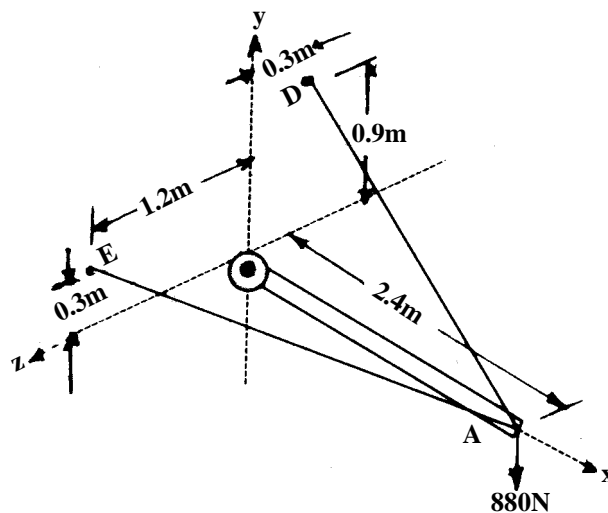
- (B)** For the beam ABCDE find reactions at support using virtual work method. Refer figure 5.2. [08]



**Fig. 5.2**

**OR**

- Q.6) (A)** A 2.4m long boom is held by a ball-and-socket joint at 'C' and by two cables AD and AE. Determine the tension in each cable. (Refer figure 6.1) [08]



**Fig. 6.1**

- (B) Using method of virtual work, determine angle ' $\theta$ ' to maintain the equilibrium for the mechanism shown in figure 6.2. Take  $W_A = 100\text{N}$  and  $W_B = 150\text{N}$ . [08]

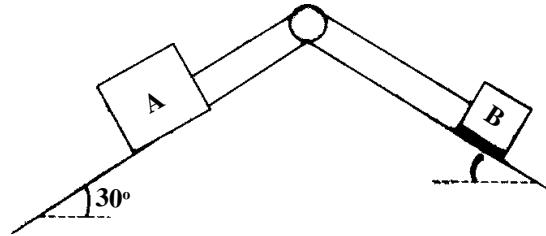


Fig. 6.2

## SECTION - II

- Q.7)** (A) Starting from first principle, obtain equations of motion for uniformly accelerated rectilinear motion. [04]
- (B) A particle moves along a horizontal path such that its acceleration is given by  $a = (8 - 4t) \text{ m/s}^2$ . Determine distance travelled by particle during  $t = 0\text{s}$  to  $t = 3\text{s}$ . Also draw  $a - t$  diagram and  $v - t$  diagram only. [06]
- (C) The  $100 \text{ kg}$  crate is subjected to the action of two forces as shown in figure 7.1. If it is originally at rest, determine the distance, it slides in order to attain speed of  $10 \text{ m/s}$ . The kinetic coefficient of friction between crate and surface is  $0.2$ . [08]

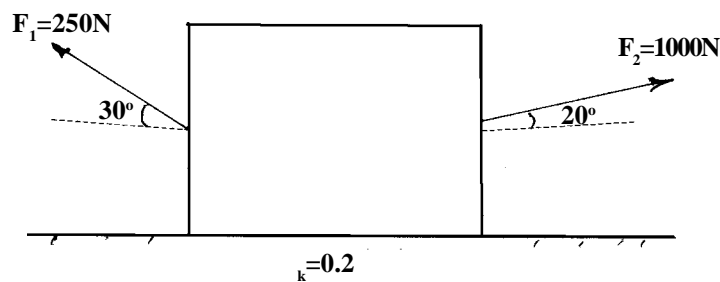
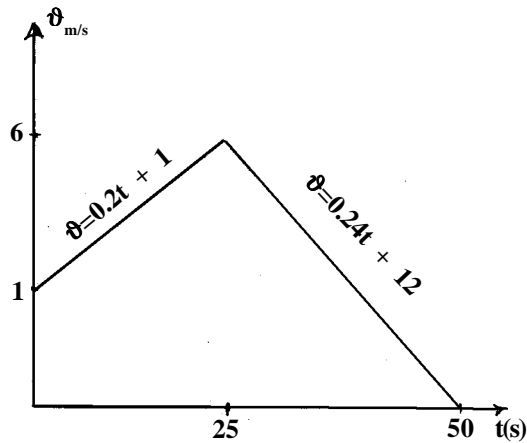


Fig. 7.1

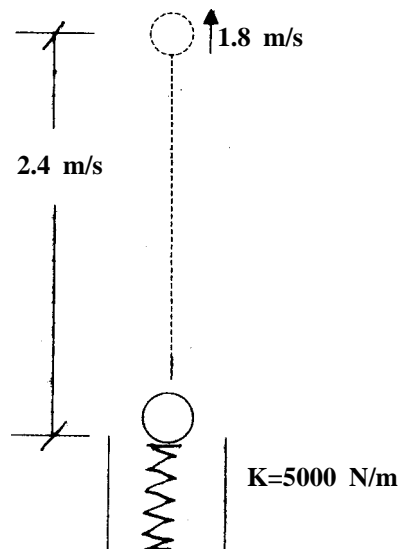
OR

- Q.8) (A)** A car travels along a straight line with velocity described by the  $v - t$  diagram shown in figure 8.1. Determine the total distance the car travels until it stops when  $t = 50\text{s}$ . Also plot  $a - t$  diagram. **[04]**



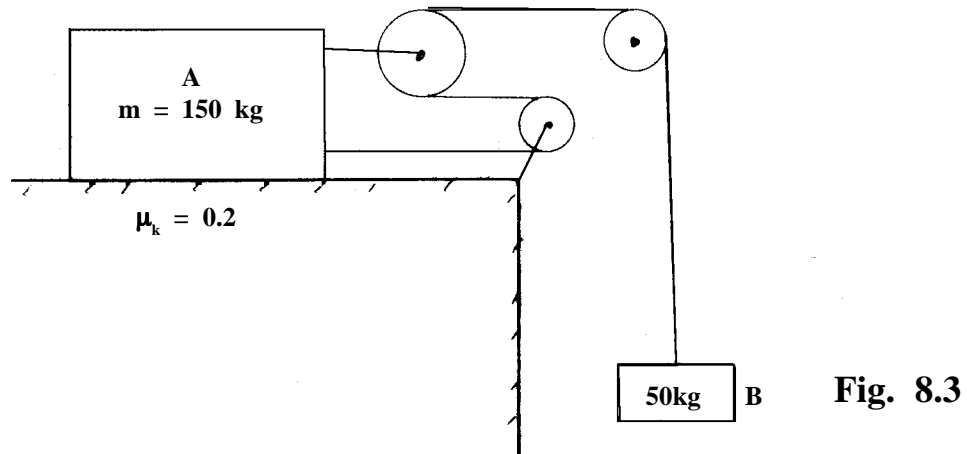
**Fig. 8.1**

- (B)** The  $50\text{N}$  ball is projected vertically from the tube by spring action as shown in figure 8.2. Determine how far the spring must be compressed to project the ball from compressed position to a height of  $2.4\text{m}$  at which point, it has velocity  $1.8\text{ m/s}$ . Assume  $K = 5000\text{ N/m}$ . **[06]**

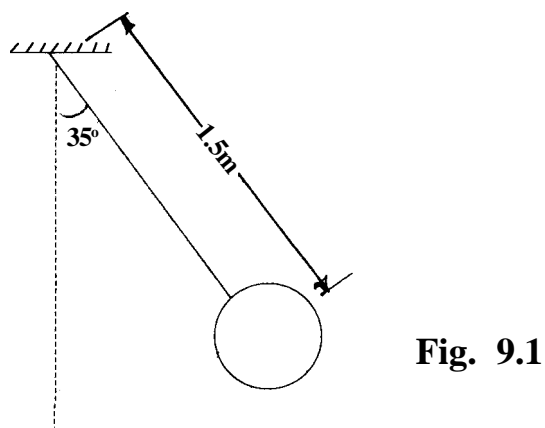


**Fig. 8.2**

- (C) The system shown in figure 8.3 is released from rest. Find –
- (1) Tension in string
  - (2) Relative acceleration of 'A' w.r.t. 'B' at  $t = 2s$ . Assume  $\mu_k = 0.2$ . [08]



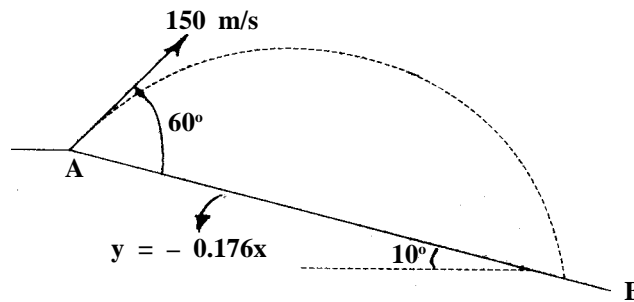
- Q.9)** (A) The  $y$  - co-ordinate of a particle in curvilinear motion is given by  $y = (4t^3 - 3t)m$ . Also the particle has an acceleration in  $x$ -direction given by  $a_x = (12t) m/s^2$ . If velocity of particle in  $x$ -direction is  $4m/s$  at  $t = 0$ , calculate tangential and normal components of acceleration at  $t = 1s$ . [08]
- (B) A bob of  $1.5m$  pendulum describes an arc of a circle in a vertical plane. When the angle of cord is  $35^\circ$  with vertical, the tension in the cord is  $1.5$  times the weight of bob. Find velocity and acceleration of the bob in this position. (Refer figure 9.1) [08]



**OR**

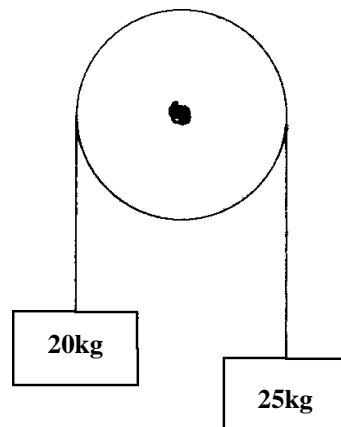


- Q.10) (A)** Derive equation of path followed by projectile when projected on horizontal plane with velocity 'u' m/s and angle of projection ' $\alpha$ '. A projectile is fired with speed 150 m/s. from a gun elevated at angle  $60^\circ$  with plane AB as shown in figure 10.1. Determine the point where it strikes the plane AB whose equation is  $y = 0.176x$ . [08]



**Fig. 10.1**

- (B) Two blocks A and B having same mass 'm'. The block 'A' is moving to right with a speed 3.6m/s when it collides with block 'B' which is at rest. Determine how far block B will slide before coming to stop. Assume  $\mu_k = 0.5$  and  $e = 0.6$ . Neglect size of blocks. [08]
- Q.11)(A)** Two blocks of masses 20 kg and 25 kg are connected by a light in extensible string which passes over 25cm diameter pulley of 2.5kg mass as shown in figure 11.1. Neglecting friction, find acceleration of the system and tensions in the string when the masses are released from rest. Assume radius gyration of pulley equal to its radius. [08]



**Fig. 11.1**

- (B) An angular acceleration  $\alpha = (0.4t^2 + 0.6)$  rad/s<sup>2</sup> is imparted to a disc of 0.15m radius by a motor. If initial angular velocity of disc is 5 rad/s, find velocity and acceleration of block 'B' at time  $t = 1.5$ s (Refer figure 11.2). [08]

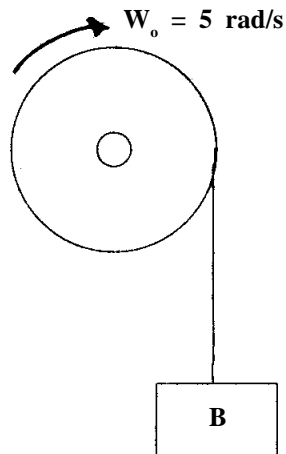


Fig. 11.2

OR

- Q.12)(A) At the instant shown in figure 12.1, the rod AB is rotating clockwise at 2.5 rad/s. If end 'C' of the rod BC is force to move on horizontal surface, compute angular velocity of rod BC and velocity of its end point 'C'. [08]

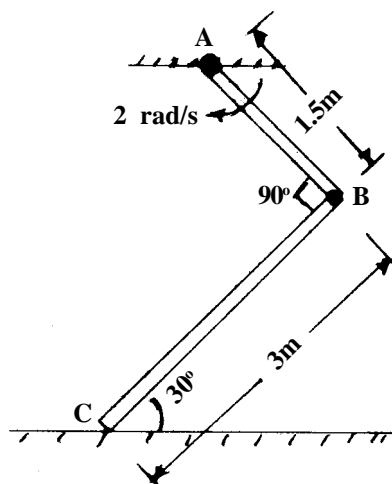


Fig. 12.1

- (B) A thin uniform bar of mass 50kg and length 1m is suspended by two vertical inextensible strings. If the right hand string 'BD' is cut, find angular acceleration of bar and tension induced in the left string AC (Refer figure 12.2). [08]

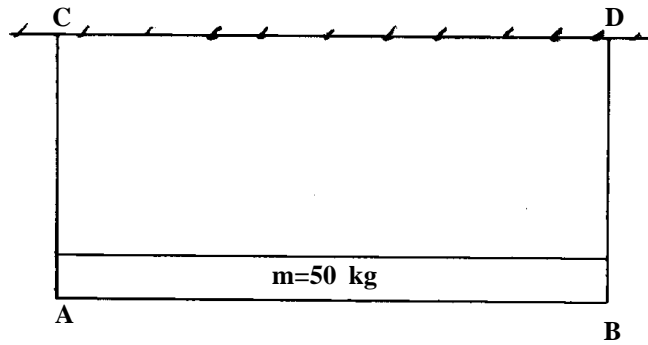


Fig. 12.2

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-17**

**F. E. Examination - 2009**

**APPLIED SCIENCE - II**

(2003 Course)

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer **any three** questions from each section.
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.
- (5) Neat diagrams must be drawn wherever necessary.
- (6) Assume suitable data, if necessary.

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**Constants :**

$$h = 6.63 \times 10^{-34} \text{ J-sec.}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg.}$$

$$e = 1.6 \times 10^{-19} \text{ C.}$$

$$c = 3 \times 10^8 \text{ m/sec.}$$

**SECTION - I**

- Q.1)** (A) State Heisenberg's Uncertainty Principle. Give one experiment to prove its validity. **[06]**
- (B) Using Schrodinger's wave equation, find energy and wave function of a particle in a rigid box. Show necessary waveforms. **[07]**
- (C) DeBroglie Wavelength of electrons in a monochromatic beam is  $7.2 \times 10^{-11}$  meters. Calculate the momentum and energy of electrons in the beam in electron volts. **[04]**

**OR**

**[3661]-17**

**1**

**P.T.O.**

- Q.2)** (A) Explain Davisson - Germer Experiment on electron diffraction and discuss the results. [07]  
 (B) Derive Schrodinger time independent wave equation. [06]  
 (C) Compute the lowest three permitted energy levels of an electron in an infinite potential well of width 1 Å. [04]

- Q.3)** (A) State the important properties of lasers. Explain the operation of Solid State Ruby Laser with the help of a neat labelled diagram. [07]  
 (B) (1) Explain the process of Holographic Recording. [03]  
 (2) Explain Meissner effect. [03]  
 (C) Explain in brief the type I and type II Superconductors. [04]

**OR**

- Q.4)** (A) Explain : [06]  
 (1) Spontaneous Emission  
 (2) Stimulated Emission  
 (3) Population Inversion  
 (B) (1) Define magnetic field intensity, susceptibility and permeability and show that  $\mu_r = 1 + \chi$ . [04]  
 (2) Discuss applications of Ferrites. [04]  
 (C) State any six applications of Laser. [03]

- Q.5)** (A) Explain the classification of solids into conductors, insulators and semiconductors on the basis of energy band theory. [06]  
 (B) Explain with a neat diagram the principle, construction and working of a Bainbridge Mass Spectrograph. [06]  
 (C) Calculate the conductivity of extrinsic silicon at room temperature if the donor impurity added is 1 in  $10^8$  silicon atoms.

Given : At room temperature,

$$n_i = 1.5 \times 10^{10} \text{ per cm}^3$$

$$\mu_e = 1,300 \text{ cm}^2/\text{volt} - \text{sec. and number of silicon atoms per unit volume} = 5 \times 10^{22}. \quad [04]$$

**OR**

- Q.6)** (A) Explain Hall effect. Obtain an expression for the Hall voltage. State applications of Hall effect. [06]
- (B) Develop a neat comparison between Optical Microscope and Electron Microscope. [06]
- (C) An electron starts at rest at the negative plate of a plane parallel capacitor across which is applied a direct voltage of 1,000 volts. The distance between the plates is 1 cm. How long will it take the electron to reach the positive plate ? Find its velocity at that instant. [04]

### SECTION - II

- Q.7)** (A) Explain the method for determination of Calorific Value of a Highly Volatile Fuel. [07]
- (B) What is Knocking ? Explain how it is related with Octane Number and Cetane Number of a Fuel. [06]
- (C) A coal sample requires 20% excess air for complete combustion. Calculate weight of air for 100 kg coal if coal contains, C = 81%, H = 4%, N = 1.5%, S = 1.2%, O = 3%. [04]

### OR

- Q.8)** (A) What is Proximate Analysis ? How it is carried out ? Give significance of percentage of the various components in a coal sample in this analysis. [07]
- (B) (1) Distinguish between low temperature carbonisation and high temperature carbonisation. [03]
- (2) Calculate GCV and NCV of a coal if 1.3 gm of coal is burnt in Bomb calorimeter, raises temperature of 2 litres of water in calorimeter by 4.65°C. Hydrogen percentage in coal is 2% and water equivalent is 690 gm. [03]
- (C) What is Rocket Propellant ? Give important characteristics of good propellant. [04]

- Q.9)** (A) Define Wet Corrosion. Explain Galvanic and Concentration Cell Corrosion with one example each. [07]
- (B) What is Secondary Battery ? Explain the construction, reactions and applications of Lead Acid Battery. [06]
- (C) Distinguish between Anodic Coatings and Cathodic Coatings. [04]

**OR**

- Q.10)** (A) What is Dry Corrosion ? Explain mechanism involved in it by using suitable example. [07]
- (B) Describe 'Anodic Protection' of metal for the Corrosion Control. [06]
- (C) Describe method of Electroplating of metal. [04]
- Q.11)** (A) Explain principle, instrumentation and working with the help of diagram for Atomic Absorption Spectroscopy. [06]
- (B) State the principle and technique involved in Thin Layer Chromatography. [06]
- (C) State the characteristics of Electromagnetic Radiation. [04]

**OR**

- Q.12)** (A) Explain experimental techniques of Column Chromatography. [06]
- (B) Give the principle and applications of Gas Chromatography. [06]
- (C) Calculate number of Vibrational Degrees of Freedom for following molecules : [04]
- (1)  $\text{NH}_3$
  - (2)  $\text{H}_2\text{O}$
  - (3)  $\text{CO}_2$
  - (4)  $\text{C}_6\text{H}_6$

Total No. of Questions : 12]

[Total No. of Printed Pages : 6

[3661]-16

F. E. Examination - 2009

ENGINEERING MATHEMATICS - II

(2003 Course)

Time : 3 Hours]

[Max. Marks : 100

Instructions :

- (1) In section I, attempt Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6.
- (2) In section II, attempt Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12.
- (3) Answers to the **two sections** should be written in **separate answer-books**.
- (4) Figures to the right indicate full marks.
- (5) Neat diagrams must be drawn wherever necessary.
- (6) Use of non-programmable electronic pocket calculator is allowed.
- (7) Assume suitable data, if necessary.

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### SECTION - I

- Q.1) (A) Form the differential equation of family of circles of fixed radius  $a$  and centre on positive side of  $y$ -axis. [05]
- (B) Solve **any three** of the following Differential Equations : [12]

$$(1) \left[ 1 + e^{\frac{x}{y}} \right] dx + e^{\frac{x}{y}} \cdot \left[ 1 - \frac{x}{y} \right] dy = 0$$

$$(2) \sin y \frac{dy}{dx} = (1 - x \cos y) \cos y$$

$$(3) (3y - 7x + 7) dx + (7y - 3x + 3) dy = 0$$

$$(4) \left[ xy^2 - e^{\frac{1}{x^3}} \right] dx - x^2y dy = 0$$

$$(5) \frac{dy}{dx} = (x + y + 1)$$

OR

[3661]-16

1

P.T.O.



**Q.2)** (A) Form the differential equation whose general solution is :

$$y = A \cdot e^{-2x} + B \cdot e^{-3x} \quad [05]$$

(B) Attempt **any three** of the following Differential Equations : [12]

(1)  $\frac{dy}{dx} = 1 - x \tan(x - y)$

(2)  $(y^3 - 2x^2y) dx + (2xy^2 - x^3) dy = 0$

(3)  $(y^4 + 2y) dx + (xy^3 + 2y^4 - 4x) dy = 0$

(4)  $(x^2y^2 + 5xy + 2) y \cdot dx + (x^2y^2 + 4xy + 2) x \cdot dy = 0$

(5)  $\cos x \frac{dy}{dx} + y \sin x = \sec x$

**Q.3)** Solve **any three** of the following :

(a) The distance 'x' descended by a person falling freely under gravity by means of a parachute, satisfy the differential equation

$$\left(\frac{dx}{dt}\right)^2 = k^2 \left[1 - e^{\frac{-2gx}{k^2}}\right] \text{ where } g \text{ and } k \text{ are constants. If he falls}$$

from rest, show that  $x = \frac{k^2}{g} \log \cosh\left(\frac{gt}{k}\right)$  [06]

(b) The series electrical circuit consisting of inductance 'L' and resistance 'R' is connected to e.m.f.  $E_0 \cdot e^{-at}$ , where  $E_0$  and  $a$  are constants. Show that the current as a function of time is given by

$$i = \frac{E_0}{R - aL} \left[ e^{-at} - e^{-\frac{R}{L}t} \right] \quad [05]$$

(c) The steady heat flow through the spherical shell of radius  $r$  ( $r_1 \leq r \leq r_2$ ) satisfy the differential equation

$$r \cdot \frac{d^2u}{dr^2} + 2 \frac{du}{dr} = 0, \text{ if temperature } u = u_1 \text{ when } r = r_1 \text{ and } u = u_2 \text{ when } r = r_2. \text{ Find the temperature } u \text{ in terms of } r. \quad [06]$$

- (d) A body cools from  $100^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  in 15 minutes when surrounding temperature is  $30^{\circ}\text{C}$ . Find time when the temperature of the body will be  $40^{\circ}\text{C}$  [05]

OR

**Q.4)** Attempt **any three** of the following :

- (a) Find the Orthogonal Trajectories of  $x^2 + 2y^2 = c^2$ . [05]
- (b) Find the current 'i' in a circuit consisting of resistance 50 ohms and condenser of capacity 0.02 Farad in a series with e.m.f.  $10\sin(2t)$ . [05]
- (c) A steam pipe 20cm in diameter is protected with a covering 6cm thick for which  $k = 0.0003$ , in steady state. Find the heat loss per hour through a meter length of the pipe, if the surface of the pipe is at  $200^{\circ}\text{C}$  and the outer surface of covering is at  $30^{\circ}\text{C}$ . [06]
- (d) An elastic string of natural length ' $l$ ' is fixed at a point A. To the lower end of it, a particle of mass ' $m$ ' is attached so that the spring is stretched to the length ' $2l$ '. If the particle is dropped from A, show that it descends a distance  $l(2 + \sqrt{3})$  before coming to rest. [06]

- Q.5)** (A) Find the equation of sphere that touches the given sphere  $x^2 + y^2 + z^2 - x + 2y + 2z - 3 = 0$  at the point  $(1, 1, -1)$  and passing through the point  $(0, 0, 3)$ . [06]
- (B) Find the equation of right circular cylinder of radius '3' with axis along the line  $x + z + 2 = 0 = x - 2y + 4$  [05]
- (C) Find the equation of cone generated by rotating the line  $2x + 3y = 6, z = 0$ , about y-axis. [05]

OR

- Q.6)** (A) Show that the plane  $4x - 3y + 6z = 35$ , is tangential to the sphere  $x^2 + y^2 + z^2 - y - 2z - 14 = 0$ ; and find the point of contact. [06]
- (B) Find the equation of right circular cone with vertex at origin and axis as the line  $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$  and semi-vertical angle  $30^\circ$ . [05]
- (C) Find the equation of cylinder whose generator is parallel to the line  $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$  and guiding curve is  $x^2 + 2y^2 = 1, z = 3$ . [05]

### SECTION - II

- Q.7)** (A) Obtain Fourier Series Expansion for the function  
 $f(x) = x - x^2, \quad -1 \leq x \leq 1$  [08]
- (B) Establish the Reduction formula connecting  $I_n$  to  $I_{n-2}$ , where  $I_n = \int_0^{\pi/2} x \cdot \sin^n x dx$  [05]
- (C) Evaluate  $\int_2^5 \sqrt{(x-2)^7 (5-x)^9} \cdot dx$  [04]

- Q.8)** (A) The following table gives the vibration of periodic current over a period.

<b>T :</b>	0	$\frac{T}{6}$	$\frac{T}{3}$	$\frac{T}{2}$	$\frac{2T}{3}$	$\frac{5T}{3}$	T
<b>A :</b>	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show by periodic harmonic analysis, that there is direct current part of 0.75 amp. in variable current and obtain the amplitude of first harmonic. [08]

(B) If  $I_n = \int_0^{\pi/2} \cos^n x \cos(nx) dx$ , prove that

$$I_n = \frac{1}{2} \cdot I_{n-1} = \frac{\pi}{2^{n+1}} \quad [05]$$

(C) Show that  $\beta(m, n) = \int_0^1 \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}} dx$  [04]

**Q.9) (A) Trace any two of the following curves :** [08]

(1)  $y^2 (x^2 + 4) = x^2 + 2x$

(2)  $r = 1 + 2\cos\theta$

(3)  $x = a (\theta - \sin\theta)$

$y = a (1 - \cos\theta)$

(B) Show that

$$\text{Erf}_c(-x) = 2 - \text{Erf}_c(x) \quad [04]$$

(C) Evaluate :  $\int_0^a \frac{\log(1+ax)}{1+x^2} dx$  [05]

**OR**

**Q.10) (A) Trace the curve : (Any Two)** [08]

(1)  $xy^2 = a(x^2 - a^2), a > 0$

(2)  $x^{2/3} + y^{2/3} = a^{2/3}$

(3)  $r = a \cos(3\theta)$

(B) If  $\alpha(x) = \sqrt{\frac{2}{\pi}} \int_0^x e^{-\left(\frac{t^2}{2}\right)} dt$ , show that

$$\text{Erf}(x) = \alpha[x\sqrt{2}] \quad [04]$$

(C) Find the length of one loop of the curve  $r^2 = a^2 \cos(2\theta)$ . [05]

**Q.11) (A)** Evaluate  $\iint_R xy(x+y) dx dy$ , where 'R' is the region bounded by  $y = x^2$  and  $y^2 = -x$ . [05]

**(B)** Evaluate  $\int_0^\infty \int_0^\infty \int_0^\infty \frac{dx dy dz}{(1+x^2+y^2+z^2)^2}$  [06]

**(C)** Find the area inside the cardioid  $r = 2a(1 + \cos\theta)$  outside the curve  $r = \frac{2a}{(1 + \cos\theta)}$ . [05]

**OR**

**Q.12) (A)** Find Mean Value (M.V) and Root Mean Square (R.M.S.) value of the ordinate of the cycloid  $x = a(\theta + \sin\theta)$ , over the range  $y = a(1 - \cos\theta)$ ,  $\theta = -\pi$  to  $\theta = \pi$  [05]

**(B)** Find the volume of the region enclosed by the cone  $z = \sqrt{x^2 + y^2}$  and paraboloid  $z = x^2 + y^2$ . [06]

**(C)** Find the centre of gravity of one loop of the curve  $r = a\sin(2\theta)$ . [05]

Total No. of Questions : 12]

[Total No. of Printed Pages : 5

**[3661]-15**

**F. E. Examination - 2009**  
**BASIC CIVIL ENGINEERING**  
(2003 Course)

Time : 3 Hours]

[Max. Marks : 100

**Instructions :**

- (1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 from section I and Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12 from section II.
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.
- (6) Assume suitable data, if necessary.

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**SECTION - I**

- Q.1)** (A) Explain the role of Civil Engineer for the branch 'Mechanical Engineering'. **[04]**
- (B) Differentiate between the following with respect to any three points : **[06]**
- (1) Flexible Pavement and Rigid Pavement
  - (2) Estimation and Valuation
- (C) State any two practical applications of each of the following : **[06]**
- (1) Fluid Mechanics
  - (2) Environmental Engineering
  - (3) Geotechnical Engineering

**OR**

- Q.2)** (A) Explain the role of Civil Engineer in construction of Infrastructure Projects for 21st century. [04]
- (B) Explain the special considerations required for Erection of Transmission Towers. [06]
- (C) State and explain six infrastructure facilities for rapid development of an area/locality. [06]
- Q.3)** (A) What is Ranging ? Explain Ranging by Line Ranger. [04]
- (B) State the principles of Surveying and explain any one with sketches. [1+3=04]
- (C) Draw conventional symbols for the following : [04]
- (1) Marshy Ground
  - (2) Lake
  - (3) Embankment
  - (4) Canal
- (D) Define Scale. What is its necessity and find scale for following : [04]
- (1) 1:50,000
  - (2)  $\frac{1}{50,00,000}$

**OR**

- Q.4)** (A) Draw the sketches to show the following bearings. Also convert them into other relevant system : [04]
- (1) S 75° 25'E
  - (2) N 70° 10'W
  - (3) 165° 30'
  - (4) 255° 00'
- (B) Explain various types of Meridians used in Surveying. [04]

(C) Differentiate between the following : [04]

- (1) Fore Bearing and Back Bearing
- (2) Base Line and Check Line
- (3) Dip and Declination
- (4) True Bearing and Magnetic Bearing

(D) For a closed compass traverse PQRSP, observed fore bearings of lines PQ, QR, RS and SP are  $93^{\circ}00'$ ,  $37^{\circ}30'$ ,  $260^{\circ}00'$  and  $160^{\circ}00'$  respectively. While back bearings of these lines are  $260^{\circ}00'$ ,  $220^{\circ}00'$ ,  $80^{\circ}00'$  and  $324^{\circ}30'$  respectively.

Draw sketch of the traverse and find included angles. [04]

**Q.5)** (A) Explain four characteristic of contours with the help of neat sketches. [04]

(B) State and briefly explain two uses (applications) of : [2x3=06]

- (1) G.I.S.
- (2) Total Station
- (3) Laser

(C) The following readings were taken with a level and 4m staff. The instrument was shifted after 4th and 8th reading.

1.950, 0.870, 2.855, 3.430, 0.855, 1.840, 2.625, 3.210, 0.945, 1.485

(1) Enter the readings in the form of a level book page and find the RL's by Collimation Plane Method.

(2) Apply usual checks. [08]

**OR**

**Q.6)** (A) Write three difference between : [06]

- (1) Rise and Fall Method – Collimation Plane Method
- (2) Differential Levelling – Simple Levelling



(B) Enlist fundamental axes of a dumpy level and state their inter-relationship. [04]

(C) Following staff readings were recorded while levelling on a continuously sloping ground, with a dumpy level and a 4.0m levelling staff.

0.420, 1.660, 2,880, 0.580, 1.385, 2.190, 2.995 and 3.800.

The R.L. of the station where first reading was taken was 300.000m.

Rule out the page of level book and enter the above readings. Determine R.L. of staff stations by Rise and Fall Method. Apply usual checks. [08]

## SECTION - II

**Q.7)** (A) Explain why, quality of concrete is better in precast concrete compared to cast-in-situ. [04]

(B) Explain in detail; Deep Foundation and Shallow Foundation. [3+3=06]

(C) Explain in detail; Dead Load and Live Load. [2+2=04]

(D) Explain the necessity of Doors and Windows in a Building. [2+2=04]

**OR**

**Q.8)** (A) Enlist any 6 fundamental requirements of a Masonry. [1x6=06]

(B) Enlist any 6 causes of Settlement of a Foundation. [06]

(C) Enlist any 4 basic materials used in Construction. Explain 2 uses of any 2 of them. [2+4=06]

**Q.9)** (A) Enlist any 6 important factors to be considered for the site selection for Residential Buildings. [06]

(B) Enlist any 8 principles of Planning : Explain with a neat sketch :

(1) Aspect and

(2) Prospect [4+3+3=10]

**OR**

**Q.10) (A)** Explain in detail Land Acquisition Act. **[06]**

**(B)** Explain following terms : **[2x2=04]**

(1) Open Space Requirement

(2) Set Back Distance

**(C)** A plot owner proposed G+1 construction with 175 m<sup>2</sup> construction on each floor, on a plot of size 17m × 22m. Find ground coverage and FSI proposed, if all margins are 2m each. If permissible FSI is 1, state with reason whether plan will be sanctioned or not. **[06]**

**Q.11) (A)** Enlist any 2 effects of Air Pollution observed on global scale. Explain any 1 in detail. **[2+6=08]**

**(B)** Write short notes on : **(Any Two)** **[08]**

(1) Conventional Energy Sources

(2) Noise Pollution

(3) Land Pollution

**OR**

**Q.12) (A)** Enlist any 4 Non-conventional Energy Sources. Explain in detail : Tidal Energy. **[2+4=06]**

**(B)** Enlist 2 effects of Air Pollution on each of the following : **[2x3=06]**

(1) Human Being

(2) Vegetation

(3) Materials and Structures

**(C)** Enlist any 4 sources of Noise. Explain any one in detail. **[2+2=04]**

Total No. of Questions : 12]

[Total No. of Printed Pages : 5

**[3661]-14**

**F. E. Examination - 2009**

**BASIC ELECTRICAL ENGINEERING**

**(2003 Course)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) *Answers to the two sections should be written in separate answer-books.*
- (2) *Black figures to the right indicate full marks.*
- (3) *Neat diagrams must be drawn wherever necessary.*
- (4) *Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam table is allowed.*
- (5) *Assume suitable data, if any.*

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**SECTION - I**

- Q.1)** (A) Explain the effect of temperature on conducting and insulating material with graph. **[06]**
- (B) Compare Lead Acid Cell and Nickel Cadmium Cell. **[06]**
- (C) An electric kettle containing 0.75 liters of water raises the temperature from 30°C to 100°C using 0.5kW of power from a 240V D.C. supply. If overall efficiency of the kettle is 80%, estimate the time required for operation. Assume specific heat of water = 4200 J/kg.°k. **[06]**

**OR**

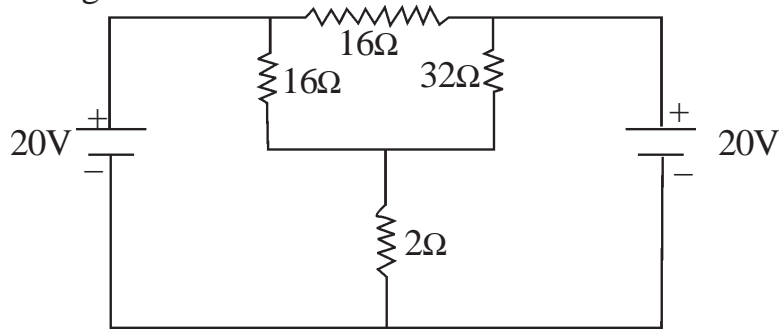
- Q.2)** (A) What is Insulation Resistance ? Derive the expression for insulation resistance of a cable. **[06]**
- (B) Determine the current flowing at the instant of switching a 100 watt lamp on 230V supply. The ambient temperature is 25°C. The filament temperature is 2000°C and the resistance temperature coefficient is 0.005/°C at 0°C. **[06]**
- (C) What are the factors governing the Value of Resistance ? Explain the term Resistivity. **[06]**

**[3661]-14**

**1**

**P.T.O.**

- Q.3)** (A) State the Kirchoff's Voltage and Current Law. Find the current flowing through  $2\Omega$  resistance using KVL for the circuit given in Fig.1. [08]



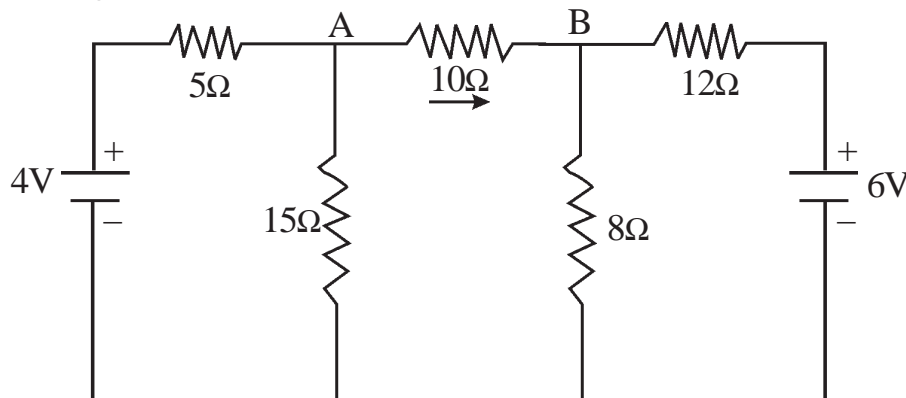
**Fig. 1**

- (B) State and explain the Thevenin's Theorem. Also give the steps for solving a network with Thevenin's Theorem. [08]

**OR**

- Q.4)** (A) Derive the equations for converting a delta connected network into its equivalent star network. [08]

- (B) Find by using Superposition Theorem, the current flowing through branch AB. [08]



- Q.5)** (A) An iron ring of 100cm mean diameter and  $10\text{cm}^2$  cross section has 1000 turns of copper wire on it. If the permeability of the material is 1500 and it is required to produce a flux density of  $1\text{Wb/m}^2$  in an air gap of 2mm wide in the ring, find

- (1) Reluctance of Ring
- (2) Flux Required
- (3) m.m.f. Required and
- (4) Current Produced

[08]

- (B) Define the following terms with its unit : [08]
- (1) Flux Density
  - (2) M.M.F.
  - (3) Magnetic Field Strength
  - (4) Reluctance

**OR**

- Q.6)** (A) Explain the term Statically Induced e.m.f. and Dynamically Induced e.m.f. [08]
- (B) Calculate the inductance of ring shaped coil having a mean diameter of 200mm wound on a wooden core of diameter 20mm of relative permeability 1. The winding is evenly wound and contains 500 turns. If the wooden core is replaced by an iron core which has relative permeability of 600 when the current is 5A, calculate new value of inductance. [08]

### SECTION - II

- Q.7)** (A) Define the following term and indicate it on a sine waveform : [06]
- (1) Frequency
  - (2) Instantaneous Value
  - (3) Amplitude
- (B) Three capacitors of values  $2\mu\text{F}$ ,  $4\mu\text{F}$  and  $6\mu\text{F}$  are connected in series across a 60V supply. Determine : [06]
- (1) Equivalent Capacitance
  - (2) Charge on Capacitor
  - (3) Voltage across each Capacitor
- (C) Derive the expression for instantaneous voltage, charge and charging current for a R-C circuit. [06]

**OR**

- Q.8)** (A) Define the following terms with its unit : [06]
- (1) Electric Field Strength
  - (2) Absolute Permittivity
  - (3) Electric Flux
- (B) Two current  $I_1 = 10 \angle 50^\circ$  and  $I_2 = 5 \angle -100^\circ$  flow in single phase A.C. circuit. Estimate : [06]
- (1)  $I_1 + I_2$
  - (2)  $I_1 - I_2$
  - (c)  $I_1/I_2$
- (C) Derive the expression for R.M.S. value of a sinusoidal varying current in terms of its peak value. [06]

- Q.9)** (A) A resistance of  $20\Omega$ , inductance of  $0.05\text{H}$  and a capacitor of  $50\mu\text{F}$  are connected in series. A supply voltage  $230\text{V}$ ,  $50\text{Hz}$  is connected across the series combination. Calculate the following : [08]
- (1) An impedance
  - (2) Current Drawn by the Circuit
  - (3) Phase Difference and Power Factor
  - (4) Active and Reactive Power Consumed by Circuit
- (B) Derive the condition for series resonance in R-L-C Circuit. Also draw the frequency response of impedance, current and power factor. [08]

**OR**

- Q.10)** (A) Two impedances  $Z_1 = 30 \angle 45^\circ$  and  $Z_2 = 45 \angle 30^\circ$  are connected in parallel across a single phase  $230\text{V}$ ,  $50\text{Hz}$  supply. Calculate : [08]
- (1) Current Drawn by each branch
  - (2) Total Current
  - (3) Overall Power Factor

Also draw the phasor diagram indicating current drawn by each branch and total current taking supply voltage as reference.

- (B) Derive an expression for the instantaneous current in a R-L series circuit when sinusoidal voltage given by  $v = V_m \sin \omega t$  is applied to the circuit. Also derive the equation for average active power consumed by circuit. [08]

**Q.11) (A)** Derive the relationship between Line Current and Phase Current, Line Voltage and Phase Voltage for a balanced star connected network connected across three phase supply. Also derive the power expression for power consumed. [08]

- (B) The iron loss of 80kVA 1000V/250V, single phase 50Hz transformer is 500W. The copper loss when the primary carries current of 50A is 400W.

Find :

- (1) Area of cross section of limb if working flux density is 1T and there are 1000 turns on primary.
- (2) Efficiency at full load and p.f. 0.8 lag
- (3) Efficiency at 75% of full load and unity p.f. [08]

**OR**

**Q.12) (A)** Three identical coils each having resistance of  $15\Omega$  and inductance of 0.03H are connected in delta across a three phase 400V, 50Hz supply :

Calculate :

- (a) Line and Phase Voltage
  - (b) Line and Phase Current
  - (c) Power Factor and Power Factor Angle
  - (d) Active and Reactive Power Consumed [08]
- (B) Write a short note on Autotransformer. [08]

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-13**

**F. E. Examination - 2009**

**BASIC MECHANICAL ENGINEERING**

**(2003 Course)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) *Answers to the two sections should be written in separate books.*
- (2) *Black figures to the right indicate full marks.*
- (3) *Neat diagrams must be drawn wherever necessary.*
- (4) *Use of logarithmic tables, slide rules, mollier charts, electronic pocket calculators and steam tables is allowed.*
- (5) *Assume suitable data, if necessary.*

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**SECTION - I**

**UNIT - I**

**Q.1) (A) Define and explain the following terms : [08]**

- (1) System
- (2) Surroundings
- (3) Property
- (4) State

**(B) State and explain Zeroth Law of Thermodynamics. What is its use ? [06]**

**(C) If air pressure in an automobile tyre shown by gauge is 2.8 bar, and barometer reads 680 mm of mercury, calculate the absolute air pressure in kPa. [04]**

**OR**

**[3661]-13**

**1**

**P.T.O.**



- Q.2)** (A) What is Continuity Equation ? [04]  
 (B) What is Internal Energy ? Elaborate it further. [06]  
 (C) In a reversible process of a closed system, undergoes a process  $pv^n = c$ . If heat transferred is +15kJ, and change in internal energy is +45kJ,  $P_1 = 1.4$  bar,  $P_2 = 8.4$  bar,  $V_1 = 0.15$  m<sup>3</sup> and  $V_2 = 0.0357$ m<sup>3</sup>. Find out the value of index 'n', workdone with significance of its sign. [08]

### UNIT - II

- Q.3)** (A) Give two applications of steam and how it is produced ? [04]  
 (B) List different Water Turbines and explain any one of them with neat sketch. [06]  
 (C) Explain working of 4 stroke diesel engine with neat sketches. [06]

### OR

- Q.4)** (A) Define a Power Absorbing Device and classify the following devices as power producing or power absorbing : [04]  
 (1) Centrifugal Water Pump  
 (2) Steam Turbine  
 (3) Air Compressor  
 (B) Explain construction and working of Vane Blower with neat sketch. [06]  
 (C) Explain construction and working of Domestic Refrigerator with neat schematic diagram. [06]

### UNIT - III

- Q.5)** (A) List different renewable and non-renewable sources of Energy. [04]  
 (B) Explain construction and working of a Hydroelectric Powerplant with a neat sketch. Name two such plants in India. [06]  
 (C) Explain construction and working of Nuclear Powerplant. Give its two advantages. [06]

### OR

- Q.6)** (A) List different modes of Heat Transfer and respective governing laws. [04]
- (B) Obtain an expression for neat conduction in a hollow cylinder and further write expression for thermal resistance. [06]
- (C) A cold storage door of size  $2\text{m} \times 1.5\text{m}$ ., consists of 2 and 6 mm. thick glass sheets, separated by an air gap of 2mm. The cold storage inside temperature is  $-20^{\circ}\text{C}$ . The outside atmospheric air temp. is  $30^{\circ}\text{C}$ . The convective heat transfer coefficient between glass and air is  $23.2 \text{ Watts/m}^2\text{K}$ ;  $K_{\text{glass}} = 0.75 \text{ Watts/mK}$  and  $K_{\text{air}} = 0.02 \text{ Watts/mK}$ , Neglect convection effects in air gap. Find, heat transfer through door, mentioning its direction. [06]

## SECTION - II

### UNIT - IV

- Q.7)** (A) Draw neat labelled block diagram of lathe machine and explain function of following parts : [08]
- (1) Bed
  - (2) Head Stock
  - (3) Tail Stock
  - (4) Carriage
- (B) Explain Pillar type drilling machine with neat sketch. [06]
- (C) State the advantages and disadvantages of CNC Machines. [04]

**OR**

- Q.8)** (A) Explain TIG Welding with neat sketch. State its advantages over Manual Metal Arc Welding. [08]
- (B) What is Resistance Welding ? Explain the procedure of Resistance Welding with neat sketch. [06]
- (C) Differentiate between Arc Welding and Gas Welding. [04]

**UNIT - V**

- Q.9)** (A) Explain steps involved in Design Procedure. [06]  
(B) State and explain any three Press Working Operations. [06]  
(C) Explain the procedure adopted during selection of the material for engineering purpose. [04]

**OR**

- Q.10)** (A) Explain Aesthetic and Ergonomic Considerations in Design. [06]  
(B) Differentiate between Unilateral and Bilateral Tolerances. [04]  
(C) State and define any six Material Properties. [06]

**UNIT - VI**

- Q.11)** (A) Draw sketch of Single Plate Clutch and explain its working. [06]  
(B) Differentiate between Individual Drive and Group Drive. [04]  
(C) Compare Flat Belt and V-Belt. [06]

**OR**

- Q.12)** (A) Explain the working of any centrifugal governor with diagram. [06]  
(B) Explain the working of Bush Bearing with sketch. [04]  
(C) State advantages and disadvantages of Chain Drive over Belt Drive. [06]

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-12**

**F. E. Examination - 2009**

**APPLIED SCIENCE - I**

**(2003 Pattern)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer **any three** questions from section I and **any three** questions from section II.
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of logarithmic tables, slide rule, electronic pocket calculator and steam tables is allowed.
- (6) Assume suitable data, if necessary.

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**SECTION - I**

- Q.1)** (A) A thin film of uniform thickness is illuminated by monochromatic light. Obtain the conditions of darkness and brightness of the film as observed in reflected light. Why does an excessively thin film appear dark in reflected light ? **[07]**
- (B) State fundamental postulate of special theory of relativity. Derive the Einstein's Mass Energy relation. **[06]**
- (C) How far must the movable mirror of the Michelson's Interferometer be moved in order that 200 fringes of wavelength  $6000\text{\AA}$  cross the field of view ? **[04]**

**OR**

- Q.2)** (A) Explain the formation of Newtons Rings. Show that the diameter of  $n^{\text{th}}$  dark ring is directly proportional to square root of natural number. **[07]**
- (B) Write down Lorentz transformation equations. Derive Lorentz-Fitzgerald contraction equation. Discuss the result. **[06]**

(C) A Beam of Sodium Light of Wavelength  $5890 \times 10^{-8}$  cm is incident on a thin film of magnesium fluoride of refractive index 1.38. Calculate the thickness of the film which will make it appear dark by reflection. [04]

**Q.3)** (A) Give the theory of plane diffraction grating. Obtain the condition for  $n^{\text{th}}$  order maxima and minima. [07]

(B) What are Ultrasonic Waves ? Explain any one application of Ultrasonic Waves. [06]

(C) A slit of variable width is illuminated by red light of wavelength  $6500\text{\AA}$ . At what width of the slit, the first minimum will fall at  $\theta = 30^\circ$  ? [04]

**OR**

**Q.4)** (A) What is Magnetostriction effect ? Draw a neat diagram and explain the Magnetostriction Oscillator for the production of Ultrasonic Waves. [07]

(B) State Rayleigh's criterion of resolutions. Obtain expression for resolving power of grating. [06]

(C) The Bragg's angle corresponding to the first order reflection from the plane of the crystal is  $30^\circ$ , when X-rays of Wavelength  $1.78\text{\AA}$  are used. Calculate the interplanar spacing. [04]

**Q.5)** (A) Explain the phenomenon of double refraction on the basis of Huygens Wave theory of light. [06]

(B) What is nuclear fission ? Explain it on the basis of Bohr and Wheeler liquid drop model. [06]

(C) A polariser and an analyser are oriented, so that the amount of light transmitted is maximum. How can the analyser be oriented, so that the transmitted light is reduced to :

(1) 0.25

(2) 0.75 [04]

**OR**

- Q.6)** (A) With the help of neat labelled diagram explain principle, construction and working of Betatron. Obtain Betatron condition. [06]
- (B) What are retardation Plates ? Deduce the expression for thickness of QWP in terms of refractive indices. [06]
- (C) In a thermonuclear reaction  $1.00 \times 10^{-3}$  kg of hydrogen is converted into  $0.993 \times 10^{-3}$  kg helium. Calculate energy released in joule. [04]

### SECTION - II

- Q.7)** (A) Classify solids on the basis of types of Bonding. Explain any one in detail. [07]
- (B) Calculate atomic packing factor for BCC and FCC Structures. [06]
- (C) Define the following :
- (1) Coordination Number
  - (2) Unit Cell
  - (3) Plane of Symmetry
  - (4) Isotropy [04]

### OR

- Q.8)** (A) Explain the properties of talc and mica on the basis of their structures. Give the applications of talc and mica also. [07]
- (B) Why are Miller Indices of a lattice plane better than the Weiss Indices ? Draw (101) and (110) planes in a simple Unit Cubic Cell. [06]
- (C) Distinguish between Frenkel and Schottky defects in Ionic Crystals. [04]
- Q.9)** (A) What are secondary pollutants ? Explain the formation reactions and effects of any one secondary pollutant. [06]
- (B) Give the causes and disadvantages of Boiler Corrosion and Caustic Embrittlement. Explain the methods to minimise these. [06]
- (C) An exhausted zeolite bed was regenerated by passing 5 litres of 10% brine solution. The bed was exhausted on passing 1200 litres of hard water. Calculate the hardness of water. [05]

### OR

- Q.10)** (A) Define BOD and COD. How are they determined for Waste Water Sample ? [06]
- (B) Explain the Electrodialysis Method for removal of ionic pollutants from water. [06]
- (C) Which are the air polluting emissions from I.C. Engines ? Explain the role of catalytic convertor for their control. [05]
- Q.11)** (A) Describe the techniques of solution and suspension polymerisation with the help of an example. [06]
- (B) Define Glass Transition Temperature. Discuss its importance and factors affecting it. [06]
- (C) Compare Natural and Vulcanised Rubber. [04]

**OR**

- Q.12)** (A) Give the preparation, properties and uses of **any two** of the following :
- (1) Butyl Rubber
- (2) Polyvinyl Chloride
- (3) Polystyrene [06]
- (B) Explain the cationic chain mechanism with the help of an example. [06]
- (C) What are Liquid Crystalline Polymers ? Give their properties and uses. [04]
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Total No. of Questions : 12]

[Total No. of Printed Pages : 7

**[3661]-11**

**F. E. Examination - 2009**

**ENGINEERING MATHEMATICS - I**

**(2003 Course)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 from section II and Q. 7 or Q.8, Q.9 or Q. 10, Q. 11 or Q.12 from section II.
- (2) Answer to the two sections should be written in **separate answer-books.**
- (3) Figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of non-programmable electronic pocket calculator is allowed.
- (6) Assume suitable data if necessary.

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**SECTION - I**

**Q.1) (A)** Reduce the following matrix to its normal form and hence find its rank :

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

**[05]**

**(B)** Examine for consistency and solve them if consistent :

$$2x + y + 2z + w = 6$$

$$6x - 6y + 6z + 12z = 36$$

$$4x + 3y + 3z - 3w = -1$$

$$2x + 2y - z + w = 10$$

**[06]**



- (C) Verify Cayley – Hamilton Theorem and hence find  $A^{-1}$  for

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -3 & 3 \end{bmatrix} \quad [06]$$

**OR**

- Q.2)** (A) Find Eigen Values and Corresponding Eigen Vectors for the matrix A :

$$A = \begin{bmatrix} 2 & -1 & 1 \\ 1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix} \quad [07]$$

- (B) Verify whether the matrix

$$A = \begin{bmatrix} \frac{1}{2} & \frac{2}{3} & \frac{2}{3} \\ \frac{2}{3} & -\frac{2}{3} & \frac{1}{3} \\ \frac{2}{3} & \frac{1}{3} & -\frac{2}{3} \end{bmatrix} \text{ is orthogonal.} \quad [05]$$

- (C) Examine for linear dependence or independence for given vectors and if dependent, find the relation between them :

$$X_1 = (1, 2, 3), X_2 = (3, -2, 1) X_3 = (1, -6, -5) \quad [05]$$

- Q.3)** (A) Find the locus of Z satisfying  $|Z - 3| - |Z + 3| = 4$  [06]

- (B) Solve the equation

$$x^7 - x^4 + x^3 - 1 = 0 \quad [06]$$

- (C) Prove that :

$$\tan \left[ i \log \left( \frac{a - ib}{a + ib} \right) \right] = \frac{2ab}{a^2 - b^2} \quad [05]$$

**OR**

- Q.4) (A)** Evaluate :  
 $(1 + i)^{100} + (1 - i)^{100}$  [05]
- (B)** If  $\cos(u + iv) = x + iy$  [06]  
 prove that :  
 (i)  $(1 + x)^2 + y^2 = (\cosh v + \cos u)^2$   
 (ii)  $(1 - x)^2 + y^2 = (\cosh v - \cos u)^2$
- (C)** If  $z_1, z_2, z_3$  represent vertices of an equilateral triangle, prove that :  
 $z_1^2 + z_2^2 + z_3^2 = z_1 z_2 + z_2 z_3 + z_1 z_3$  [06]

- Q.5) (A)** Find  $n^{\text{th}}$  derivative of  $2e^x \cos x \cos 2x$ . [05]
- (B)** If  $y = (\sin^{-1} x)^2$   
 prove that :  
 $(1 - x^2) y_{n+2} - (2n + 1) x y_{n+1} - n^2 y_n = 0$  [06]
- (C)** Verify the Lagrange's Mean Value Theorem for  $f(x) = 1 - 3x$  in  $(1, 4)$ . [05]

**OR**

- Q.6) (A)** If  $y = \tan^{-1} \left( \frac{1 + x}{1 - x} \right)$   
 Find  $y_n$ . [05]
- (B)** Find  $n^{\text{th}}$  derivative of :  
 $x^2 e^x + x^2 \cos 3x$  [06]
- (C)** Verify Rolle's Theorem for :  
 $f(x) = x(x + 3) e^{x/2}$  in  $[-3, 0]$ . [05]

## SECTION - II

**Q.7) (A)** Test for convergence the series :

$$1 + \frac{3}{4}x + \frac{5}{9}x^2 + \frac{7}{28}x^3 + \dots + \frac{(2n+1)}{n^3+1}x^n + \dots \quad [05]$$

**(B)** Test for convergence of the series : **(Any One)** [04]

(1)  $\frac{1}{1+5} + \frac{2}{1+5^2} + \frac{3}{1+5^3} + \dots$

(2)  $\frac{1}{2} - \frac{2}{5} + \frac{3}{10} - \frac{4}{17} + \dots$

**(C)** Attempt **any two** : [08]

(1) Expand  $\log(1+x+x^2+x^3)$  upto a term in  $x^8$ .

(2) Prove that :

$$\tan^{-1} \left( \frac{\sqrt{1+x^2}-1}{x} \right) = \frac{1}{2} \left( x - \frac{x^3}{3} + \frac{x^5}{5} - \dots \right)$$

(3) Expand  $x^4 - 3x^3 + 2x^2 - x + 1$  in powers of  $(x-3)$ .

**OR**

**Q.8) (A)** Test of convergence the series : [05]

$$\frac{x}{1.2} + \frac{x^2}{3.4} + \frac{x^3}{5.6} + \frac{x^4}{7.8} + \dots$$

**(B)** Attempt **any one** : [04]

(1) Find whether the series

$$1 - \frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{3}} - \frac{1}{4\sqrt{4}} + \dots \text{ is absolutely convergent.}$$

(2) Test the convergence of the series

$$\frac{1}{3^p} + \frac{1}{5^p} + \frac{1}{7^p} + \frac{1}{9^p} + \dots$$

(C) Attempt **any two** : [08]

(1) Prove that :  $e^x \cos x = 1 + x - \frac{x^3}{3} - \frac{x^4}{6} + \dots$

(2) Expand  $\sin^{-1} \left( \frac{2x}{1+x^2} \right)$  in ascending powers of  $x$ .

(3) Prove that :

$$f(mx) = f(x) + (m-1)xf'(x) + \frac{(m-1)^2}{2!}x^2f''(x) + \dots$$

**Q.9) (A)** Attempt **any two** of the following : [08]

(1) Evaluate :  $\lim_{x \rightarrow 0} \log_{\tan x} (\tan 2x)$

(2) Evaluate :  $\lim_{x \rightarrow 2} \left[ \frac{1}{x-2} - \frac{1}{\log(x-1)} \right]$

(3) Evaluate :  $\lim_{x \rightarrow 0} \left[ \frac{a^x + b^x}{2} \right]^{1/x}$

(B) If  $v = \frac{c}{\sqrt{t}} e^{-x^2/4a^2t}$  then show that  $\frac{\partial v}{\partial t} = a^2 \frac{\partial^2 v}{\partial x^2}$  [05]

(C) If  $U = \sin^{-1} (x^3 + y^3)^{2/5}$  find  $x^2 U_{xx} + 2xy U_{xy} + y^2 U_{yy}$ . [04]

**OR**

**Q.10) (A)** Attempt **any two** of the following : **[08]**

(1) Evaluate :  $\lim_{x \rightarrow e} (\log x)^{1/(1 - \log x)}$

(2) Evaluate :  $\lim_{x \rightarrow 0} \frac{\log \sin x}{\cot x}$

(3)  $\lim_{x \rightarrow a} \sqrt{\frac{a+x}{a-x}} \tan^{-1} \sqrt{a^2 - x^2}$  Evaluate.

(B) If  $x = \frac{r}{2} (e^\theta + e^{-\theta})$ ,  $y = \frac{r}{2} (e^\theta - e^{-\theta})$  then show that

$$\left(\frac{\partial x}{\partial r}\right)_\theta = \left(\frac{\partial r}{\partial x}\right)_y \quad [04]$$

(C) If  $u = \sin(\sqrt{x} + \sqrt{y})$ , **[05]**

prove that :

$$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{1}{2} (\sqrt{x} + \sqrt{y}) \cos(\sqrt{x} + \sqrt{y})$$

**Q.11) (A)** A power dissipated in a resistor is given by  $P = \frac{E^2}{R}$ . Find the approximate percentage error in P when E is increased by 3% and R is decreased by 2%. **[05]**

(B) Find the extreme values of  $xy(a - x - y)$ . **[06]**

(C) If  $u = x + y + z$ ,  $v = x^2 + y^2 + z^2$ ,  $w = xy + yz + zx$  examine whether u, v, w are functionally dependent and if so find the relation between them. **[05]**

**OR**

**Q.12) (A)** Verify  $JJ' = 1$  for the transformation

$$x = uv, y = \frac{u}{v}. \quad [05]$$

**(B)** If  $u = xyz$ ,  $v = x^2 + y^2 + z^2$ ,  $w = x + y + z$ ,

$$\text{find } \frac{\partial x}{\partial u}. \quad [06]$$

**(C)** As the deminsions of a triangle ABC are varied, show that the maximum value of  $\cos A \cos B \cos C$  is obtained when the triangle is equilateral. **[05]**

Total No. of Questions : 12]

[Total No. of Printed Pages : 3

**[3661]-110**

**F. E. (Semester - II) Examination - 2009**

**BASIC MECHANICAL ENGINEERING**

**(June 2008 Pattern)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Solve questions No. 1 or 2, Q. No. 3 or 4, Q. No. 5 or 6 from section I and Q. No. 7 or 8, Q. No. 9 or 10, Q. No. 11 or 12 from section II.
- (2) Answers to the **two** sections should be written in **separate answer-books**.
- (3) Neat diagrams must be drawn wherever necessary.
- (4) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- (5) Assume suitable data, if necessary.

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**SECTION - I**

- Q.1)** (A) Explain with definition : Internal Energy, Irreversible Process, Enthalpy, Pure Substance. **[2x4=08]**
- (B) A 'closed vessel' contains 2 kg of carbondioxide at temperature 20°C and pressure 0.7 bar. Heat is supplied to the vessel till the gas acquires a pressure of 1.4 bar. Calculate final temperature, work done on or by gas, Heat added, change in internal energy. [ $C_v = 0.657$  kJ/kg.K.] **[2x4=08]**

**OR**

- Q.2)** (A) Define with example : System, Surrounding, Isolated System, Throttling. **[2x4=08]**
- (B) Draw sketch of Heat Engine and Refrigerator using source and sink concepts. Also state relations for efficiency and COP. What is PMMII ? **[4+2+2=08]**

- Q.3)** (A) Give classification of I.C. Engine with applications. [09]  
(B) Explain Split Air Conditioner with sketch. [09]

**OR**

- Q.4)** (A) How Boilers are classified ? State any four mounting and their functions. [5+4=09]  
(B) Explain Double Acting Reciprocating Pump and Impulse Turbine with sketches. [09]

- Q.5)** (A) Explain working of 'Solar-wind Hybrid Power Plant' with sketch. [08]  
(B) State Fourier's Law and Newton's Law of Cooling with their equations and units of each term.

A 60W incandescent lamp has coil surface temperature 2500K and room temperature 300 K. Estimate surface area of coil. [4+4=08]

**OR**

- Q.6)** (A) Compare Thermal and Nuclear Power Plants on any four parameters. Draw sketch of Nuclear Power Plant. [4+4=08]  
(B) Explain concept of Thermal Resistance with Electrical Analogy for two slabs.

The glass windows of a room has total area of 10 m<sup>2</sup> and glass is 4 mm thick. Calculate quantity of heat leaving from room through glass, when inside surface of windows are at 25°C and outside surface is at 10°C. The value of thermal conductivity for a glass is 0.84 W/mK. [5+3=08]

## **SECTION - II**

- Q.7)** (A) Describe Geneva Mechanism with sketch. State its applications. [4+3+1=08]  
(B) Draw sketches of Open Belt, Cross Belt and state their uses. What is velocity ratio in case of belts ? State advantages of belt compared to chain. [4+2+2=08]

**OR**



**Q.8)** Explain following with sketches and applications : **[4x4=16]**

- (a) Worm and Worm Wheel
- (b) Single Plate Clutch
- (c) Internal Expanding Brake
- (d) Gib Headed Key

**Q.9)** (A) Describe Gas Welding with sketch, applications, advantages and disadvantages. **[4+2+2=08]**

(B) What are steps to be followed for designing a component ? Explain with a flow chart and example. **[08]**

**OR**

**Q.10)** (A) Explain various ergonomic considerations in design with an industrial example. **[08]**

(B) State and explain (any eight) material selection criteria used for designing a component. **[08]**

**Q.11)** (A) Draw a neat sketch of Column and Knee Type Milling Machine and explain its working. **[5+4=09]**

(B) Describe Cylindrical Grinding, Centerless Grinding and Surface Grinding with sketch. **[3x3=09]**

**OR**

**Q.12)** (A) How Lathe Machine is specified ? Explain any three operations on lathe with sketch. **[3+6=09]**

(B) How Drilling Machine is classified ? Explain reaming, tapping and counter sinking on Drilling Machine. **[3+6=09]**

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-109**

**F. E. (Semester - II) Examination - 2009**

**BASIC ELECTRONICS ENGINEERING**

**(June 2008 Pattern)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer **any three** questions from each section.
- (2) Answers to the **two** sections should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Use of electronic pocket calculator is allowed.
- (5) Assume suitable data, if necessary.

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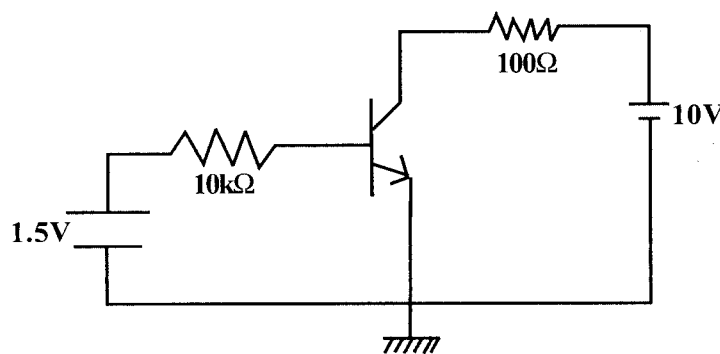
**SECTION - I**

- Q.1) (A)** A Bridge Rectifier is applied with input from step-down transformer having turns ratio 8 : 1 at 230V, 50Hz. If the diode forward resistance is  $1\Omega$ , secondary resistance is  $10\Omega$  and load resistance connected is  $2k\Omega$ . Find –
- (1) DC Power Output
  - (2) PIV of each diode
  - (3) % efficiency
  - (4) Regulation at full load **[08]**
- (B) Describe with the help of neat circuit diagram the operation of Zener Voltage Regulator. **[06]**
- (C) Explain the concept of Multiplexed Display. **[04]**

**OR**

- Q.2)** (A) Explain the principle of operation of LED. State various material used to Fabricate LED. [04]
- (B) Design zener regulator for following specifications :  
 $V_o = 5V$ ,  $I_L = 20 \text{ mA}$ ,  $P_Z = 500 \text{ mW}$ ,  $V_i = 12 \pm 2V$ ,  
 $I_Z (\text{min}) = 8 \text{ mA}$ . [08]
- (C) Give comparison between Half Wave, Full Wave and Bridge Rectifier. [06]

- Q.3)** (A) Determine  $I_B$ ,  $I_C$ ,  $I_E$ ,  $V_{CE}$  in the circuit of fig. 1 The Transistor has a  $\beta = 150$ . Assume  $V_{BE} = 0.7V$ . [06]



**Fig. 1**

- (B) Explain the construction, working and V-I characteristics of SCR. [06]
- (C) Define the following terms : [04]
- (1) Pinch Off Voltage
  - (2) Gate Cutoff Voltage

**OR**

- Q.4)** (A) Sketch and explain the typical BJT common base input, output and transfer characteristics. [06]
- (B) If the midband gain of an amplifier is 100 and if the half power frequencies are  $F_L = 40\text{Hz}$  and  $F_H = 16 \text{ kHz}$ . Calculate the amplifier gain the at the frequencies of 20Hz and 20 kHz. [06]
- (C) Explain construction and working of enhancement MOSFET. [04]

- Q.5)** (A) (a) Explain the following ideal characteristics of OP-Amp :
- (1) CMRR
  - (2) Slew Rate
  - (3) Band Width
- (b) Why is it necessary to reduce the gain of OP-Amp from its open loop value ? [08]
- (B) Draw and explain the working of square wave generator using OP-Amp. [08]

**OR**

- Q.6)** (A) Draw and explain the circuit diagram for obtaining  $V_o = V_1 + V_2$ . Derive the equation. [08]
- (B) Explain following application of OP-Amp : [08]
- (1) Integrator
  - (2) Differentiator
- Give area of applications of these circuits.

## SECTION - II

- Q.7)** (A) Design and implement Full Adder Circuit. [06]
- (B) What do you mean by Shift Resistor ? Explain different types of Shift Resistor. [06]
- (C) What are the advantages of using Microprocessor and Microcontrollers ? [04]

**OR**

- Q.8)** (A) Use DeMorgan's Theorem to simplify following Boolean expressions :
- (1)  $\overline{\overline{AB} + \overline{AB}}$
  - (2)  $\overline{(A + \overline{B})(C + \overline{D})}$  [06]
- (B) Draw and explain D Flip-Flop. Give the applications of Flip-Flops. [06]
- (C) Draw the diagram of 1 : 8 demultiplexer. What is the relation between number of select lines and outputs ? [04]

- Q.9)** (A) Write short note on CNC Machine. [04]  
(B) Draw a block diagram of Electronic Weighing Machine and explain its operation. [06]  
(C) Draw and explain different temperature transducers with its advantages and disadvantages. [06]

**OR**

- Q.10)** (A) Write short note on : [06]  
(1) PLC  
(2) Alarm Annunciator  
(B) Draw and explain different types of Pressure Transducers. [08]  
(C) Differentiate between Active and Passive Transducer. [02]
- Q.11)** (A) Draw and explain Electromagnetic Spectrum. [08]  
(B) Explain basic concept of Superheterodyning. [04]  
(C) Write short note on : [06]  
(1) Wireless Communication Media  
(2) Twisted Wire Cables

**OR**

- Q.12)** (A) What is the concept of Phase Modulation ? [04]  
(B) Explain following thing about FM : [08]  
(1) Deviation Ratio  
(2) Mathematical Representation of FM  
(3) Advantages and disadvantages of FM.  
(4) Effect of Modulation Index in FM.  
(C) Draw the block diagram of basic Communication System. Explain each block in detail. [06]

Total No. of Questions : 12]

[Total No. of Printed Pages : 9

[3661]-108

F. E. ( Semester - II ) Examination - 2009

ENGINEERING MATHEMATICS

(June 2008 Pattern)

Time : 3 Hours]

[Max. Marks : 100

Instructions :

- (1) Answer Q.1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 from section I. Answer Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12 from section II.
- (2) Answers to the **two** sections should be written in **separate answer-books**.
- (3) Figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of logarithmic tables, slide rule, electronic pocket calculate is allowed.
- (6) Assume suitable data, if necessary.

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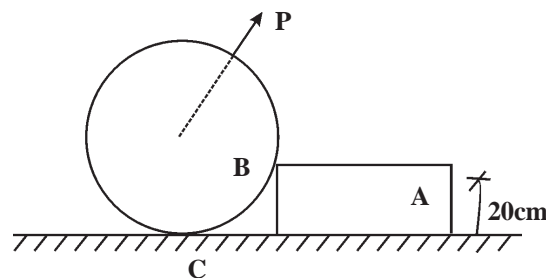
### SECTION - I

Q.1) (A) Define resultant of a System of Forces. What are the various methods to determine the resultant of concurrent forces ? [06]

(B) A uniform wheel of 50 cm diameter and 1 kN weight rests against a rigid rectangular block of thickness 20 cm. Considering all surfaces smooth, determine

(i) Least pull to be applied through the centre of wheel to just turn it over the corner of block.

(ii) Reaction of block [06]

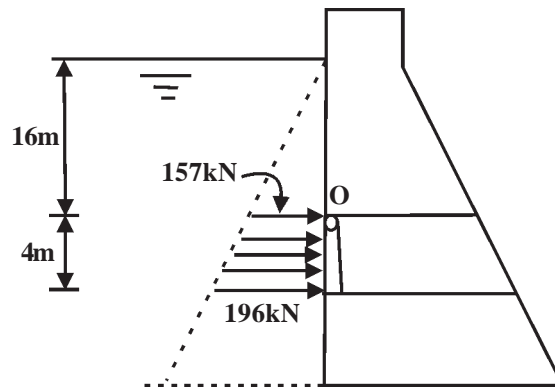


[3661]-108

1

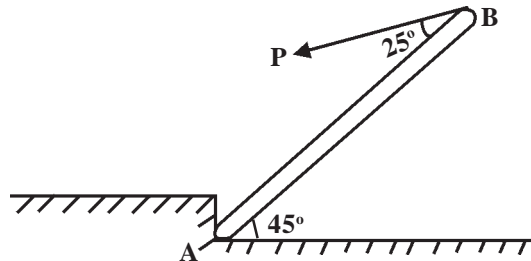
P.T.O.

- (C) Determine moment of hydrostatic force on the dam gate about hinge 'O'. [06]

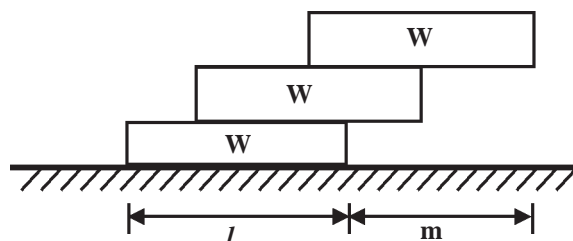


OR

- Q.2) (A) Explain how a system of non-concurrent forces can be reduced to an equivalent force-couple system. [06]
- (B) A joist of length 4m and weighing 200N is raised by pulling a rope as shown in figure. Determine the tension T induced in the rope and reaction at end A of joist. [06]



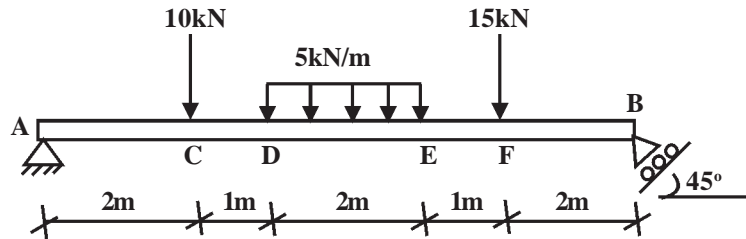
- (C) Three identical boxes, each having length  $l$  and weight  $W$  are placed as shown in figure. Find out the maximum possible distance 'm' through which the top box can extend out from the bottom so that there is no possibility of topping the stack. [06]



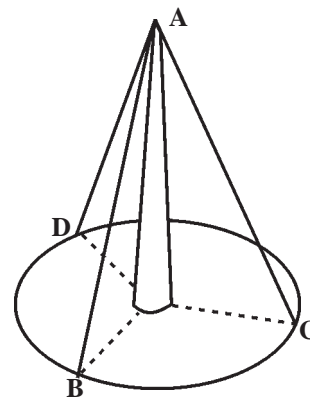
**Q.3) (A)** State conditions of equilibrium for –

- (i) Co-planer Concurrent Forces
- (ii) Concurrent Forces in Space
- (iii) Co-planer Non-concurrent Forces
- (iv) Non-concurrent Forces in Space

**(B)** Find support reactions for the beam loaded as shown in figure. [



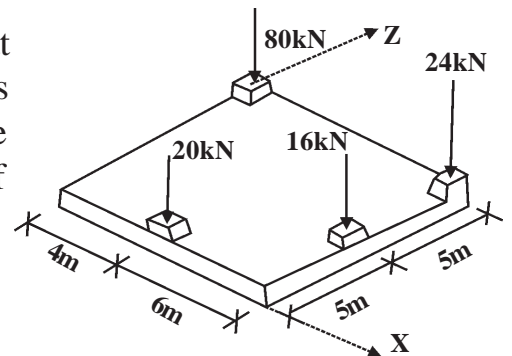
**(C)** A mast of height 'h' is supported by three cables AB, AC and AD placed equidistant around the circumference of circle of radius r on the ground level. Determine the resultant of tensions at A if tension in each cable is T. [



**OR**

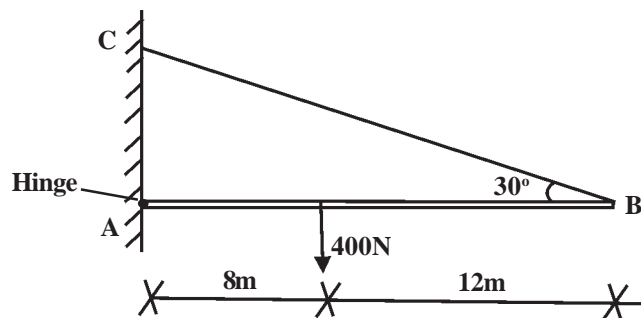
**Q.4) (A)** How do you convert the uniformly distributed load and uniformly varying load in equivalent point load. [

**(B)** A square foundation mat supports four columns as shown in figure. Determine magnitude and point of application of resultant of four loads.

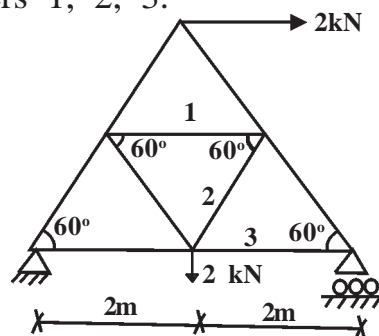




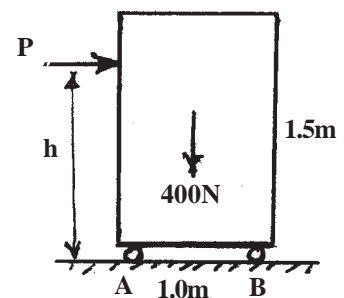
- (C) The rail AB of foundry crane is horizontal and is 20m long. End A is hinged to vertical wall and end B is tied to a tie rod BC making an inclination of  $30^\circ$  with the rail. The other end C of tie rod is connected to wall. If a load of 400 N is placed on rail at a distance of 8m from end A, find the tension produced in the tie rod and reaction developed at end A. [06]



- Q.5) (A) Name different methods of finding out the forces in members of a truss. When do you use these Methods ? [04]
- (B) A truss is loaded and supported as shown in figure. Find forces in members 1, 2, 3. [06]



- (C) A steel shelf 1.5m high 1.0m wide and weighing 400N is mounted on bushes A and B. These bushes do not rotate when the shelf is moved along the floor. Assuming that the coefficient of friction between the bushes and floor is 0.75, work out force required just to cause the shelf to move. If the shelf is not to tip over, determine the maximum height at which the force can be applied. [06]



OR

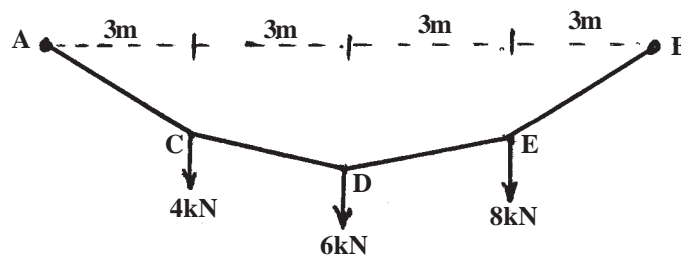
**Q.6) (A)** Define the terms :

- (i) Coefficient of Friction
- (ii) Angle of Friction
- (iii) Angle of Repose
- (iv) Cone of Friction

[04]

(B) A cable AB supports three loads as shown in figure. If the dip at central load is 2m, work out the components of reaction at supports, the sag under 4kN load and tension in portion CD and DE of the cable.

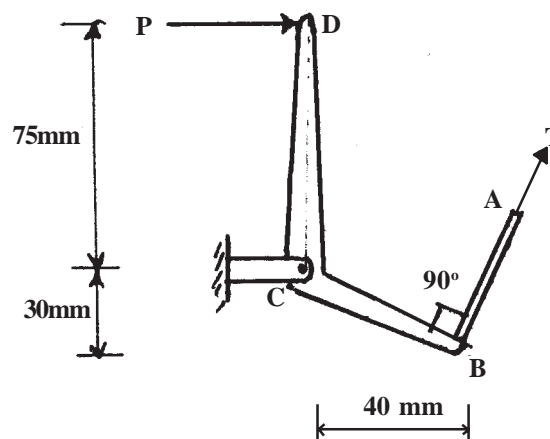
[06]



(C) The lever BCD is hinged at C and is attached to a control rod at B. If  $P = 200\text{N}$ . Determine :

- (i) the tension in rod AB
- (ii) the reaction at C

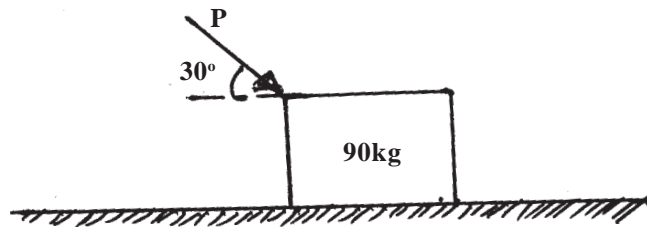
[06]



## SECTION - II

**Q.7)** (A) The acceleration of point 'A' is defined by the relation  $a = 600x (1 + kx^2)$ , where 'a' and 'x' are expressed in  $\text{m/s}^2$  and meters respectively and k is constant. Knowing that the velocity of A is 7.5 m/s when  $x = 0$  and 15m/s when  $x = 0.45\text{m}$ , determine the value of k. [08]

(B) A 90 kg block rests on a horizontal plane. Find the magnitude of the force 'P' required to give the block an acceleration of  $3 \text{ m/s}^2$  to the right. The coefficient of friction between the block and the plane is  $\mu_k = 0.25$ . [09]



OR

**Q.8)** (A) Two ships 'A' and 'B' are at a given instant 4km away from each other and both are on south-east line. Ship 'A' is travelling at 8 kmph due east and ship 'B' is travelling at 12 kmph due north. Determine –

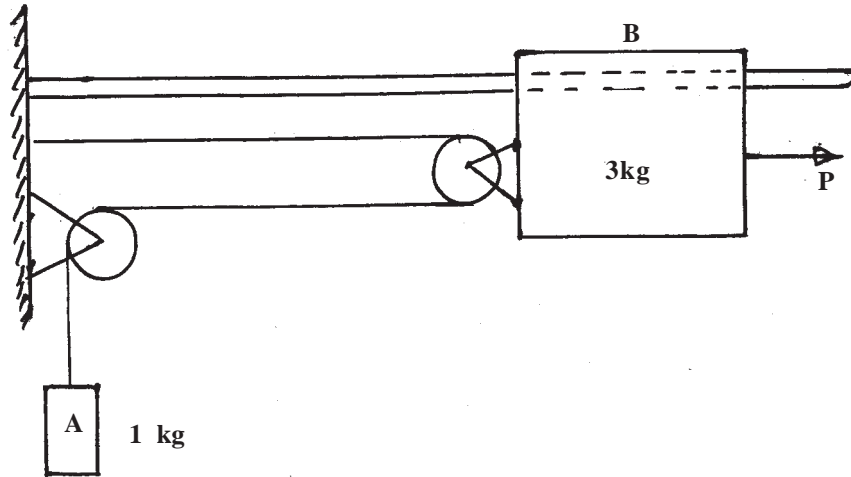
- (i) Velocity of 'B' with respect to 'A'.
- (ii) The shortest distance between the two ships.
- (iii) Time to get the shortest distance. [08]

(B) The system shown in fig. is initially at rest. Neglecting friction, determine

(i) The force 'P' required if the velocity of the collar 'B' is to be 5m/s after 2 sec.

(ii) The corresponding tension in the cable.

[09]



**Q.9) (A)** A speed of racing car is increasing at constant rate from 100 kmph to 120 kmph over a distance of 180 m along a curve of 240 m radius. Determine magnitude of total acceleration of car after it has travelled 120m along the curve. [08]

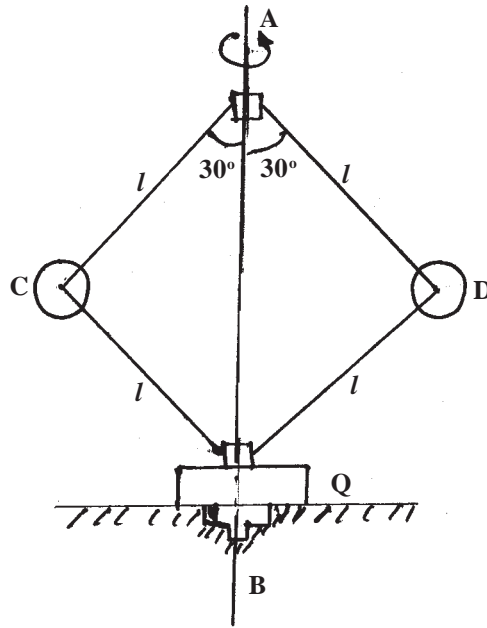
(B) A motor cyclist is moving in a spherical cage of 3.6 m radius in a circus show. The mass of motor cycle and the rider together is 240 kg. What shall be the minimum speed with which the Motor Cyclist can pass through the highest point without losing the contact inside the cage ?

If he is moving with 36 kmph, what force is transmitted to the cage ? [08]

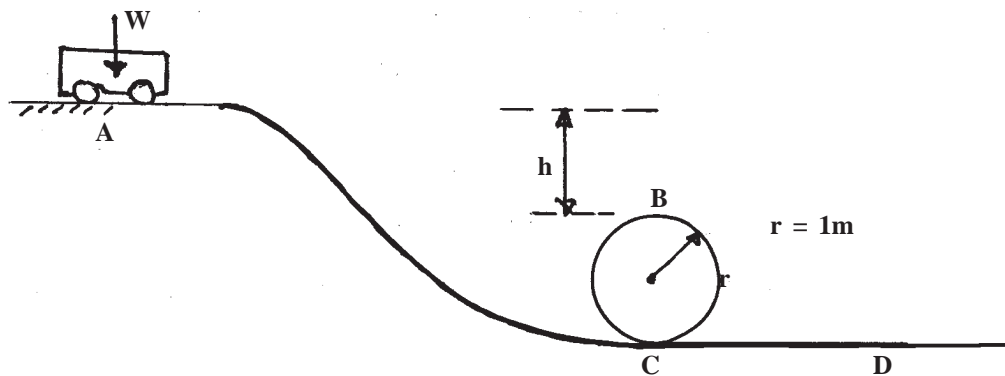
**OR**

**Q.10) (A)** A projectile is fired with an initial velocity of 240 m/s at a target 'B' located 600 m above the gun and at a horizontal distance of 3600m. Neglecting air resistance determine the value of the firing angle . [08]

- (B) At what uniform speed of rotation around the vertical axis AB will the ball 'C' and 'D' of equal weight 'W' begin to lift the weight 'Q' of the device as shown in fig. ? Neglect all frictions and weights of four hinged bars of length ' $l$ '. The weight 'Q' can slide freely along the shaft 'AB'. Take  $W = 44.5\text{N}$ ,  $Q = 89\text{N}$ ,  $l = 250\text{mm}$ . [08]



- Q.11) (A) A small weight 'W' starts from rest from point 'A' and rolls without friction along the loop 'ABCD'. What is the least height 'h' above the top of the loop at which car can start without falling off the track at point 'B' and for such starting position, what velocity the car will have along the portion CD of the track ? [09]



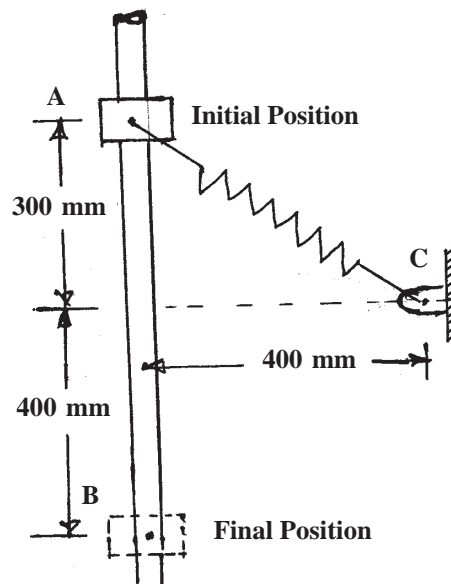
- (B) A 20 g bullet is fired with a velocity of magnitude  $V_0 = 600$  m/s. into a 4.5 kg block of wood which is stationary. Knowing that the coefficient of kinetic friction between the block and the floor is 0.4, determine

- (i) How far the block will move.  
 (ii) The percentage of the initial energy lost in friction between the block and the floor. Refer the fig. [08]



OR

- Q.12) (A) A collar of mass 10 kg moves on a vertical guide as shown in fig. Neglecting friction between the guide and collar, find the velocity of the collar after it has fallen 700 mm, starting from rest from the position A as shown. The unstretched length of the spring is 200mm and its stiffness is 200 N/m. [09]



- (B) A ball 'A' of mass 0.25 kg, moving on smooth horizontal table with velocity of 10 m/s, strikes on identical stationary ball 'B' on the table. Find the velocity of ball 'B' just after the impact. Consider the impact as perfect plastic. [08]

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-107**

**F. E. (Semester - II) Examination - 2009**

**APPLIED SCIENCE - II**

**(June 2008 Pattern)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) *Answers to the two sections should be written in separate answer books.*
- (2) *Neat diagrams must be drawn wherever necessary.*
- (3) *Black figures to the right indicate full marks.*
- (4) *Use of logarithmic tables, slide rule, Mollier charts, electronic pocket is allowed.*
- (5) *Assume suitable data, if necessary.*

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**SECTION - I**

- Q.1)** (A) What is Power Alcohol ? Give methods of preparation, merits and demerits of Power Alcohol. **[06]**
- (B) Write note on Hydrogen Gas as a Fuel. **[05]**
- (C) In Boy's gas calorimeter's experiment when 0.1m<sup>3</sup> of a fuel gas is burnt during which 25 kg of water is circulated. Temperature of incoming water and outgoing water is 20°C and 33°C respectively. Weight of steam condensed is 250 gm. Calculate gross calorific value and net calorific value, if heat liberated in condensing water vapour and cooling the condensate is 586 kcal/kg. **[03]**
- (D) Explain the Kjeldahl's method for the determination of nitrogen from coal sample. Also give significance of analysis. **[03]**

**OR**

**[3661]-107**

**1**

**P.T.O.**

- Q.2)** (A) What is Calorific Value of Fuel ? Explain Bomb Calorimeter method for determination of a non-volatile solid fuel. [06]
- (B) What is ultimate analysis of coal ? Give method's for determination of carbon, hydrogen and sulphur from coal. Give significance of it. [06]
- (C) Write note on 'Refining of Crude Oil'. [05]
- Q.3)** (A) Differentiate between Anodic and Cathodic Coating. [03]
- (B) What is Electroplating ? Explain process of Electroplating, its advantages and applications. [05]
- (C) Define Corrosion. Give types of it and explain mechanism of Dry Corrosion. [05]
- (D) Write note on 'Pourbaix Diagram'. [03]

**OR**

- Q.4)** (A) Define Corrosion and explain different factors affecting Corrosion Process. [06]
- (B) Write note on Galvanic Protection Method with its applications. [04]
- (C) What is Blacodizing ? Describe its process, advantages and application. [06]
- Q.5)** (A) What is Hardness of Water ? Give the reasons behind hardness of water and explain the EDTA Method for determination of Hardness of Water. [05]
- (B) A zeolite softner was completely exhausted and was regenerated by passing 100 litre of NaCl containing 120 gm/lit of NaCl. How many litres of a sample of water of hardness 500 ppm can be soften by this softner ? [04]
- (C) Write note on Ion Exchange Method for demineralization of water. [05]
- (D) 50 ml of a chloride water sample is titrated against 0.01 M  $\text{AgNO}_3$  solution by Mohr's Method. The burette reading is 5.8 ml. Calculate quantity and chloride ions per litre of the water sample. [03]

**OR**



- Q.6)** (A) What is Priming and Foaming ? What are disadvantages of Priming and Foaming ? How can be they prevented ? [06]
- (B) What is meant by Softening of Water ? Explain the Zeolite Method of Water Softening. [05]
- (C) 50 ml of water sample requires 3.7 ml of 0.025 N  $H_2SO_4$  upto phenolphthalein end point and further 4.8 ml upto methyl orange end point during the titration. Calculate the types and amounts of alkalinities in the water sample. [03]
- (D) Explain phosphate conditioning for Water Softening. [03]

### SECTION - II

**Constants :**  $h = 6.63 \times 10^{-34}$  J-sec.

$$e = 1.6 \times 10^{-19} \text{ coulomb}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

- Q.7)** (A) Derive equation of energy and wave function when a free particle is trapped in an infinite potential well. [07]
- (B) State Heisenberg's Uncertainty Principle and illustrate it by electron diffraction at a single slit. [06]
- (C) Find the Energy of Neutron in units of electron volt whose de-Broglie Wavelength is 1 Å.  
(Given : Mass of Neutron =  $1.674 \times 10^{-27}$  kg.) [04]

**OR**

- Q.8)** (A) What is Schrodinger's wave equation ? Derive Schrodinger's time independent wave equation. [07]
- (B) Explain de-Broglie Hypothesis of matter waves and obtain the equation of de-Broglie Wavelength of Matter Wave in terms of Energy by analogy with radiation. Also obtain equation of de-Broglie wavelength of an electron. [06]
- (C) Explain the physical significance of  $\Psi$  and  $|\Psi|^2$ . [04]

- Q.9)** (A) Explain the operation of Ruby Laser with neat labelled diagram. [06]  
(B) Explain the following properties of Super-conductors : [06]  
(a) Meissner Effect  
(b) Critical Field  
(C) Explain any one application of Laser. [04]

**OR**

- Q.10)** (A) Explain the terms : [06]  
(a) Stimulated Emission  
(b) Population Inversion  
(c) Persistent Current  
(B) What are the special properties of Laser ? Hence explain the working of Semi-conductor Laser. [06]  
(C) Explain the BCS Theory of Superconductors. [04]

**OR**

- Q.11)** (A) Explain Hall Effect in Semi-conductors. Derive the equations of Hall Voltage and Hall Coefficient. [07]  
(B) Explain any two properties of Nano-materials. [06]  
(C) Calculate the conductivity of Ge specimen if donor impurity is added to the extent of one part in  $10^8$  Ge atoms at room temperature. (Given : Atomic Weight of Ge = 72.6, Density of Ge :  $5.32 \text{ gm/cm}^3$ , Mobility of Electrons =  $3800 \text{ cm}^2/\text{v-sec.}$ , Avagadro Number =  $6.02 \times 10^{23}$  atoms/mole) [04]

**OR**

- Q.12)** (A) Comparing with zero basis explain the working of PN Junction diode in forward bias and reverse bias on the basis of energy level diagram. [07]  
(B) (a) Explain briefly how colloids are synthesized by a chemical route. [03]  
(b) Discuss any one application of Nano Technology. [03]  
(C) In an N-type semi-conductor the Fermi level lies 0.3 eV below the conduction band at room temperature. If the temperature is raised to 330 K, find the position of Fermi level. [04]

Total No. of Questions : 12]

[Total No. of Printed Pages : 6

[3661]-106

F. E. (Semester - II) Examination - 2009

ENGINEERING MATHEMATICS - II

(June 2008 Pattern)

Time : 3 Hours]

[Max. Marks : 100

*Instructions :*

- (1) *In section I, attempt Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6. In section II, attempt Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12.*
- (2) *Answers to the two sections should be written in separate answer-books.*
- (3) *Figures to the right indicate full marks.*
- (4) *Neat diagrams must be drawn wherever necessary.*
- (5) *Use of non-programmable electronic pocket calculator is allowed.*
- (6) *Assume suitable data, if necessary.*

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**SECTION - I**

- Q.1)** (A) Form a differential equation whose general solution is  $y = Ax + B/x$ . [05]
- (B) Solve the following : **(Any Three)** [12]
- (a)  $(2x + e^x \log y)y dx + e^x dy = 0$
- (b)  $(y^4 - 2x^3y) dx + (x^4 - 2xy^3) dy = 0$
- (c)  $\frac{dy}{dx} = \frac{x - y + 3}{2x - 2y + 5}$
- (d)  $(x^3y^3 + xy) \frac{dy}{dx} = 1$

**OR**

[3661]-106

1

P.T.O.

**Q.2) (A)** Form a differential equation whose general solution is  $y = (c_1 + c_2 t) e^t$  [05]

**(B)** Solve the following : **(Any Three)** [12]

(a)  $x^4 \frac{dy}{dx} - x^3 y - \sec(xy) = 0$

(b)  $(y^4 + 2y) dx + (xy^3 + 2y^4 - 4x) dy = 0$

(c)  $x \frac{dy}{dx} + \frac{y^2}{x} = y$

(d)  $x \cos x \frac{dy}{dx} + y (x \sin x + \cos x) = 1$

**Q.3) Solve any three :**

(a) A body starts moving from rest, is opposed by a force per unit mass of value  $cx$  and resistance per unit mass of value  $bv^2$ , where  $x$  and  $v$  are the displacement and velocity of the particle at that instant. Show that the velocity of the particle

is given by  $v^2 = \frac{c}{2b^2} (1 - e^{-2bx}) - \frac{cx}{b}$ . [06]

(b) A pipe 20 cms. in diameter contains steam at  $150^\circ\text{C}$  and is protected with a covering 5 cms. thick, for which  $k = 0.0025$ . If the temperature of the outer surface of the covering is  $40^\circ\text{C}$ , find the temperature half way through the covering, under steady-state conditions. [06]

(c) A constant emf 'E' volts is applied to a circuit containing constant resistance 'R' ohms in series with constant inductance 'L' henries. If the initial current is zero, show that the current builds upto half of its theoretical maximum in  $(L \log 2)/R$  seconds. [05]

(d) If 30% of a radioactive substance disappeared in 10 days, how long will it take for 90% of it to disappear ? [05]

**OR**

**Q.4)** Solve **any three** :

(a) A body at temperature  $100^{\circ}\text{C}$  is placed in a room whose temperature is  $25^{\circ}\text{C}$ , and cools to  $80^{\circ}\text{C}$  in 10 minutes. Find the time when the temperature will be  $60^{\circ}\text{C}$ . [05]

(b) The distance 'x' descended by a parachuter satisfies the

equation  $v \frac{dv}{dx} = g \left( 1 - \frac{v^2}{k^2} \right)$ , where v is velocity, k, g are

constants. If  $v = 0$  and  $x = 0$  at time  $t = 0$ , show that

$$x = \frac{k^2}{g} \log \cosh \left( \frac{gt}{k} \right). \quad [06]$$

(c) A circuit consists of resistance 'R' ohms and a condenser 'C' farads, connected to a constant e.m.f. If q/C is voltage of the condenser at time t after closing the circuit, show that the voltage at time t is  $E(1 - e^{-t/RC})$ . [05]

(d) The amount x of a substance present in a certain chemical reaction at time t is given by  $\frac{dx}{dt} + \frac{x}{10} = 2 - 1.5 e^{-t/10}$ . If at  $t = 0$ ,  $x = 0.5$ , find x at  $t = 10$ . [06]

**Q.5)** (A) Find Fourier series to represent the function  $f(x) = \pi^2 - x^2$  in the interval  $-\pi \leq x \leq \pi$  and  $f(x + 2\pi) = f(x)$ . Deduce that

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}. \quad [07]$$

(B) If  $I_n = \int_0^{\pi/2} x \cos^n x \, dx$ , prove that

$$I_n = -\frac{1}{n^2} + \frac{n-1}{n} I_{n-2} \quad [05]$$

(C) Evaluate  $\int_3^7 (x-3)^{1/4} (7-x)^{1/4} \, dx$  [04]

**Q.6) (A)** Evaluate  $\int_0^{\infty} x^9 e^{-2x^2} dx$  [04]

(B) Find reduction formula for

$$I_n = \int_0^{\pi/4} \sec^n x dx. \quad [05]$$

(C) The following table gives variation of periodic current over a period :

t sec.	0	T/6	T/3	T/2	2T/3	5T/6	T
<b>A (amp)</b>	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is direct current part of 0.75 amp in variable current and obtain the amplitude of the first harmonic. [07]

### SECTION - II

**Q.7) (A)** Trace the following curves : (Any Two) [08]

(a)  $x^2y^2 = a^2 (y^2 - x^2)$

(b)  $r = a \sin 3\theta$

(c)  $x = t, y = t(t^2 - 1)$

(B) Verify the rule of differentiation under the integral sign for the integral [05]

$$\int_a^{a^2} \frac{1}{x+a} dx$$

(C) Find the length of the arc of the cycloid  $x = a(\theta - \sin\theta)$ ,  $y = a(1 - \cos\theta)$  between two consecutive cusps. [04]

OR

**Q.8) (A)** Trace the following curves : **(Any Two)** **[08]**

(a)  $x^3 + y^3 = 3axy$

(b)  $r = \frac{a}{2} (1 + \cos\theta)$

(c)  $x = a\cos^3t, y = a\sin^3t$

**(B)** Show that  $\int_0^{\infty} e^{-x^2-2bx} dx = \frac{\sqrt{\pi}}{2} [1 - \operatorname{erf}(b)]$  **[04]**

**(C)** Find the length of one loop of the curve  $8y^2 = x^2(1 - x^2)$ . **[05]**

**Q.9) (A)** Find the equation of the sphere which passes through the circle  $x^2 + y^2 + z^2 - 2x + 2z - 2 = 0, y = 0$  and touches the plane  $y - z - 7 = 0$ . **[06]**

**(B)** Find the semi-vertical angle and the equation of the right circular cone having vertex at  $(0, 0, 3)$  and passing through the circle  $x^2 + y^2 = 16, z = 0$ . **[05]**

**(C)** Find the equation of a right circular cylinder of radius 4, whose axis passes through origin and makes equal angles with the co-ordinate axes. **[05]**

**OR**

**Q.10) (A)** Find the equation of the sphere which passes through the point  $(6, 4, 3)$  and meets the plane  $x + 2y - 2z + 11 = 0$ , in a circle of radius 4 units with centre at  $(1, -1, 5)$ . **[06]**

**(B)** Find the equation of the right circular cylinder whose axis is the line  $2(x - 1) = y + 2 = z$  and radius is 3. **[05]**

**(C)** Find the equation of the right circular cone generated by rotating the line  $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$  about the line  $\frac{x}{-1} = y = \frac{z}{2}$ . **[05]**

**Q.11) (A)** Evaluate  $\int_0^a \int_{\sqrt{ax-x^2}}^{\sqrt{a^2-x^2}} x\sqrt{x^2 + y^2} \, dydx$  [06]

(B) Find the area inside the cardioide  $r = 2a (1 + \cos\theta)$  and outside the circle  $x^2 + y^2 = a^2$ . [05]

(C) Find the C.G. of the area bounded by the curve  $y^2 (2a - x) = x^3$  and its asymptote. [06]

**OR**

**Q.12) (A)** Evaluate  $\int_0^2 \int_0^{\sqrt{4-y^2}} \frac{y \, dx \, dy}{\sqrt{(4 - x^2)(x^2 + y^2)}}$  [06]

(B) Find the volume enclosed between the cone  $z = \sqrt{x^2 + y^2}$  and the paraboloid  $z = x^2 + y^2$ . [05]

(C) The density at any point  $(x, y)$  on a square lamina of side 'a' units, varies as the square of its distance from one of the diagonals. Show that the moment of inertia (M.I.) about the diagonal is  $\frac{Ma^2}{5}$ , where M is the mass of the lamina. [06]



Total No. of Questions : 12]

[Total No. of Printed Pages : 8

**[3661]-105**

**F. E. (Semester - I) Examination - 2009**

**ENGINEERING GRAPHICS - I**

**(June 2008 Pattern)**

**Time : 4 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer **one** question from each **unit**. Answer **three** questions from section I and **three** questions from section II.
- (2) Answers to the **two sections** should be drawn on **separate drawing sheet**.
- (3) Figure in bracket indicate full marks.
- (4) Retain all construction lines.
- (5) Use of log table, electronic pocket calculator is allowed.
- (6) Use only half imperial size drawing papers as answer sheets.
- (7) Assume suitable data, if necessary.

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**SECTION - I**

**UNIT - II : ENGINEERING CURVES**

- Q.1) (A)** Draw a parallelogram of 160mm and 120mm sides with included angle of  $120^\circ$ . Inscribe an ellipse within this parallelogram. Determine the major and minor axis of the ellipse. Draw tangent and normal to the ellipse at a point 20 mm above the major axis and at the left side of center O. **[08]**
- (B)** A line MN, 144 long revolves about its midpoint O in anticlockwise direction. A point P moves along this line MN from M to N during one complete revolution by uniform speed. Draw the locus of point P and name the locus. **[07]**

**OR**

**[3661]-105**

**1**

**P.T.O.**

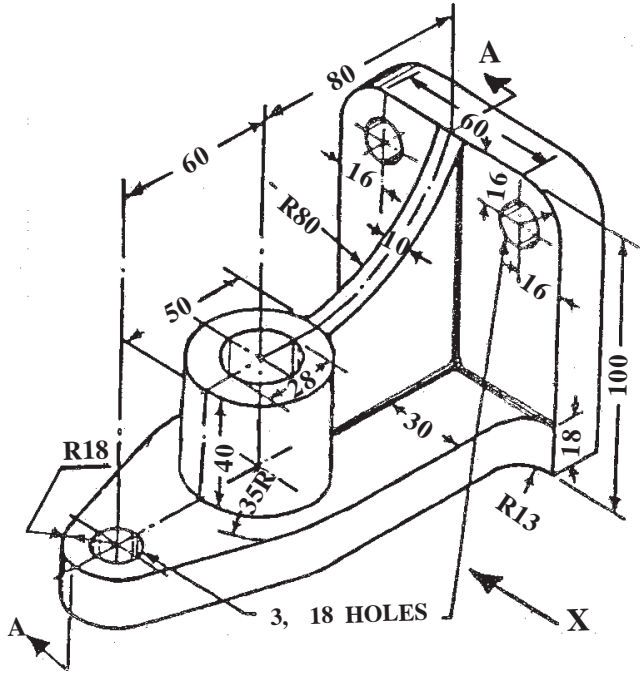
**Q.2)** (A) Two asymptotes OX and OY are at  $75^\circ$  angle with each other. Point P is 30 mm and 40 mm away from OX and OY respectively. Draw the hyperbola passing through the point P taking at least 10 points. Draw tangent and normal at a point on hyperbola 40 mm away from OX. [08]

(B) A circle of 60 mm diameter rolls on outside the circumference of the directing circle of same diameter without slipping. Draw an epicycloid of point P, touching the point of contact of both the circles for one complete evolution. [07]

**UNIT - III : ORTHOGRAPHIC PROJECTIONS**

**Q.3)** For the object shown in fig. 1, draw the following views, using First Angle Method of Projection :

- (a) Sectional Elevation in the direction of arrow 'X' (section along A-A) [06]
- (b) Plan [06]
- (c) End View from Left Hand Side [05]
- (d) Give all dimensions [03]

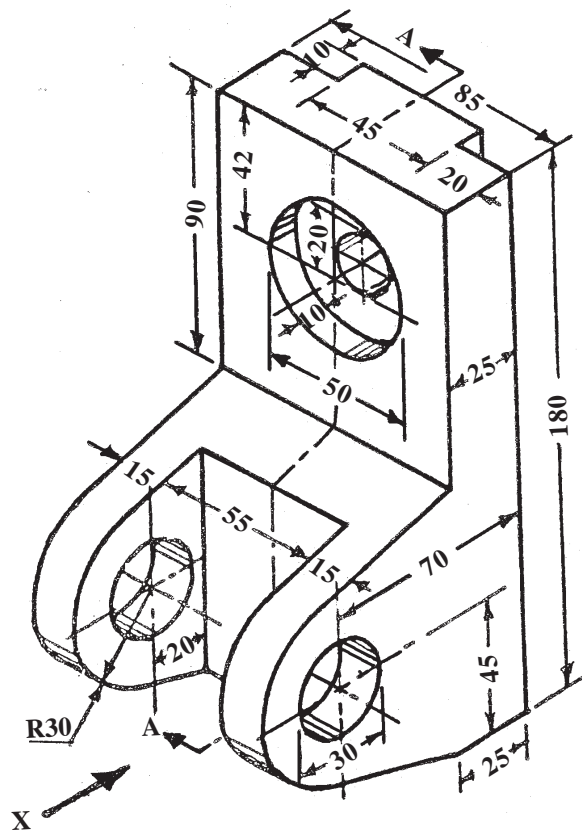


**Fig. 1**

**OR**

**Q.4)** For the object shown in fig. 2, draw the following views, using First Angle Method of Projection :

- (a) Elevation looking in the direction of arrow 'X' [06]
- (b) Plan [05]
- (c) Sectional End View from the Right Hand Side (section along A-A) [06]
- (d) Give all dimensions [03]

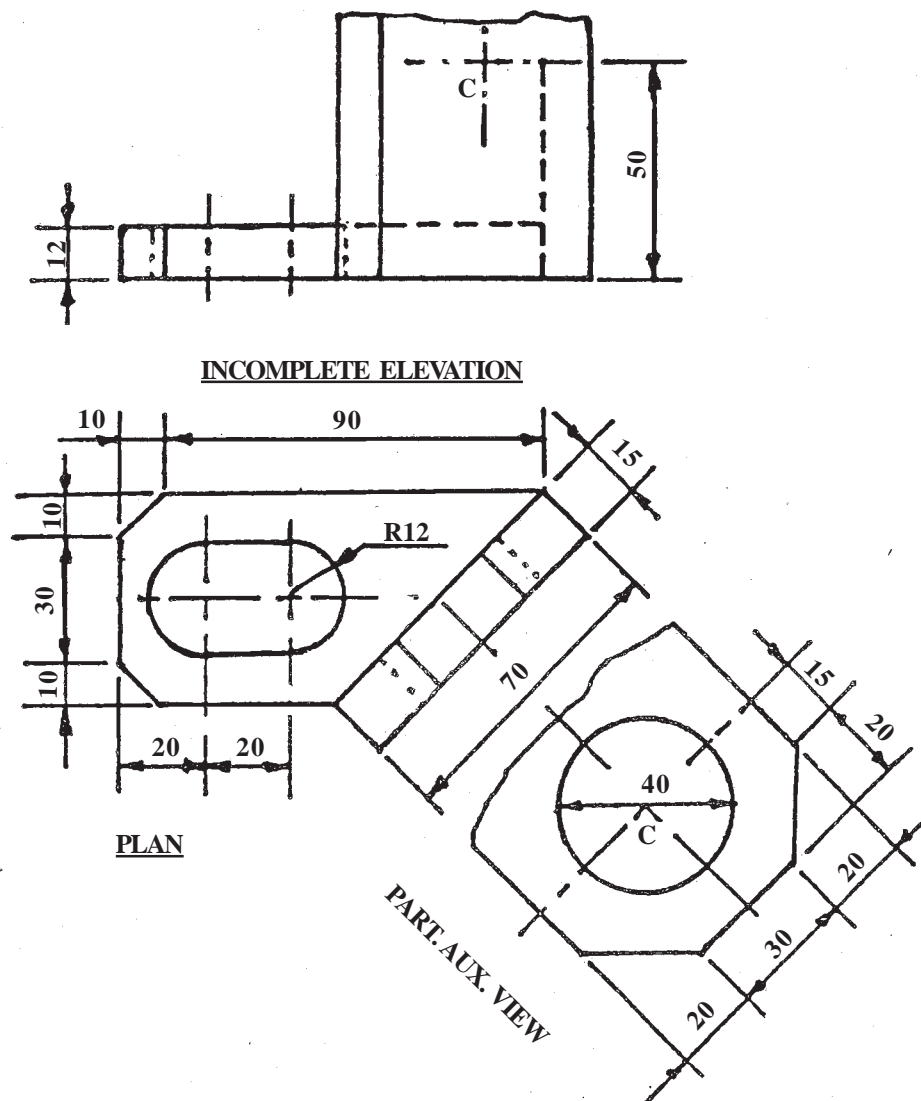


**Fig. 2**

**UNIT - IV : AUXILIARY PROJECTIONS**

**Q.5)** Fig. 3 shows incomplete elevation, plan and partial auxiliary view of a 'Bracket'.

- (a) Redraw the given views [05]
- (b) Complete the Elevation [08]
- (c) Show all the dimensions [02]

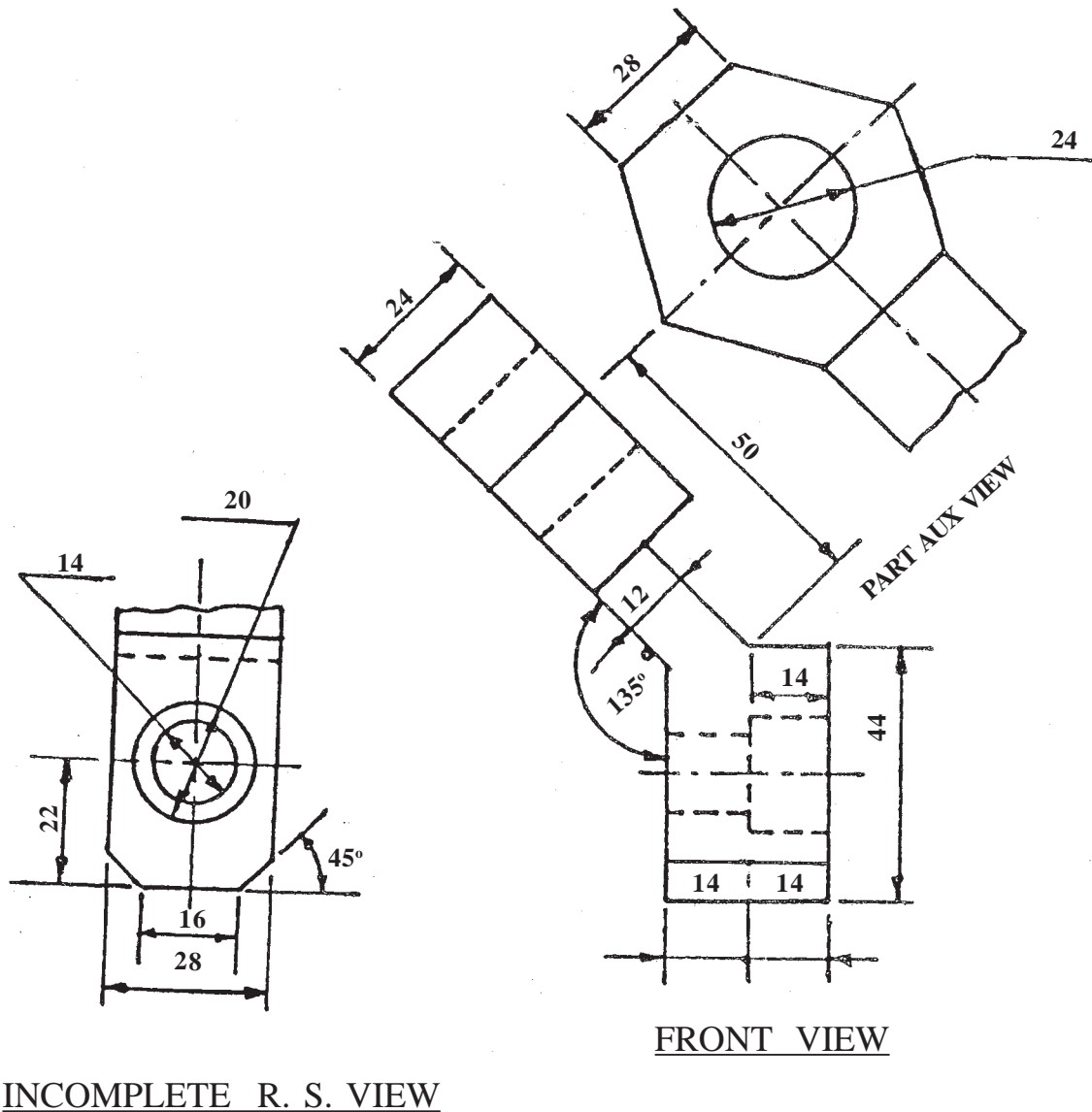


OR

**Fig. 3**

**Q.6)** Fig. 4 shows elevation, incomplete right hand side view and partial auxiliary view of an object :

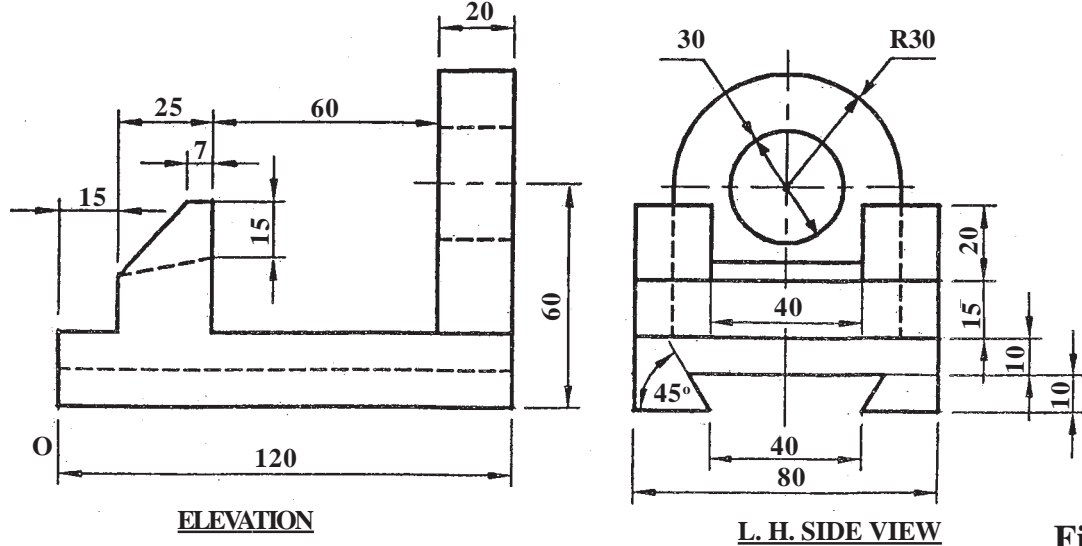
- (a) Redraw the given views [05]
- (b) Complete the Right Hand Side View [08]
- (c) Show all dimensions [02]



**Fig. 4**

**SECTION - II**  
**UNIT - V : ISOMETRIC**

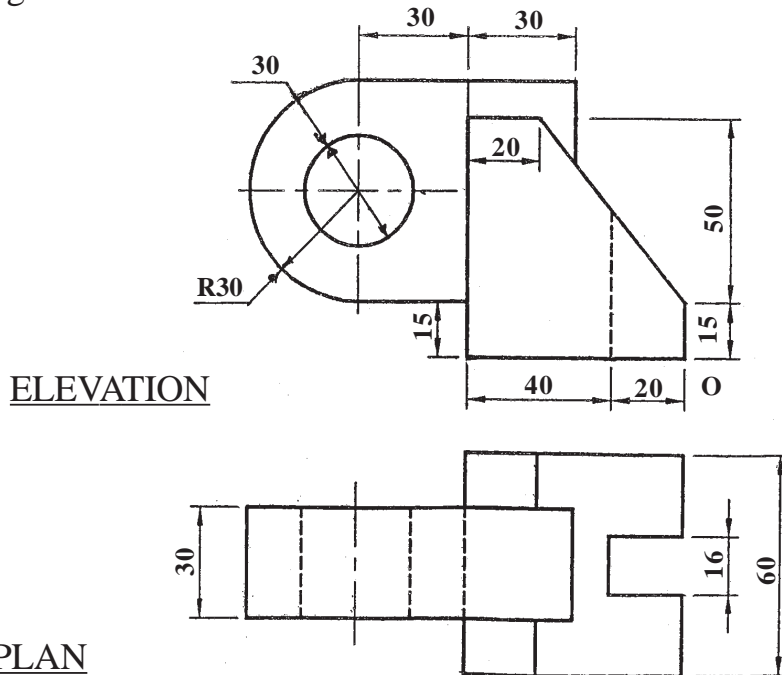
**Q.7)** Fig. 5 shows the Elevation and Left Hand Side View of an object by First Angle method of Projection. Draw an isometric projection taking origin at 'O' and give all dimensions : [17+3]



**Fig. 5**

**OR**

**Q.8)** Fig. 6 shows the Orthographic Views of an object by First Angle Method of Projection. Draw its Isometric View taking origin at 'O' and give all dimensions : [17+3]

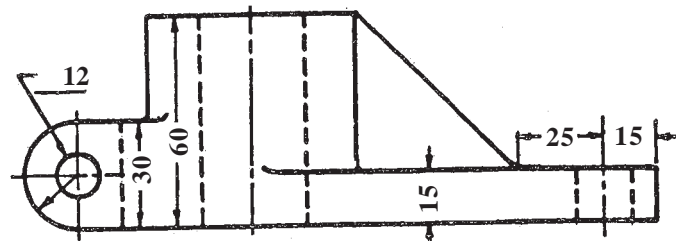


**Fig. 6**

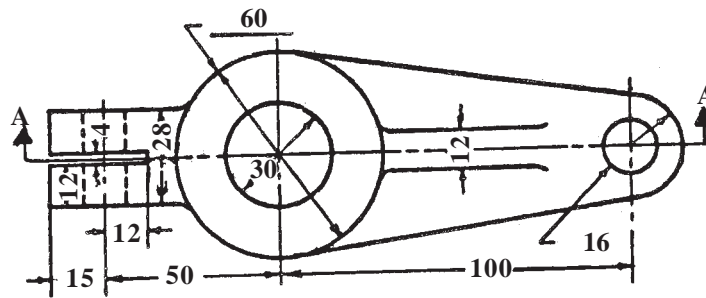
## UNIT - VI : MISSING VIEWS

**Q.9)** Fig. 7 shows Elevation and Plan of an Object. Draw the following view by First Angle Method of Projection :

- |     |   |      |
|-----|---|------|
| (a) | Sectional Elevation (section along A-A) | [07] |
| (b) | Plan                                    | [03] |
| (c) | Left Hand Side View                     | [08] |
| (d) | Give all dimensions.                    | [02] |



ELEVATION



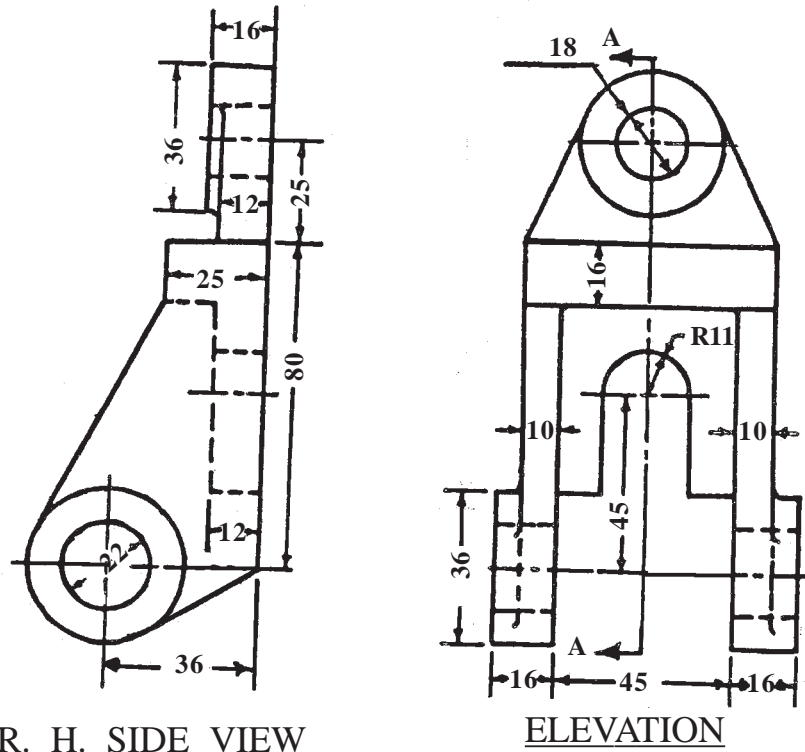
PLAN

**Fig. 7**

**OR**

**Q.10)** Fig. 8 shows Elevation and Right Hand Side View of an object. Draw the following views by First Angle Method of Projection :

- |     |   |      |
|-----|---|------|
| (a) | Elevation   | [03] |
| (b) | Plan  | [07] |
| (c) | Sectional Left Hand Side View (section along A-A) | [08] |
| (d) | Give all dimensions.                              | [02] |



**Fig. No. 8**

R. H. SIDE VIEW

ELEVATION

**UNIT - VII : FREE HAND SKETCHES**

**Q.11)** Draw proportionate free hand sketches of the following :

- |     |                        |      |
|-----|------------------------|------|
| (a) | Sellers Thread Profile | [03] |
| (b) | Half-lap Muff Coupling | [03] |
| (c) | Lewis Foundation Bolt  | [04] |

**OR**

**Q.12)** Draw proportionate free hand sketches of the following :

- |     |  |      |
|-----|--|------|
| (a) | Gib Headed Key                           | [03] |
| (b) | Semi-elliptical Leaf Spring with eyelets | [03] |
| (c) | Double riveted (zigzag) Lap Joint        | [04] |



Total No. of Questions : 12]

[Total No. of Printed Pages : 4

**[3661]-104**

**F. E. Examination - 2009**

**BASIC CIVIL AND ENVIRONMENTAL ENGINEERING**

**(June 2008 Pattern)**

**Time : 3 Hours]**

**[Max. Marks : 100**

**Instructions :**

- (1) Answer Q. 1 or 2, Q. No. 3 or 4, Q. No. 5 or 6 from section I. Answer Q. No. 7 or 8, Q. No. 9 or 10, Q. No. 11 or 12 from section II.
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of electronic pocket calculator is allowed.
- (6) Assume suitable data, if necessary.
- (7) Use of cell phone is prohibited in the examination hall.

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**SECTION - I**

- Q.1)** (A) Enlist and explain the infrastructural facilities that are to be provided in a locality for its development. **[05]**
- (B) Explain two applications of : **[06]**
- (1) Remote Sensing
  - (2) Fluid Mechanics
  - (3) Quantity Surveying
- (C) Explain the role of Civil Engineer in Transportation Engineering in the 21st Century. **[05]**

**OR**

- Q.2)** (A) Explain necessity and application of Project Management. **[05]**
- (B) Explain the role of Civil Engineer in various construction activities. **[05]**

**[3661]-104**

**1**

**P.T.O.**

- (C) Explain two applications of : [06]  
 (1) Earthquake Engineering  
 (2) Structural Engineering  
 (3) Town Planning
- Q.3)** (A) Discuss the characteristics of Smart Materials. [05]  
 (B) Differentiate between : [06]  
 (1) Load Bearing Structure and Framed Structure  
 (2) Live Load and Dead Load  
 (3) Uniform Settlement and Differential Settlement  
 (C) Write a short note on : Recycling of construction and demolition materials and its market. [05]
- OR**
- Q.4)** (A) Explain the general precaution to be observed in cement concrete construction. [05]  
 (B) Differentiate between : [06]  
 (1) Shallow Foundation and Deep Foundation  
 (2) Brick Masonary and Stone Masonary  
 (3) Prestressed concrete and R.C.C.  
 (C) Write a short note on : Automation in construction industry- Necessity and applications. [05]
- Q.5)** (A) Explain the types and applications of Lasers in construction. [04]  
 (B) Differentiate between : [06]  
 (1) Collimation Plane Method and Rise and Fall Method  
 (2) Contour Interval and Horizontal Equivalent  
 (C) Explain in brief the uses of contour maps. [04]  
 (D) What are the steps to require for measurement of distance by Electronic distance measuring instrument (EDM) ? [04]

**OR**

- Q.6)** (A) Write a short note on : Digital mapping and its applications. [04]  
(B) The following consecutive readings were taken on continuously sloping ground at a common interval of 20 meter.  
0.375, 1.250, 2.25, 2.75, 0.750, 2.375  
The reduced level of the first point was 100.00m. Find the R'L's of the points by Rise and Fall Method. [06]  
(C) List out any four surveying software and give salient features of any one. [04]  
(D) What are the advantages and limitations of Global Positioning System (GPS) ? [04]

### SECTION - II

- Q.7)** (A) State the main objectives of Environmental Impact Assessment. [04]  
(B) List out any four type's ecosystem and give salient features of Pond ecosystem. [06]  
(C) Explain the Engineer's role in achieving sustainable development. [06]

**OR**

- Q.8)** (A) Write short notes : [06]  
(1) Oxygen Cycle  
(2) Disposal of Electronic Wastes  
(B) How the human behaviour and the technological advancement create impact on environment ? [06]  
(C) State the main objectives of Solid Waste Management. [04]
- Q.9)** (A) What is Prospect ? Draw sketches to show how prospect can be achieved. [06]  
(B) Differentiate between : [06]  
(1) Building Line and Control Line  
(2) Principles of Planning and Building Bye-Laws  
(3) Aspect and Orientation  
(C) What is Green Building ? What are the advantages of Green Building ? [04]

**OR**

- Q.10) (A)** What is meant by 'Building By-Laws' ? Write down the specific bye-laws for – **[06]**
- (1) Open Space Requirement
  - (2) Height of Building
  - (3) F.A.R.
- (B)** Determine the F.S.I. allowed for G+1 storeyed building from the following data : **[04]**
- (1) Carpet area per floor =  $350\text{m}^2$
  - (2) Ratio of carpet area to built up area = 0.82
  - (3) Plot area =  $900\text{m}^2$
- (C)** List out various eco-friendly materials used in construction and what are the properties of eco-friendly material ? **[06]**

- Q.11) (A)** State the advantages and disadvantages of Non-conventional Source of Energy. **[05]**
- (B)** Enlist the various types of Water Pollutants and describe briefly, the causes and its ill effects (any three). **[05]**
- (C)** What are the Methods of Noise Control ? **[04]**
- (D)** Differentiate between Solar Energy and Wind Energy. **[04]**

**OR**

- Q.12) (A)** What is mean by Land Pollution ? State the method used for controlling land pollution. **[05]**
- (B)** Explain the various techniques used to control air pollution. **[05]**
- (C)** What is Green House Effect ? State any four ill effect of it. **[04]**
- (D)** Write a short note on : Geothermal Energy **[04]**

Total No. of Questions : 12]

[Total No. of Printed Pages : 6

**[3661]-103**

**F. E. (Semester - I) Examination - 2009**

**BASIC ELECTRICAL ENGINEERING**

**(June 2008 Pattern)**

**Time : 3 Hours]**

**[Max. Marks : 100**

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**SECTION - I**

- Q.1)** (A) Define resistance temperature coefficient of a conducting material and state its unit. Discuss the effect of temperature on resistance temperature coefficient. **[06]**
- (B) A copper coil when connected to a 40 Volt supply, initially takes current of 4 Amp and has a mean temperature of 20°C. After sometime, the current flowing in the coil fall to 3.90 Amp, supply voltage remain same. The mean temperature of coil is then 34°C. Determine the temperature coefficient of resistance of 0°C and 20°C. **[06]**
- (C) Distinguish between Primary and Secondary Cells. What are the indications which confirm that a lead acidic cell is fully charged ? **[06]**

**OR**

- Q.2)** (A) A single core insulated cable of length L m has its conductor diameter d m and the thickness of insulation surrounding the conductor is t m. Derive the expression for its insulation resistance, if the resistivity of the insulating material is  $\rho$  ohm - m. **[06]**
- (B) A bucket contains 20 liters of water at 20°C. A 2.5 KW immersion heater is used to raise the temperature of water to 95°C. The overall efficiency of process is 90% and the specific heat capacity of water is 4200 J/KG°K. Find the time require for the process. Also find cost of energy (electricity bill) for 365 days if rate of energy is Rs. 3 per unit. **[06]**

**[3661]-103**

**1**

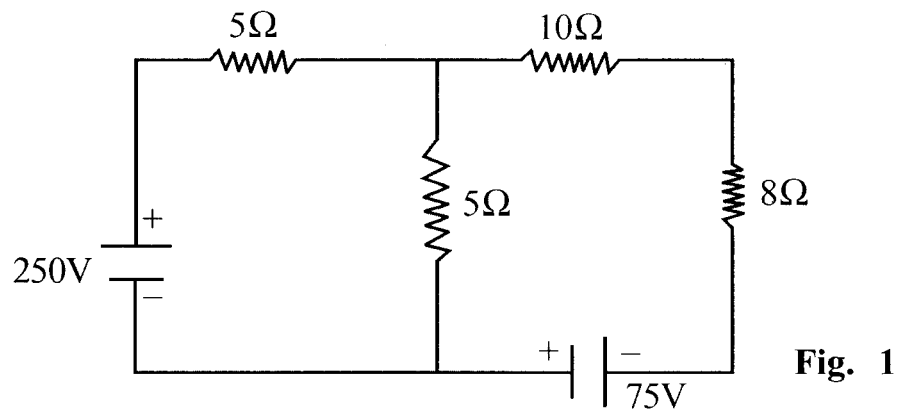
**P.T.O.**

(C) If four cells, each rated for 2V, 0.15A can be connected as a batteries in three different ways. Find voltage and current rating of each type. [06]

Q.3) (A) Explain the following terms with reference to d.c. resistive networks : [06]

- (1) Unilateral and Bilateral Networks
- (2) Linear and Non-linear Networks
- (3) Active and Passive Networks

(B) Using Thevenin's Theorem find the current flowing through 8 ohm resistance for the network shown in fig. 1 : [10]



OR

Q.4) (A) Define Star and Delta Network, hence derive an expression to convert star connected network into its equivalent delta network. [08]

(B) Using Superposition Theorem find the current flowing through 4 Ohm resistance for the network shown in fig. 2. [08]

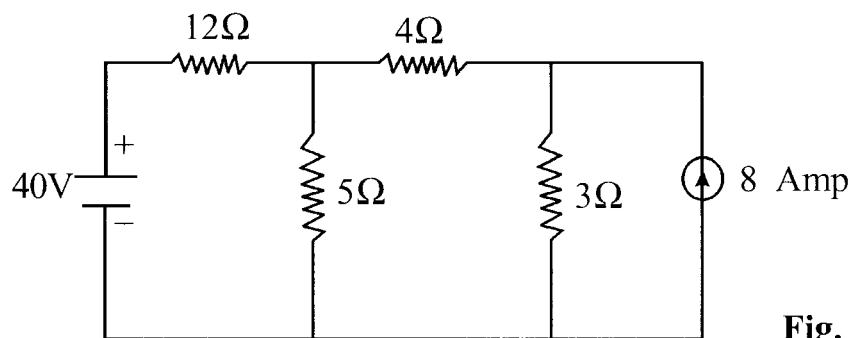


Fig. 2

- Q.5)** (A) Compare electric and magnetic circuits stating clearly similarities and dissimilarities between them. **[08]**
- (B) An iron ring has its mean length of flux path as 60 cm and has a circular cross-section of 6.5 cm diameter. Air gap of 2mm is cut in it. A coil of 650 turns is uniformly wound around it and a current of 2.5A passes through it. Calculate the flux produced in the air gap and in the iron ring, if the relative permeability of iron is 1050. Ignore Leakage and Fringing. **[08]**

**OR**

- Q.6)** (A) State the factor upon which inductance of a coil depends. Also obtain an expression for the energy stored in a magnetic field in terms of self-inductance and current. **[08]**
- (B) The Coils A and B in a Magnetic Circuit have 700 and 600 turns respectively. A current of 10A in coil A produces a flux of .04 Wb. If the Co-efficient of Coupling is 0.2.

**Calculate :**

- (1) Self-inductance of the Coil A when B is open circuit.
- (2) Flux Linkage with the Coil B.
- (3) Mutual Inductance
- (4) E.m.f. induced in the Coil B when the flux linking with it changes from zero to full value in 0.02s. **[08]**

## **SECTION - II**

- Q.7)** (A) Derive an expression for the capacitance of a parallel plate capacitor with a composite dielectric. **[06]**
- (B) Define the following terms related to sinusoidal waveform : **[04]**
- (1) Form Factor
  - (2) Crest Factor

- (C) A circuit consist of three parallel branches. The branch currents are given as

$$i_1 = 10 \sin \omega t, i_2 = 20 \sin(\omega t + 60) \text{ and } i_3 = 7.5 \sin(\omega t - 30).$$

Find the resultant current and express it in the form  $i = I_m \sin(\omega t \pm \phi)$ . If the supply frequency is 50 Hz calculate the resultant current when

(1)  $t = 0$  sec. and

(2)  $t = 0.001$  sec. [06]

**OR**

- Q.8)** (A) A  $12\mu\text{F}$  capacitor in series with an  $1.2\text{ M}\Omega$  resistor is connected across a 100 volt d.c. supply. Determine

(1) The time constant of the circuit.

(2) The initial value of charging current.

(3) The initial rate of rise of voltage across the capacitor.

(4) The voltage across the capacitor 4 sec. after switch on. [06]

- (B) What do you understand by dielectric strength and breakdown voltage of a capacitor ? [04]

- (C) An alternating current of Frequency 60Hz has maximum value of 110 A. Calculate

(1) Its value  $1/600$  sec. after the instant current is zero and its value decreasing thereafter.

(2) Time required to reach 90A after the instant current is zero and increasing positively. [06]

- Q.9)** (A) A sinusoidal voltage of  $v = V_m \sin \omega t$  is appalled across a single phase series circuit and current flowing through the circuit is  $i = I_m \sin(\omega t - \phi)$ . Derive an expression for average power consumed by the circuit. Also sketch the wareform of voltage, current and power. [08]



- (B) A circuit consist of a pure inductor, a pure resistor and a capacitor connected in series. When the circuit is supplied with 100 volt, 50 Hz supply, the voltage across inductor and resistor are 240 volt and 90 volt respectively. If the circuit takes 10A leading current calculate :
- (1) Values of inductance, resistance and capacitance
  - (2) Power Factor of Circuit
  - (3) Voltage Across Capacitor
- [08]

**OR**

- Q.10) (A)** Define the terms Admittance, Conductance and Susceptance as applied to a.c. circuit. [03]
- (B) Obtain the expression for resonant frequency is series R-L-C circuit. [04]
- (C) A coil having resistance and inductance of  $15\Omega$  and 8 mH respectively is connected in parallel with another coil having resistance and inductance of  $4\Omega$  and 18 mH. If this parallel combination is to be replaced by a single coil, calculate value of resistance, inductance of that coil. What value of capacitance should be connected in parallel with this coil in order to get unity power factor. Assume operating frequency to be 50Hz. [09]
- Q.11) (A)** Explain the following terms with reference to polyphase system
- (1) Balanced Load
  - (2) Phase Sequence
- [04]
- (B) A single phase 90 kVA, 3.2 kV/220V, 50Hz transformer has 89% efficiency at unity power factor both at full load and half load. Determine the efficiency at 70% of full load and 0.8 power factor leading. [06]
- (C) What is an Autotransformer ? State its merits and demerits over a two winding transformer. [04]
- (D) Prove that power taken by three phase balanced delta connected load is three times to the power taken by same three phase balanced star connected load. [04]

**OR**

- Q.12)** (A) Derive the e.m.f. equation of Single Phase Transformer. [04]
- (B) Three similar coils take a power of 3KW at 0.6 power factor when connected in star to a 3pH, 415 volt, 50Hz supply. Calculate :
- (1) Line Current
- (2) Resistance and Inductance of each Coil [06]
- (C) With neat circuit diagram explain the direct loading test on single phase transformer for finding the voltage regulation and efficiency. [08]
-

Total No. of Questions : 12]

[Total No. of Printed Pages : 4

[3661]-102

F. E. (Semester - I) Examination - 2009

APPLIED SCIENCE - I

(June 2008 Pattern)

Time : 3 Hours]

[Max. Marks : 100

Instructions :

- (1) Answer **any three** questions from each section.
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- (6) Assume suitable data, if necessary.

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Constants :  $h = 6.63 \times 10^{-34}$  J.sec.

$m = 9.1 \times 10^{-31}$  kg.

$e = 1.6 \times 10^{-19}$  C

$c = 3 \times 10^8$  m/sec.

### SECTION - I

- Q.1) (A) Define and explain the Vulcanization of Natural Rubber. [06]
- (B) Classify the Polymer on the basis of Heat Effect and Number Monomers. [06]
- (C) Write short note on Biodegradable Polymer. [05]

OR

- Q.2) (A) Explain the Compounding of Polymer. [06]
- (B) Give the polymerization reaction, properties and applications of any two : [06]
- (1) Polystyrene
  - (2) PF Resin
  - (3) Silicon Rubber
  - (4) ABS Plastic
- (C) Give the difference between Addition Polymerization Reaction and Condensation Polymerization Reaction. [05]

[3661]-102

1

P.T.O.

- Q.3)** (A) What are the types of Symmetries in Crystal ? Discuss them with respect to Cubic Crystal. [06]
- (B) Define the following terms : [06]
- (1) Unit Cell
  - (2) Anisotropy
  - (3) Co-ordination Number
  - (4) Radius Ratio
- (C) (1) Calculate APF for BCC. [03]
- (2) Draw the following planes in simple Cubic System : (111) and (110) [02]

**OR**

- Q.4)** (A) (1) Explain the structure and properties of Fullerene. [04]
- (2) Give the Structure of Polypyrrole and justify its conducting nature. [03]
- (B) What is Point Defect ? What are their types and explain the Point Defect in Ionic Crystal. [06]
- (C) At what glancing angle, would the first order diffraction from (110) plane of KCl can be observed by using X-ray of wavelength  $0.715 \text{ \AA}$ . The Unit Cell dimension is  $3.1 \text{ \AA}$ . [04]
- Q.5)** (A) How are the pH of titration mixture calculated at various stages during weak acid - strong base ? [06]
- (B) Define : [06]
- (1) Normality
  - (2) Molarity
  - (3) Equivalence Point
  - (4) Primary Standard
  - (5) Indicator
  - (6) End Point
- (C) Calculate the equivalent weight of  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ . (Given Mole wt.  $\text{K}_2\text{Cr}_2\text{O}_7 = 294$  and  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} = 248$ ) [04]

**OR**

- Q.6)** (A) What are types of Complexometric Titration ? Explain any one of them with suitable example. [06]
- (B) Write note on Redox Titration. [06]
- (C) 20ml of standard solution of 0.04M KCl takes 35.5 ml of  $\text{AgNO}_3$  from burette, during standardization of the  $\text{AgNO}_3$ . 100ml of water sample requires 12.5 ml of the  $\text{AgNO}_3$  solution. Calculate the quantity of chloride ions per liter in the given water sample. [04]

### SECTION - II

- Q.7)** (A) Derive the expression for brightness and darkness for a monochromatic light beam reflected from a thin parallel film of transparent material. [07]
- (B) Explain the motion of an electron in a transverse magnetic field. Obtain an expression for the displacement produced. [06]
- (C) Two optically plane glass strips of length 10cm are placed one over the other. A thin foil of thickness 0.010mm is introduced between the plates at one end to form an air film. If the light used has wavelength 5900 Å, find the separation between consecutive bright fringes. [04]

### OR

- Q.8)** (A) Prove that in Newton's Rings by reflected light the diameters of bright rings are proportional to the square root of the odd natural numbers. [06]
- (B) What is Velocity Selector ? How this principle is used in Bainbridge Mass Spectrograph to determine the mass of the isotopes ? [07]
- (C) Electrons accelerated by a potential difference of 200V enter in an electric field at an angle of  $60^\circ$  with the normal to the interface of the higher potential region and gets refracted at an angle of  $45^\circ$  with the normal. Find the potential difference between the plates. [04]

- Q.9)** (A) What is Ultrasonics ? Explain how Piezo-electric Effect can be used for generating Ultrasonic Waves. [07]
- (B) Explain :
- (1) Diffraction of Light
- (2) Rayleigh's Criterion of Resolution [06]
- (C) An ultrasonic pulse of frequency 80 kHz is sent down towards the seabed. The echo is recorded after 0.7 sec. If the velocity of sound in sea water is 1500 m/s. Calculate the depth of the sea and the wavelength of the pulse. [04]

**OR**

- Q.10)** (A) Obtain the conditions for principal maximum and minimum in Fraunhofer diffraction due to a single slit. [07]
- (B) Describe any two engineering applications of Ultrasonic Waves. [06]
- (C) Find the maximum value of resolving power of a diffraction grating 3 cm wide having 5,000 lines per cm if the wavelength of light used is  $5890\text{\AA}$ . [04]
- Q.11)** (A) Define Plane of Polarisation and Plane of Vibration. Explain the phenomenon of double refraction in calcite. [06]
- (B) What is meant by Nuclear Fusion ? Give an account of Carbon-Nitrogen Cycle in Fusion Reaction. [06]
- (C) Two polarising plates have polarising directions parallel so as to transmit maximum intensity of light. Through what angle must either plates be turned if the intensity of the transmitted beam is one third the intensity of the incident beam. [04]

**OR**

- Q.12)** (A) Explain the working of Betatron. Obtain the Betatron Condition. [06]
- (B) What are Retardation Plates. Deduce the thickness of a quarter wave plate for a given  $\lambda$  in terms of its refractive index. [06]
- (C) If the frequency of the a.c. potential applied to the dees of a cyclotron is 9 MHz, calculate the magnetic flux density required to accelerate  $\alpha$  - particles. Given the mass of  $\alpha$  - particles to be  $6.643 \times 10^{-27}$  kg. [04]

Total No. of Questions : 12]

[Total No. of Printed Pages : 7

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F. E. (Semester - I) Examination - 2009

ENGINEERING MATHEMATICS - I

(June 2008 Pattern)

Time : 3 Hours]

[Max. Marks : 100

Instructions :

- (1) Solve questions No. 1 or 2, Q. No. 3 or 4, Q. No. 5 or 6 from section I and Q. No. 7 or 8, Q. No. 9 or 10, Q. No. 11 or 12 from section II.
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of non-programmable calculator is allowed.
- (6) Assume suitable data, if necessary.

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**SECTION - I**

- Q.1) (A) Find Non-singular Matrices P and Q such that PAQ is in the normal form and hence find  $A^{-1}$  if it exists. [06]

$$A = \begin{bmatrix} 4 & -1 & -5 \\ 15 & 1 & -5 \\ 5 & 4 & 9 \end{bmatrix}$$

- (B) Solve the following system of linear equations :

$$10x + 4y - 2z = -4$$

$$-17x + y + 2z - 3w = 2$$

$$x + y + w = 6$$

$$-34x + 16y - 10z + 8w = 4$$

[06]

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P.T.O.

- (C) Verify Cayley Hamilton Theorem for the following Matrix and also find its inverse if it exists : [05]

$$\begin{bmatrix} 1 & 1 & 2 \\ 3 & 1 & 1 \\ 2 & 3 & 1 \end{bmatrix}$$

**OR**

- Q.2)** (A) Find Eigen Values and Eigen Vectors of the Matrix :

$$\begin{bmatrix} 1 & 2 & -2 \\ 2 & 1 & -4 \\ 1 & -1 & -2 \end{bmatrix} \quad [06]$$

- (B) Examine for linear dependence the following system of vectors. If dependent, find the relation between them :

$$[-1, 5, 0], [16, 8, -3], [-64, 56, 9] \quad [06]$$

- (C) Find values of a, b, c if the matrix A is orthogonal where

$$A = \frac{1}{3} \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & b \\ 2 & -2 & c \end{bmatrix} \quad [05]$$

- Q.3)** (A) Two opposite vertices of a square are represented by complex numbers  $(9 + 12i)$  and  $(-5 + 10i)$ , find the complex numbers representing the other two vertices of a square. [06]
- (B) If  $z = -1 + i\sqrt{3}$  and n is an integer, prove that  $z^{2n} + 2^n z^n + z^{2n}$  is zero, if n is not multiple of 3. [05]
- (C) Express  $\log [\sin (x + iy)]$  in the form  $a + ib$ . [05]

**OR**



- Q.4)** (A) If  $Z_1$  and  $Z_2$  are two complex numbers and if  $|Z_2 + Z_1| = |Z_1 - Z_2|$  then prove that the difference of the amplitudes of  $Z_1, Z_2$  is  $\frac{\pi}{2}$ . [05]
- (B) Find all solutions of  $Z^4 - (1 + 4i)Z^2 + 4i = 0$ . [06]
- (C) If  $\cosh x = \sec\theta$ , prove that  $\tanh^2\left(\frac{x}{2}\right) = \tan^2\left(\frac{\theta}{2}\right)$ . [05]

**Q.5)** (A) Test for convergence of the following series : (Any Two) [08]

(1) 
$$\sum_{n=1}^{\infty} \frac{n+2}{(n+1)\sqrt{n}}$$

(2) 
$$\sum_{n=1}^{\infty} \frac{x^n}{n^2 + 1}, \text{ for } x > 0$$

(3) 
$$\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n^2(n+1)}$$

(B) Find  $y_n$  for  $y = e^{ax} \cos^2 x \sin x$  [04]

(C) If  $y = e^{m \cos^{-1} x}$  then prove that

$$(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - (n^2 + m^2)y_n = 0 \quad [05]$$

**OR**

**Q.6)** (A) Test for convergence the following series : (Any Two) [08]

(1) 
$$\sum_{n=1}^{\infty} \frac{2.4.6 \dots (2n)}{5.8.11 \dots (3n + 2)}$$

(2) 
$$\sum_{n=1}^{\infty} \frac{1}{(\log n)^n}$$

(3) 
$$1 + \frac{1}{2.3} + \frac{1.3}{2.4.5} + \frac{1.3.5}{2.4.6.7} + \dots$$

(B) Find  $y_n$  for  $y = \frac{x^2}{(x-2)^2(x+1)}$  [04]

(C) If  $\sin^{-1} y = 2\log(x+1)$  then prove that  
 $(x+1)^2 y_{n+2} + (2n+1)(x+1)y_{n+1} + (n^2+4)y_n = 0$  [05]

### SECTION - II

**Q.7)** (A) Expand  $(1+x)^{1/x}$  upto the term containing  $x^2$ . [04]

(B) Expand  $2x^3 + 5x^2 + 3x - 4$  in powers of  $(x+3)$ . [05]

(C) Attempt **any two** of the following : [08]

(1) Evaluate  $\lim_{x \rightarrow 1} \frac{x - x^x}{1 + \log x - x}$

(2) Find the values of  $a$  and  $b$  if

$$\lim_{x \rightarrow 0} \frac{x(1 + a \cos x) - b \sin x}{x^3} = 1$$

(3) Evaluate  $\lim_{x \rightarrow a} \sin^{-1} \sqrt{\frac{a-x}{a+x}} \operatorname{cosec} \sqrt{a^2 - x^2}$

**OR**

**Q.8)** (A) Obtain the expansion of

$$\log \left[ \frac{1 + e^{2x}}{e^x} \right] \text{ upto the sixth power of } x. \quad [04]$$

(B) Using Taylor's Series, expand  $\log \tan \left( \frac{\pi}{4} + x \right)$  upto fifth power of  $x$ . [05]

(C) Attempt **any two** of the following :

[08]

(1) Evaluate  $\lim_{x \rightarrow 0} \left[ \frac{2x^2 - 2e^{x^2} + 2\cos\left(x^{3/2}\right) + \sin^3 x}{x^4} \right]$

(2) Evaluate  $\lim_{x \rightarrow 0} \left( \frac{5 \sin x - 7 \sin 2x + 3 \sin 3x}{\tan x - x} \right)$

(3) Determine a, b, c so that

$$\lim_{x \rightarrow 0} \frac{(a + b \cos x)x - c \sin x}{x^5} = 1$$

**Q.9)** (A) Prove that at a point of the surface  $x^x \cdot y^y \cdot z^z = c$

where  $x = y = z$ ,  $\frac{\partial^2 z}{\partial x \partial y} = -(x \log ex)^{-1}$  [05]

(B) If  $u = ax + by$ ,  $v = bx - ay$ , find the value of

$$\left( \frac{\partial u}{\partial x} \right)_y \cdot \left( \frac{\partial x}{\partial u} \right)_v \cdot \left( \frac{\partial y}{\partial v} \right)_x \cdot \left( \frac{\partial v}{\partial y} \right)_u$$
 [05]

(C) If  $u = \tan^{-1} \left( \frac{x^3 + y^3}{x - y} \right)$ , prove that

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \sin 2u [1 - 4 \sin^2 u]$$
 [06]

**OR**

**Q.10) (A)** If  $u = f(r)$  where  $r = \sqrt{x^2 + y^2}$ , prove that

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r) \quad [05]$$

**(B)** If  $\frac{x^2}{a^2 + u} + \frac{y^2}{b^2 + u} + \frac{z^2}{c^2 + u} = 1$  where  $u$  is an homogeneous function of degree  $n$  in  $x, y, z$ , show that

$$\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial y}\right)^2 + \left(\frac{\partial u}{\partial z}\right)^2 = 2nu \quad [06]$$

**(C)** If  $u = f(x - y, y - z, z - x)$  then prove that

$$\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0 \quad [05]$$

**Q.11) (A)** If  $x = u(1 - v)$ ,  $y = uv$

show that  $JJ' = 1$  [05]

**(B)**  $z = 2xy^2 - 3x^2y$ ,  $x$  increases at the rate of 2cm./sec. as it passes through 3cm. show that  $y$  decreases at the rate of

$\frac{32}{15}$  cm./sec. as it passes through 1cm. if  $z$  remains constant. [06]

**(C)** As the dimensions of a triangle ABC are varied, show that the maximum value of  $\cos A \cos B \cos C$  is obtained when the triangle is equilateral. [06]

**OR**

**Q.12) (A)** Examine for functional dependence

$u = \frac{x - y}{1 + xy}$  ,  $v = \tan^{-1}x - \tan^{-1}y$ , if dependent find the relation between them. **[06]**

**(B)** Find the percentage error in the area of an ellipse, when the errors of 2% and 3% are made in measuring its major and minor axes respectively. **[05]**

**(C)** Find the extreme values of  $f(x, y) = xy (a - x - y)$  **[06]**