Total No. of Questions : 9]

SEAT No. : ☐

PC1675

[6351]-101

[Total No. of Pages : 4

F.E.

ENGINEERING MATHEMATICS - I

(2019 Pattern) (Semester- I) (107001) (Credit System)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) ***Attempt Q.1 (Compulsory); Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.***
2) ***Use of electronic pocket calculator is allowed.***
3) ***Assume suitable data wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) Write the correct option for the following multiple choice questions. **[10]**

a) If $u = x^4 + y^4 + z^4$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} =$ **[2]**

i) u ii) $4u$

iii) $2u$ iv) 0

b) If $x = u^2 - v^2$ and $y = 2uv$ and $\frac{\partial(x,y)}{\partial(u,v)} = 4(u^2 + v^2)$ then $\frac{\partial(u,v)}{\partial(x,y)} =$ **[2]**

i) $4(u^2 + v^2)$ ii) $4(x^2 + y^2)$

iii) $\frac{1}{4(x^2 + y^2)}$ iv) $\frac{1}{4(u^2 + v^2)}$

c) For square matrix P to be an orthogonal matrix, **[2]**

i) $PP^T = A^{-1}$ ii) $PP^T = I$

iii) $P^2 = I$ iv) $P = P^T$

d) The quadratic form corresponding to the matrix $A = \begin{bmatrix} 1 & 0 & 3/2 \\ 0 & 2 & 1 \\ 3/2 & 1 & -3 \end{bmatrix}$ is **[2]**

i) $Q(x) = x_1^2 + 2x_2^2 - x_3^2$ ii) $x_1^2 + x_2^2 - 3x_3^2 + 3x_1x_2 - 2x_2x_3$

iii) $x_1^2 + 2x_2^2 - 3x_3^2 + 3x_1x_3 + 2x_2x_3$ iv) $x_1^2 + 2x_2^2 - 3x_3^2 + \frac{3}{2}x_1x_3 + x_2x_3$

P.T.O.

e) If $u = \ln\left[\frac{\sqrt{x^2+y^2}}{x+y}\right]$ then u is a homogeneous function of degree. **[1]**

i) 1 ii) 1/2

iii) 2 iv) 0

f) For a square matrix A, sum of the eigen values is 3 and product of the eigen values is 2 then characteristic equation of A is **[1]**

i) $\lambda^2 - 3\lambda - 2 = 0$ ii) $\lambda^2 - 3\lambda + 2 = 0$

iii) $\lambda^2 + 2\lambda + 3 = 0$ iv) $\lambda^2 + 2\lambda - 3 = 0$

Q2) a) If $u = \log(x^3 + y^3 - y^2x - x^2y)$ then show that $\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y}\right)^2 u = \frac{-4}{(x+y)^2}$ **[5]**

b) If $u = \sin^{-1}\left(x^2 + y^2\right)^{1/5}$ then prove that **[5]**

$$x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{2}{5}\tan u\left[\frac{2}{5}\tan^2 u - \frac{3}{5}\right]$$

c) If $z = f(x,y)$ where $x = u + v$; $y = uv$ then prove that **[5]**

$$u\frac{\partial z}{\partial u} + v\frac{\partial z}{\partial v} = x\frac{\partial z}{\partial x} + 2y\frac{\partial z}{\partial y}.$$

OR

Q3) a) If $u = ax + by$; $v = bx - ay$ find value of $\left(\frac{\partial u}{\partial x}\right)_y\left(\frac{\partial x}{\partial u}\right)_v\left(\frac{\partial y}{\partial v}\right)_x\left(\frac{\partial v}{\partial y}\right)_u$. **[5]**

b) If $T = \sin\left(\frac{xy}{x^2+y^2}\right) + \sqrt{x^2+y^2} + \frac{x^2y}{x+y}$. Find the value of

$$x\cdot\frac{\partial T}{\partial x} + y\cdot\frac{\partial T}{\partial y}.$$ **[5]**

c) If Z = F(x, y) where $x = e^u \cos v$; $y = e^u \sin v$ then prove that

$$y\cdot\frac{\partial z}{\partial u} + x\cdot\frac{\partial z}{\partial v} = e^{2u}\frac{\partial z}{\partial y}.$$ **[5]**

Q4) a) If $x = uv,\ y = \frac{u+v}{u-v}$, find $\frac{\partial(u,v)}{\partial(x,y)}$. **[5]**

b) A power dissipated in a resistor is given by $P = \frac{E^2}{R}$. Find the approximate percentage error in P if E is increased by 3% and R is increased by 2%. **[5]**

c) Find stationary point of $f(x, y) = x^3 + y^3 - 3axy$ where $a < 0$. **[5]**

OR

Q5) a) If $u^3 + v^3 = x + y,\ u^2 + v^2 = x^3 + y^3$, find $\frac{\partial(u,v)}{\partial(x,y)}$. **[5]**

b) Examine for functional dependence $u = y + z,\ v = x + 2z^2,\ w = x - 4yz - 2y^2$. **[5]**

c) Find stationary value of $u = x^2 + y^2 + z^2$ under the condition $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$ using Lagrange's method. **[5]**

Q6) a) Examine for consistency the following system of equations and solve if consistent. **[5]**

$x + 2y + z = 2$

$2x - y - z = 2$

$4x - 7y - 5z = 2$

b) Examine whether the vectors $x_1 = (2, -1, 3, 2)$, $x_2 = (1, 3, 4, 2)$ and $x_3 = (3, -5, 2, 2)$ are linearly independent or dependent. If dependent, find the relation between them. **[5]**

c) For which values of a, b, c the matrix A is orthogonal where **[5]**

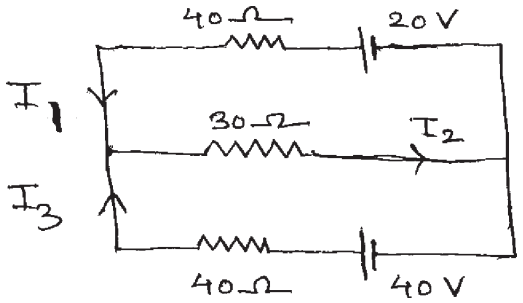
$$A = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} & a \\ \frac{2}{3} & \frac{1}{3} & b \\ \frac{2}{3} & -\frac{2}{3} & c \end{bmatrix}$$

OR

Q7) a) Determine values of λ for which the system of equations $3x - y + \lambda z = 0$, $2x + y + z = 2$, $x - 2y - \lambda z = -1$ is inconsistent. **[5]**

b) Examine whether the vectors $x_1 = (3, 1, 1)$, $x_2 = (2, 0, -1)$ and $x_3 = (4, 2, 1)$ are linearly independent or dependent. If dependent find the relation between them. **[5]**

c) Determine the currents in the following network. **[5]**



Q8) a) Find the eigen values and eigen vectors of the matrix $A=\begin{bmatrix}3 & 1 & 4\\ 0 & 2 & 6\\ 0 & 0 & 5\end{bmatrix}$. **[5]**

b) By using cayley Hamilton theorem find the inverse of the matrix $\begin{bmatrix}1 & 1 & 3\\ 1 & 3 & -3\\ -2 & -4 & -4\end{bmatrix}$. **[5]**

c) Reduce the matrix $A=\begin{bmatrix}5 & 4\\ 1 & 2\end{bmatrix}$ to its diagonal form by finding modal matrix P. **[5]**

OR

Q9) a) Find the eigen values of $A=\begin{bmatrix}2 & 0 & 1\\ 0 & 2 & 0\\ 1 & 0 & 2\end{bmatrix}$. Also find eigen vector corresponding to smallest eigen value of A. **[5]**

b) Verify cayley Hamilton theorem for $A=\begin{bmatrix}1 & 2\\ 2 & 2\end{bmatrix}$. Hence find A^{-1}, if it exists. **[5]**

c) Find the transformation which reduces the quadratic form $3x^2 + 5y^2 + 2z^2 - 2yz + 2zx - 2xy$ to the canonical form by using congruent transformations. Also write the canonical form. **[5]**

Total No. of Questions : 8]

SEAT No. : ____

PC1676

[6351]-102

[Total No. of Pages :3

F.E.

ENGINEERING PHYSICS

(2019 Pattern) (Semester- I/II) (107002) (Credit System)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
4) ***Assuem Suitable data, if necessary.***

Constants:

Mass of electron = 9.1×10^{-31} kg.

Charge on electron = 1.6×10^{-19} c

Velocity of light = 3×10^{8} m/s

Planck's Constant = 6.63×10^{-34} J.s

Q1) a) State de Broglie hypothesis. Derive de Broglie's wavelength in terms of kinetic energy E and Potential difference V. **[6]**

b) What is normalisation condition, the wavefunction must satisfy? Write down the other conditions the wave function must satisfy. **[4]**

c) Show that the energy of a particle in an infinite potential well is quantised by giving the expression of energy and with energy level diagram. **[4]**

d) An electron is confined to a box of lenght 2 Å. Calculate the minimum uncertainty in its velocity. **[4]**

OR

Q2) a) Derive Schrodinger's time independent wave equation. **[6]**

b) Using $\Delta x.\Delta p = h$, prove Heisenberg's uncertainty relation of energy and time. **[4]**

c) Write down any four properties of matter waves. **[4]**

d) An electron is trapped in an infinite potential well of width 1Å calculate the lowest two permissible energies (in eV) the electron can have. **[4]**

P.T.O.

Q3) a) Explain Hall Effect. Derive the equation for Hall voltage. **[6]**

b) What is Fermi-Dirac Probability distribution function. Write the terms involved in the equation. Draw the Energy diagrams with Fermi energy level for intrinsic and extrinsic semiconductors at 0°k. **[4]**

c) Draw the I-V characteristics of solar cell and define the terms; **[4]**

i) Fill factor

ii) Open circuit voltage

iii) Short circuit current

d) Calculate the energy gap in silicon if it transparent to a radiation of wavelengths greater than or equal to 11,000 Å. **[3]**

OR

Q4) a) By using energy band theory of solids explain classification of solids into conductors, semiconductors and insulators. **[6]**

b) Draw the energy band diagrams for Forward and Reverse biasing of the P-N junction diode. **[4]**

c) Write down the experssion for conductivity of a semiconductor. Using this, find the expresions for, intrinsic semiconductors and extrinsic semiconductor. **[4]**

d) Calculate the number of acceptors to be added to a Germanium sample to obtain the resistivity of 10Ω-cm. Given μ = 17000 cm^2/V.sec. **[3]**

Q5) a) Explain the origin of magnetism in brief Differentiate between paramagnetic materials and diamagnetic materials on the basis of magnetic susceptibility & magnetic permeability. **[6]**

b) Explain Meissner effect. Show that superconductors are diamagnetic in nature. **[4]**

c) Explain the following terms: **[4]**

i) Critical magnetic field

ii) Persistent current

d) The critical temperature for lead is 7.2K. However at 5K it loses its superconductivity when subjected to a magnetic field of 3.3×10^4 A/m. Find the maximum value of critical magnetic field which will allow the metal to retain its superconductivity at 0°K. **[4]**

OR

Q6) a) Explain superconductivity. Differentiate between Type I & Type II superconductors (Any 4 pts). **[6]**

b) Explain in brief the process of magnetic recordingand retreiving. **[4]**

c) What is magnetic permeability. Find the relation between relative permeability (μ_r) and magnetic susceptibility (χ). **[4]**

d) The critical field of Niobium is 1×10^5 A/m at 8K and 2×10^5 at 0 K. calculate the critical temperature of the element. **[4]**

Q7) a) What is meant by Non-destructive testing. Explain Acoustic Emission testing technique. **[6]**

b) Explain optical and electrical properties of nanoparticles in brief. **[4]**

c) Differentiate between Destructive and Non-destructive testing techniques. **[4]**

d) Find the echo time of ultrasonic pulse which is travelling with the velocity of 3.1×10^3 m/s in a sheet of mild steel of thickness 9 mm. **[3]**

OR

Q8) a) What is Nanotechnology? Explain briefly the variation in properties of nanoparticles on the basis of **[6]**

i) Surface area to volume ratio

ii) Quantum confinement Effect.

b) State any two applications of nanoparticles in **[4]**

i) Automobiles and

ii) Medicine

c) Explain flaw detection method using ultrasonic testing. **[4]**

d) An ultrasonic pulse is sent through a copper block and echo is recorded after 4 μs. If velocity of ultrasonic waves is 5000 m/s, calculate the thickness of the copper block. **[3]**

Total No. of Questions : 8]

SEAT No. : ____

PC-1677

[Total No. of Pages : 2

[6351] - 103
F.E.
Systems in Mechanical Engineering (SME)
(2019 Pattern) (Semester - I) (102003)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

All questions are compulsory

Q1) a) Classify automobiles based on various considerations and specify examples of each type. **[7]**

b) Explain electric vehicle with neat sketch. Mention its components. **[7]**

c) Write a short note on cost analysis of the vehicle. **[4]**

OR

Q2) a) Explain various components of S. I.engine with neat sketch. **[7]**

b) State importance of vehicle specification. Provide vehicle specifications for any two-wheeler. **[7]**

c) State difference between electric and hybrid vehicle with examples. **[4]**

Q3) a) Explain various components mounted on the chassis with neat sketch.**[7]**

b) State importance of suspension system. Explain telescopic suspension system with neat sketch. **[7]**

c) Explain working of water - coolitig system in vehicle with neat diagram.**[3]**

OR

P.T.O.

Q4) a) A pillion with 110 mm pitch circle diameter meshes with a gear of 450 mm pitch circle diameter. The number of teeth on pinion is 20 and it rotates at 1550 rpm. Determine

i) Gear ratio

ii) Number of teeth on gear and

iii) Speed of the gear. **[7]**

b) State types of steering system? Explain Ackerman steering mechanism with neat sketch. **[7]**

c) Draw a block diagram of fuel supply system for petrol engines wtth its components. **[3]**

Q5) a) Explain sand casting process with neat sketch. State its advantages and disad vantages. **[7]**

b) With neat sketch explain the shielded metal arc welding. State its applications. **[7]**

c) Explain a process of product development using 3D printing process. **[4]**

OR

Q6) a) Define metal forming process. Discuss extrusion and drawing process with neat sketch. **[7]**

b) State the importance of sheet metal working in manufacturing. Explain Punching and Blanking with neat sketch. **[7]**

c) Explain concept of Internet of Things (IoT) and its applications in manufacturing. **[4]**

Q7) a) State various applications of springs in domestic appliances. With neat sketch, explain any one mechanism marking use of spring. **[7]**

b) Explain working of a printer with block diagram. **[7]**

c) Draw neat sketch of water pump used for overhead tank. **[3]**

OR

Q8) a) With the help of block diagram, explain working of electric geyser. State various specifications for an electric geyser. **[7]**

b) Why product specifications are important? Explain the specifications for refrigerator and air conditioner. **[7]**

c) An electric motor driven pump fills an over headed tank placed at a height of 20m from the ground level. The mass of the water pumped per second is 5.56 kg. input power of the motor is 2200W. Calculate the efficiency of the motor. (Use $g = 9.81\ m/s^2$) **[3]**

Total No. of Questions : 9]

SEAT No. :

PC1678

[Total No. of Pages :4

[6351]-104

F.E.

ENGINEERING CHEMISTRY

(2019 Pattern) (Semester-I/II) (Credit System) (107009)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Q.No. 1 is compulsory.***
2) ***Solve Q.No.2 or Q.No.3, Q.No.4 or Q.No.5, Q.No.6 or Q.No.7, and Q.No.8 or Q.No.9.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Assume suitable data, if necessary.***
6) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam table is allowed.***

Q1) Multiple choice questions.

a) In p-doping of conducting polymers _____ is used as dopant and ____ reaction occurs. **[2]**

i) I_2, reduction ii) Na, oxidation

iii) I_2, oxidation iv) Na, reduction

b) Size of nanomaterials is in the range _____. **[1]**

i) 1 μm - 100 μm ii) 1 nm - 100 nm

iii) 1 mm - 100 cm iv) 1 mm - 100 mm

c) Calorific value of gaseous fuel can be determined using _____ **[1]**

i) Colorimeter ii) Bomb calorimeter

iii) Viscometer iv) Boy's calorimeter

P.T.O.

d) Choose the correct option that is true for biodiesel. **[1]**

i) Biodiesel attacks rubber hoses.

ii) Biodiesel is prepared by fermentation of molasses.

iii) Biodiesel has high octane number.

iv) All of the above

e) H_2O and NH_3 show ____ and ____ fundamental modes of vibrations, respectively. **[2]**

i) 3, 6 ii) 5, 3

iii) 5, 8 iv) 2, 4

f) Shift of absorption maxima of a compound to longer wavelength is _____ shift. **[1]**

i) Blue ii) Hyperchromic

iii) Red iv) Hypochromic

g) Galvanising is coating of _____. **[1]**

i) Sn on Fe ii) Fe on Sn

iii) Fe on Zn iv) Zn on Fe

h) Which amongst the following is an example of cathodic coating? **[1]**

i) Sn on Fe ii) Zn on Fe

iii) Zn on Sn iv) Fe on Sn

Q2) a) What are polymer composites? give their classification based on the dispersed phase. State four properties of fibre reinforced polymer composites. **[6]**

b) Define quantum dots. Give their classification. State 2 applications of quantum dots. **[5]**

c) Give the structure, 3 properties and 3 applications of poly para phenylene vinylene (PPV). **[4]**

OR

Q3) a) Describe the structure of graphene with the help of diagram. Give 3 properties & 3 applications of graphene. **[6]**

b) What are biodegradable polymers? Give structure, 3 properties and 3 applications of Biopol. **[5]**

c) Give classification of nanomaterials with examples. **[4]**

Q4) a) Draw neat labelled diagram of Bomb calorimeter. Give the principle and explain the working of Bomb calorimeter. State the formula with corrections to calculate GCV of a fuel. **[6]**

b) What is power alcohol? Give the procedure and reactions involved in the preparation of ethanol from molasses. List 2 advantages of power alcohol. **[5]**

c) 1.2 g of coal sample on complete combustion increased the weight of U-tube containing $CaCl_2$ by 0.8 g and tube containing KOH by 2.4 g. Calculate % of C & H in wal. **[4]**

OR

Q5) a) Discuss the production of hydrogen by steam reforming of methane and coke with reaction conditions and removal of CO_2. **[6]**

b) Give the principle and describe the process of fractional distillation of Petroleum with labelled diagram. **[5]**

c) 1.0 g of coal sample after heating for 1 hour at 110 ºC gave a residue of 0.85 g . The residue was then ignited to a constant weight of 0.12 g. In an another experiment, 1.0 g of the same coal sample was heated at 950 I 20ºC for exactly 7 minutes. The weight of the residue was 0.62 g. Calculate % moisture, volatile matter, ash and fixed carbon. **[4]**

Q6) a) Draw block diagram of single beam UV-Vis spectrophotometer. Explain its various components and give function of each. **[6]**

b) Discuss any 5 applications of IR spectroscopy. **[5]**

c) Define: **[4]**

i) Chromophore

ii) Auxochrome

iii) Hyperchromic shift

iv) Hypochromic shift

OR

Q7) a) Explain the fundamental modes of stretching and bending vibrations in IR spectroscopy. **[6]**

b) Explain the possible transitions occuring on absorption of UV-Vis radiations by an organic molecule. **[5]**

c) What are the conditions of absorption of IR radiations by a molecule? Calculate the possible number of fundamental modes of vibration in CH_4 & CO_2. **[4]**

Q8) a) Explain any 6 factors affecting the rate of corrosion of metals. **[6]**

b) Give the principle and explain the process of electroplating with diagram and reactions. Give two applications of electroplating. **[5]**

c) State the nature of oxide film formed in the oxidation corrosion of Na, Al and give reactions involved. **[4]**

OR

Q9) a) Explain hydrogen evolution and oxygen absorption mechanism of wet corrosion. **[6]**

b) Give the principle of cathodic protection. Explain cathodic protection using impressed current. Give advantage and limitations of this process. **[5]**

c) What is tinning? Explain the process with neat labelled diagram. **[4]**

Total No. of Questions : 8]

SEAT No. : ____

PC-1679

[Total No. of Pages : 4

[6351]-105

F.E. (All Branches)

BASIC ELECTRICAL ENGINEERING

(2019 Pattern) (Semester - I/II) (103004)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) ***Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7or Q.8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***
5) ***Use of non-programmable electronic pocket calculator is permitted.***

Q1) a) Derive the expression. for resonant frequency in case of an RLC series circuit. **[4]**

b) Obtain an expression for instantaneous current in a pure capacitance excited by a sinusoidal voltage source. Hence obtain the instantaneous and average power. **[6]**

c) An AC voltage given by e = 200 sin 100πt is applied to a load having R = 200 Ω in series with L = 638 mH. Find (i) Expression for current (ii) power consumed by load (iii) Reactive power of load (iv) voltage across R and L. **[8]**

OR

Q2) a) Define admittance of an AC circuit. Write the admittance in complex form for an inductive circuit and state the meaning of each term. **[4]**

b) Obtain the expression for average power drawn by an R-L series circuit when excited with a sinusoidal voltage source. Hence draw the power triangle. **[6]**

c) A resistance of 10 Ω is connected in series with a pure capacitor of 150 μF. The circuit is connected across a 100V, 50Hz supply. Calculate (i) impedance of circuit (ii) power factor of circuit (iii) current in the circuit (iv) voltages across resistor and capacitor (v) active, reactive and apparent power in the circuit. **[8]**

P.T.O.

Q3) a) Define the following terms as applicable to a three phase AC system : **[3]**

i) Symmetric AC supply

ii) Phase sequence

iii) Balanced load

b) Derive an expression for emf induced in a single phase transformer. **[6]**

c) A balanced 3- phase load consists of three coils, each of series combination of 6 Ω resistance and 8 Ω inductive reactance. Determine the line current and power absorbed when the coils are (i) star-connected and (ii) delta-connected across 400V, 3-phase supply. **[8]**

OR

Q4) a) State and explain principle of working of a single phase transformer. **[3]**

b) State the relationship between line and phase voltage, Line and phase current in case of three phase star connected balanced load. Hence, obtain the expression for 3-ph power. **[6]**

c) A direct loading test is performed on a 1 kVA, 230 V/115 V, 50 Hz single phase transformer. Draw the connection diagram involving all necessary measuring instruments and determine the following : **[8]**

i) Full load primary and secondary current

ii) Range of ammeters and voltmeters

iii) Range of wattmeters

Q5) a) State and explain Kirchhof's Laws in the context of DC circuits. **[4]**

b) Obtain the formulae for converting a set of given delta connected resistances into equivalent star connection. **[6]**

c) Using Thevenin's theorem, find the current through 10 Ω resistor in following circuit. **[8]**

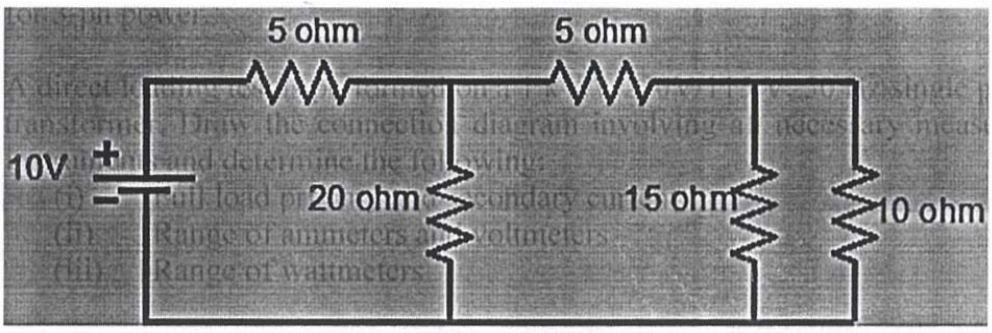


Fig. Q.5 (c)

OR

Q6) a) What is an ideal voltage source? Mention the following for an ideal voltage source : **[4]**

i) Diagrammatic representation

ii) Internal resistance value

iii) Voltage and output current characteristics

b) State the Superposition Theorem and apply it for finding current through AB for the circuit given below. Fig 6(b) **[6]**

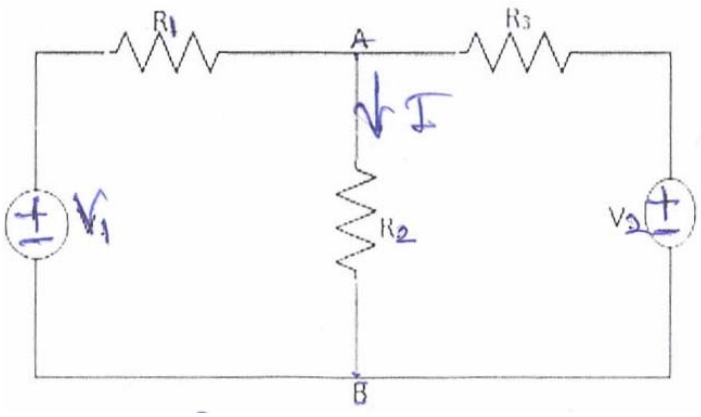


Fig 6(b)

c) Determine the effective resistance between terminals A and B for the circuit shown in Fig. below. **[8]**

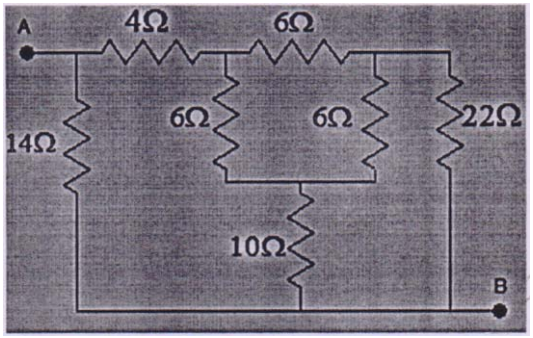


Fig. Q.6(c)

Q7) a) Explain the concept of depth of discharge (DoD) of a battery in brief.**[3]**

b) Derive an expression for insulation resistance of a single core cable. **[6]**

c) Explain the construction and working of a Lead Acid Battery and state it's any two applications. **[8]**

OR

Q8) a) State any three major precautions taken while maintaining a Lead Acid Battery. **[3]**

b) Explain the construction and working of a Lithium-Ion Cell and state it's any two applications. **[6]**

c) The electrical installation in a house is utilised as mentioned below:

i) 5 Tubelights, 18W each, for 12 hrs a day

ii) 3 ceiling fans, 60W each, for 10 hrs a day

iii) 2 electric ovens, 1.2 KW each, for 2 hrs a day

iv) 2 electric geysers, 3 KW each for 30 minutes a day

Calculate (i) Daily energy consumption in kWH (ii) total cost of energy at a rate of Rs.6 per unit for 30 days. **[8]**

Total No. of Questions : 8]

SEAT No. :

PC-1680

[Total No. of Pages : 2

[6351]-106
F.E.
BASIC ELECTRONICS ENGINEERING
(2019 Pattern)(Semester - I & II)(104010)(Credit System)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q5 or Q6, Q7 or Q8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

Q1) a) Convert **[6]**

i. $(43)_{10} = (?)_2$ - Decimal to Binary.

ii. $(45)_8 = (?)_{10}$ - Octal to Decimal.

iii. $(10101101)_2 = (?)_8$ - Bianry to Octal.

b) State and prove De Morgan's Theorems. **[6]**

c) Draw and explain Block Diagram of Microprocessor. **[6]**

OR

Q2) a) Waht is Flip-Flop? Explain 'D' FF with logic symbol and truth table. **[6]**

b) Why NAND and NOR are known as universal logic gates? **[6]**

c) Design and implement half adder with the help of truth table, logic equations and circuit diagram. **[6]**

Q3) a) Draw block diagram of function generator and explain function of each block. **[6]**

b) Differentiate between Ammeter and Voltmeter. **[5]**

c) Explain with block diagram of Digital Multimeter. **[6]**

P.T.O.

OR

Q4) a) Explain block diagram of digital storage oscilloscope. **[6]**

b) Draw block diagram of power scope and explain it's operation. **[6]**

c) Explain application of auto transformer with diagram. **[5]**

Q5) a) Explain Thermistor with it's construction and application. **[6]**

b) Explain selection criteria for sensor. **[6]**

c) Differentiate between active and passive sensors. **[5]**

OR

Q6) a) Explain the construction and working of LVDT. **[6]**

b) Explain Biosensor with one application. **[6]**

c) Explain load cell. **[5]**

Q7) a) Explain need of modulation. What are the different techniques of modulation. **[6]**

b) Explain different types of cables used in electronic communication. **[6]**

c) Explain cellular concept of mobile communication system. **[6]**

OR

Q8) a) Draw block diagram of communication system and explain each block in brief. **[6]**

b) Draw block diagram of AM transmitter and explain. **[6]**

c) Draw and explain the block diagram of GSM. **[6]**

Total No. of Questions : 8]

SEAT No. :

PC-1681

[Total No. of Pages : 5

[6351]-107
F.E. (Common)
ENGINEERING MECHANICS
(2019 Pattern) (Semester - I) (101011)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Neat diagram must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***
5) ***Use of cell phone is prohibited in the examination hall.***
6) ***Use of electronic pocket calculator is allowed.***

Q1) a) A 20 kg homogeneous smooth sphere rests on two inclinations at 75° and 30° as shown in **Fig. 1 a.** Calculate the contact forces at A & B. **[6]**

b) The square plate has mass of 1800kg with mass center at 'G'. Calculate the tension in each of the three cables with which the plate is lifted while remaining horizontal as shown in **Fig. 1 b.** **[8]**

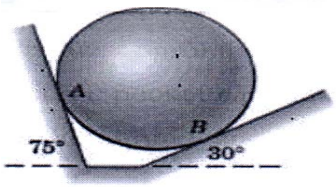


Fig. 1 a

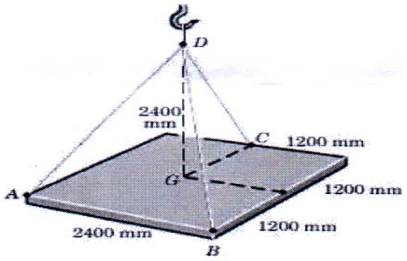


Fig. 1 b

c) Explain how uniformly distributed load (UDL) and uniformly varying load (UVL) is converted in to a point load with sketch. **[4]**

OR

P.T.O.

Q2) a) Determine the support reactions at roller A and pin at B for a beam loaded with 300kg box as shown in **Fig. 2 a.** Neglect the weight of beam. **[5]**

b) A uniform steel plate of 20 cm × 20 cm weighing 750 N is suspended in horizontal plane by three vertical wires as shown in **Fig. 2 b.** Calculate the tension in each wire at A, B and C. **[7]**

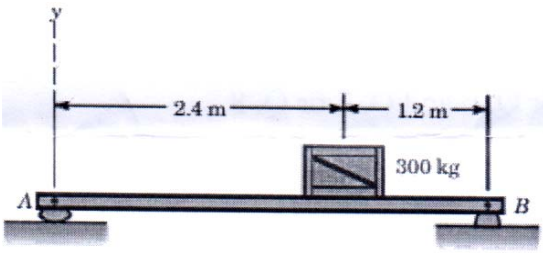


Fig. 2 a

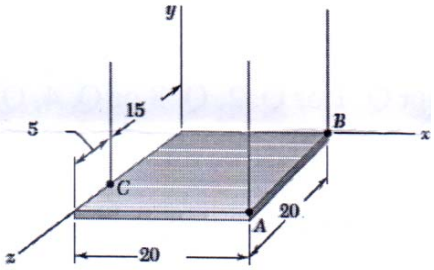


Fig. 2 b

c) Explain Simple, Roller, Hinge and Fixed support with number of reactions developed at each joint with sketch. **[6]**

Q3) a) Determine the force in all members of the truss loaded with 1000 N force at A, B and C with supports as shown in **Fig. 3 a.** **[6]**

b) Determine the x and y components of forces acting at joint B and D on the member BD for a frame loaded and supported as shown in **Fig. 3 b.** **[7]**

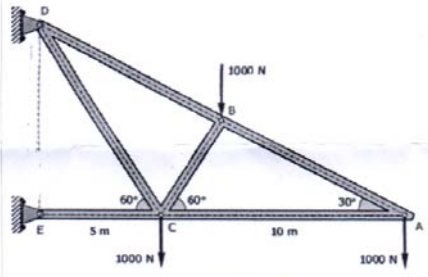


Fig. 3 a

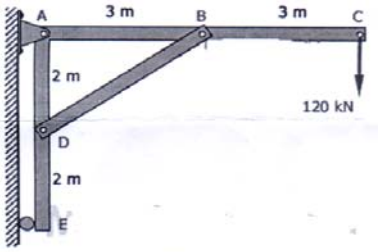


Fig. 3 b

c) Define two force and multi force member with a sketch. **[4]**

OR

Q4) a) Determine the forces in the members AC, BC and BD for the truss loaded and supported as shown in **Fig. 3 a.** **[6]**

b) Knowing that m_C= 50 kg, determine the tension in each segment of the cable and magnitude of mass 'm_B' for cable supported and loaded as shown in **Fig. 4 b.** **[6]**

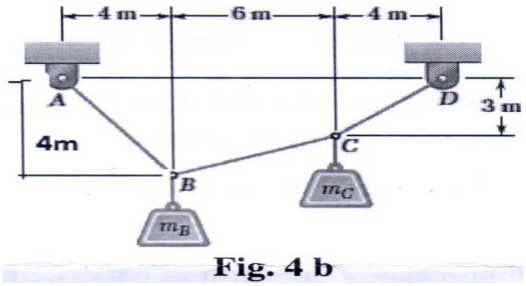


Fig. 4 b

c) Explain deficient, determinate and indeterminate truss with a sketch. **[5]**

Q5) a) Acceleration of a particle moving along a straight line is given as 'a=t/6', where 'a' is acceleration in m/s^2 and 't' is time in seconds. Initially, then t = 0 sec, the velocity is 2 m/s and displacement is 7m. Determine velocity and displacement of particle at t=3 seconds. **[6]**

b) A stone thrown vertically upward with 20 m/s from top of a tower 80 m high. Determine velocity with which it hits the ground at base level of tower and total time required to reach the ground level. **[6]**

c) A golf player hits the ball from point A with a velocity 45 m/s as shown in **Fig. 5c** at an angle of 20° with horizontal. Determine the maximum height it reaches and the horizontal distance it falls w.r.to A. Consider ground to be horizontal. **[6]**

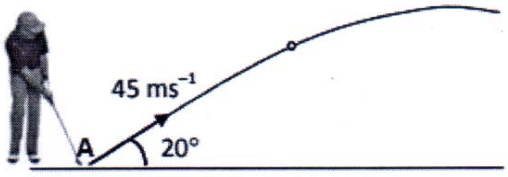


Fig. 5 c

OR

Q6) a) The acceleration of a particle is given by an expression, a = k.t^2. At t = 0, velocity of the particle is – 12 m/s. Knowing that v = 0 and x = 15 m when t = 4 s, write the equation of motion of a particle. **[6]**

b) A golf player hits the ball from point A with a velocity 45 m/s as shown in **Fig. 6b** at an angle of 20° with horizontal. Determine whether the ball will pass over the 12m high tree placed at 80m from A. Consider ground to be horizontal. **[6]**

c) A motorist starts from rest at point A on a circular ramp of 150 m radius when t = 0 s, increases speed at a constant rate and enters the highway at point B as shown in **Fig. 6c.** Knowing that her speed increases with same rate till it reaches to 100 km/h at point C, determine the speed at point B. **[6]**

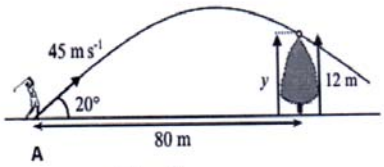


Fig. 6 b

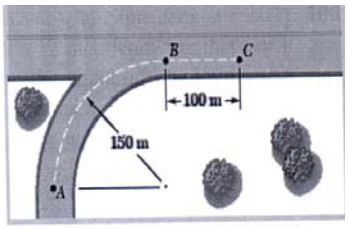


Fig. 6 c

Q7) a) A 15 kg ball suspended by 3m describes an arc of a circle leftwards as shown in **Fig. 7a.** If the tension in the string is 2.5 times weight of the ball, for the position as shown, determine the velocity and acceleration of the ball in that position. **[6]**

b) A racing car travels around the horizontal circular track of radius 100m. If the car starts from rest and accelerates with tangential acceleration of 7 m/s^2 for some time. Determine the time and velocity when the total acceleration of the racing car reaches to 8 m/s^2. **[6]**

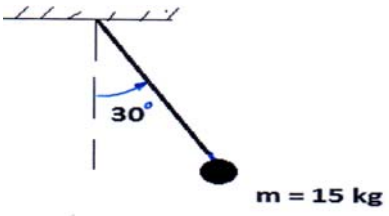


Fig. 7 a

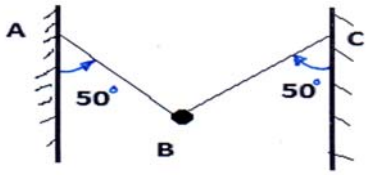


Fig. 8 a

c) A ball of mass 1kg dropped from 5m height on a horizontal floor rebounds back to 3m height. Determine the coefficient of restitution between the floor and ball. Also Determine its renounced height after falling from 3m again. **[5]**

OR

Q8) a) A 65 kg wrenching ball 'B' is suspended through cables AB and BC as shown in **Fig. 8a**. Determine the tension in the cable BC at that moment, if the cable AB is cut. **[6]**

b) Cylinder A of 0.5 kg is dropped from 2.4 m onto pan B of 2.5 kg, which is at a resting on a spring constant k = 3kN/m. Assuming the impact to be perfectly plastic, determine the compression of the spring after impact.**[6]**

c) Ball 'A' of 5 kg moving with 10 m/s rightwards, strikes with ball 'B' of 1 kg which is at rest. If after the impact the velocity of the ball 'B' is 10 m/s rightwards. Determine, the velocity of the ball 'A' after impact and coefficient of restitution 'e'. **[5]**

♦ ♦ ♦

Total No. of Questions : 8]

SEAT No. :

PC-1682

[Total No. of Pages : 3

[6351] - 108
F.E.
Programming and Problem Solving
(2019 Pattern) (Semester - I/II) (110005)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.***
2) ***Neat Diagrams must be drawn wherever necessary.***
3) ***Assume suitable data wherever necessary.***

Q1) a) Explain the concept of a module and a package in python. **[6]**

b) What are the good programming practices in python? Explain any six. **[6]**

c) Write a program to find factorial of a number using user defined function. **[5]**

OR

Q2) a) Explain use of global statement with a suitable example. **[6]**

b) Explain 'the return statement' syntax in a function. Explain implicit and explicit return value in a function with a suitable example. **[6]**

c) Write a program using lambda for the division of two numbers. **[5]**

Q3) a) Explain the following string operations with examples. **[6]**

i) concatenation ii) slicing iii) String multiplication

b) Explain with a suitable example strings are immutable. **[6]**

c) Write a program that accepts a string from user and displays the same string after removing vowels from it. **[5]**

P.T.O.

OR

Q4) a) Explain string iterating using while and for loop with suitable example. **[6]**

b) Explain following string methods with example. **[6]**

i) strip()

ii) ljust()

iii) rindex()

c) Write a program to create a mirror of the given string. For example "abc" = "cba". **[5]**

Q5) a) Explain the following Programming Paradigms in detail. **[6]**

i) Monolithic

ii) Structured

iii) Object Oriented

b) What is class instantiation? How is it done? **[6]**

c) Write a program to calculate area of triangle using a class. **[6]**

OR

Q6) a) Explain the following features of OOP **[6]**

i) Inheritance

ii) Polymorphism

iii) Data abstraction

b) Explain class method with suitable example. **[6]**

c) Write a program that has a class Circle. Use a class variable to define the value of constant P1. Use this class variable to calculate area and circumference of a circle with specified radius **[6]**

Q7) a) What is a file? Explain different Access Modes. **[6]**

b) Explain the following file handling methods. **[6]**

i) seek()

ii) write()

iii) read()

c) Write a program to read a file that contains small case characters. Then write these characters into another file with all lowercase characters converted into Uppercase. **[6]**

OR

Q8) a) Explain the following directory methods with suitable example **[6]**

1) getcwd()

2) rmtree()

3) makedirs()

b) What is a file path? Explain absolute path and relative path. **[6]**

c) Explain the following dictionary methods. **[6]**

i) fromkeys()

ii) copy ()

iii) update

Total No. of Questions : 9]

SEAT No. : ____

PC-1683

[Total No. of Pages : 4

[6351]-109

F.E.

ENGINEERING MATHEMATICS - II

(2019 Pattern) (Semester - I/II) (107008)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates :

1) ***Q.1 is compulsory.***
2) ***Attempt Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

Q1) Write the correct option for the following multiple choice questions.

i) The value of integral $\int_0^\infty \sqrt{x}\, e^{-x^3}\, dx$ by using substitution $x^3 = t$ is _____. **[2]**

a) $\frac{\sqrt{\pi}}{6}$ b) $\frac{\sqrt{\pi}}{2}$

c) $3\sqrt{\pi}$ d) $\frac{\sqrt{\pi}}{3}$

ii) The region of absence for the curve represented by the equation $y^2(2a - x) = x^3$ is _____. **[2]**

a) $x > 0$ and $x < 2a$ b) $x < 0$ and $x > 2a$

c) $x < 0$ and $x < 2a$ d) $x > 0$ and $x > 2a$

iii) Find the centre and radius of a sphere $x^2 + y^2 + z^2 - 4x + 6y - 2z - 11 = 0$. **[2]**

a) (2, –3, 1) and 5 b) (–2, 3, –1) and 11

c) (4, –6, –2) and 6 d) (2, 3, –1) and 5

P.T.O.

iv) The value of the integral $\int_0^1 \int_0^y dx\,dy$ is _____. **[2]**

a) $\frac{1}{4}$ b) $\frac{1}{3}x$

c) $\frac{1}{2}$ d) $\frac{1}{2}y$

v) Using polar transformations $x = r\cos\theta$, $y = r\sin\theta$ the cartesian double integral $\iint f(x,y)\,dx\,dy$ is transformed to **[1]**

a) $\iint_R f(r,\theta)\,dr d\theta$ b) $\iint_R f(r,\theta)\frac{1}{2}dr d\theta$

c) $\iint_R f(r,\theta)\,2dr d\theta$ d) $\iint_R f(r,\theta)\,r\,dr d\theta$

vi) The number of loops in the rose curve $r = a\cos 2\theta$ are _____ **[1]**

a) 4 b) 2

c) 8 d) = 3

Q2) a) If $I_n = \int_0^{\pi/2} x^n \cos x\,dx$ then prove that $I_n = \left(\frac{\pi}{2}\right)^n - n(n-1)\,I_{n-2}$. **[5]**

b) Evaluate $\int_0^\infty \frac{x^2}{2^x}dx$. **[5]**

c) Evaluate $\frac{d}{dx}\,erf\left(\sqrt{x}\right)$. **[5]**

OR

Q3) a) If $I_n = \int_0^{\pi/4} \sec^n x\,dx$ then prove that $I_n \frac{\left(\sqrt{2}\right)^{n-2}}{n-1} + \frac{n-2}{n-1} I_{n-2}$. **[5]**

b) Evaluate $\int_0^3 x^4\,(3-x)^5\,dx$. **[5]**

c) Prove that $\int_0^\infty \frac{e^{-x} - e^{-ax}}{x\sec x}dx = \frac{1}{2}\log\left(\frac{a^2+1}{2}\right)$. **[5]**

Q4) a) Trace the curve $y^2(a - x) = x^2(a + x)$, $(a > 0)$. **[5]**

b) Trace the curve $r = a\,(1 - \sin\theta)$, $(a > 0)$. **[5]**

c) Find the arc length of the astroid $x = a\cos^3 t$, $y = a\sin^3 t$, $(a > 0)$. **[5]**

OR

Q5) a) Trace the curve $y^2 = (x - 1)(x - 2)(x - 3)$. **[5]**

b) Trace the curve $r = a\cos 5\theta$, $(a > 0)$. **[5]**

c) Trace the curve $x = t^2,\ y = t - \frac{t^3}{3}$ **[5]**

Q6) a) Show that the plane $2x - y - 2z = 4$ is tangential to the sphere $x^2 + y^2 + z^2 + 2x - 6y + 1 = 0$ and find the point of contact. **[5]**

b) Find the equation of right circular cone whose vertex is at (0, 0, 0), semivertical angle $\pi/4$ and axis along the line $\frac{x}{-2} = \frac{y}{1} = \frac{z}{-2}$. **[5]**

c) Find the equation of right circular cylinder having its radius '4' and equation of the axis is $\frac{x+1}{1} = \frac{y+1}{-1} = \frac{z+1}{1}$. **[5]**

OR

Q7) a) Show that the two spheres $x^2 + y^2 + z^2 - 2x + 4y - 4z = 0$ and $x^2 + y^2 + z^2 + 10x + 2z + 10 = 0$ touch each other externally and find the point of contact. **[5]**

b) Find the equation of right circular cone whose vertex is (1, 1, 1), axis is the line $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-1}{3}$ and semivertical angle $\pi/4$. **[5]**

c) Find the equation of right circular cylinder of radius 03 units and axis is the line $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-2}{3}$. **[5]**

Q8) a) Evaluate $\iint_R xy\,dxdy$ over the region R bounded by the parabolas $y^2 = x$ and $x^2 = y$. **[5]**

b) Find the area of one loop of the rose curve $r = a\cos 2\theta$. **[5]**

c) Find the x-coordinate of centre of gravity of the area enclosed by the parabola $y^2 = 4x$ and the line $y = 2x$. **[5]**

OR

Q9) a) Evaluate the integration by changing the order : **[5]**

$$\int_0^1 \int_y^1 e^{x^2}\,dx\,dy$$

b) Find the volume of the tetrahedron bounded by the co-ordinate planes $x = 0, y = 0, z = 0$ and the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **[5]**

c) Prove that the moment of inertia of the area between the curves $y^2 = ax$ and $x^2 = ay$ about x-axis is $\frac{9}{35}Ma^2$.

(Given that the density $\rho = \frac{3M}{a^2}$ where M is the mass) **[5]**

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Total No. of Questions : 8]

SEAT No. : [ ]

PC-1684

[Total No. of Pages : 3

[6351]-110
F.E.
ENGINEERING GRAPHICS
(2019 Pattern) (Semester - I/II) (102012)

Time : 2½ Hours] ***[Max. Marks : 50***

Instructions to the candidates :

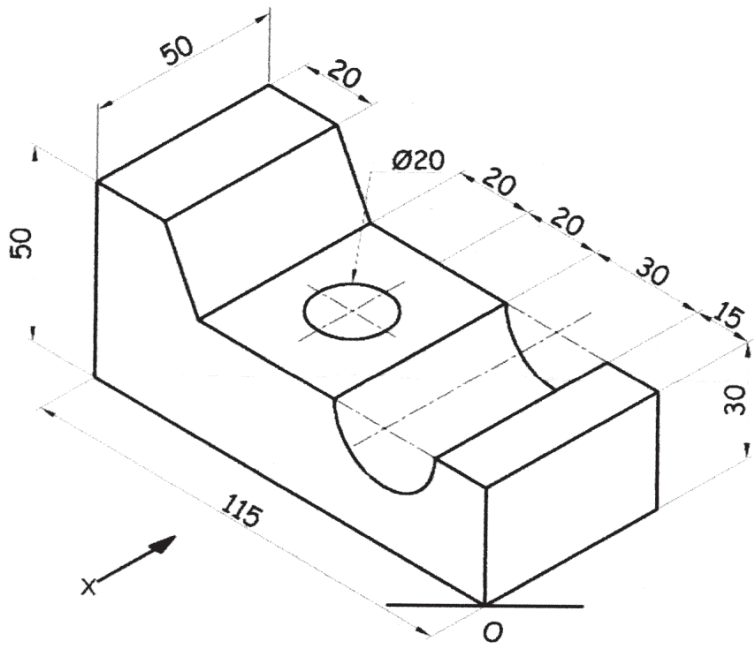
1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Assume suitable data, if necessary.***
3) ***Retain all the construction lines.***

Q1) Draw a helix on the cone of diameter 60 mm and height 100 mm when point 'P' starts from an apex and while rolling over the periphery reaches on the cone base in front of the observer in one turn. **[8]**

OR

Q2) Draw an involute of circle of diameter 40 mm. **[8]**

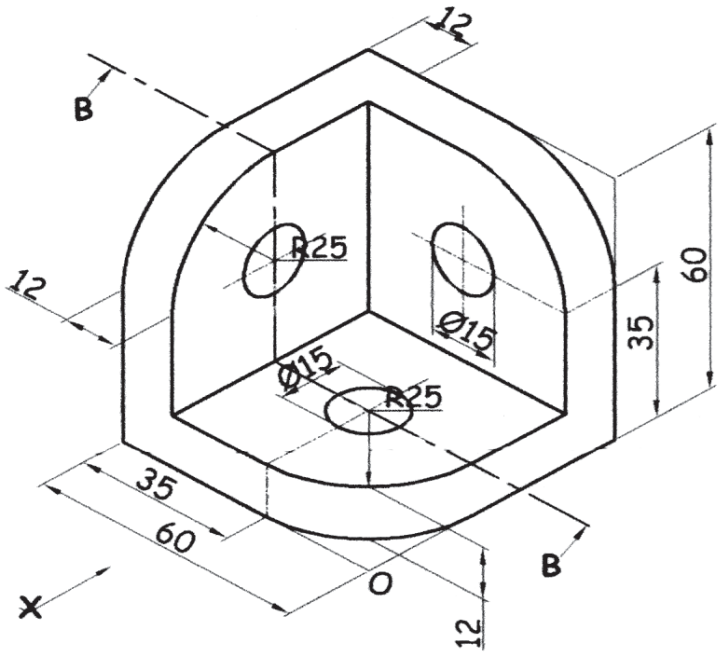
Q3) Figure shows a pictorial view of an object. By using first angle method of projection draw, Front View in the direction of X, Top View and Right-Hand Side View. Give dimensions in all views. **[16]**



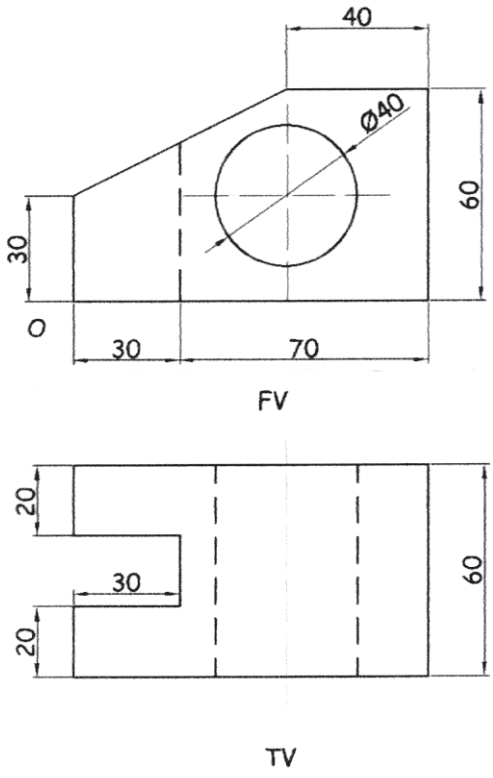
OR

P.T.O.

Q4) Figure shows a pictorial view of an object. By using first angle method of projection draw, Sectional Front View in the direction of X along B-B, Top View and Right-Hand Side View. Give dimensions in all views. **[16]**

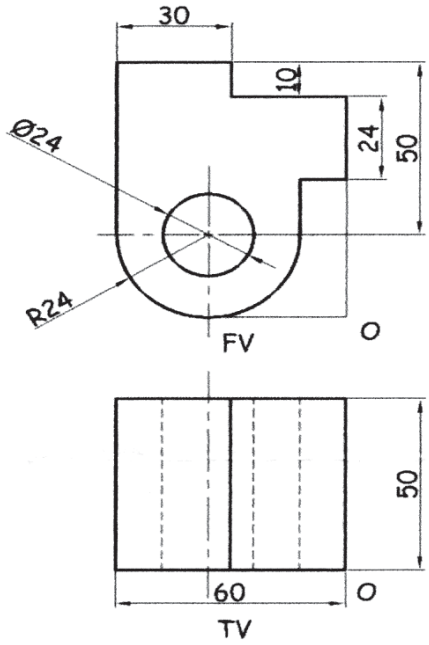


Q5) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. **[16]**



OR

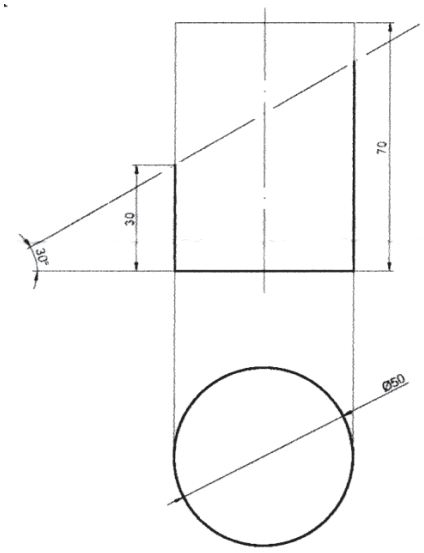
Q6) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. **[16]**



Q7) A Pentagonal pyramid side of base 25 mm and axis 60 mm long is kept on HP in such a way that one of its base edges is parallel to the VP and away from the observer. A cutting plane bisects its axis at 45º Draw the development of the pentagonal pyramid. **[10]**

OR

Q8) Figure shows the FV and TV of a cylinder. Draw the development of lateral surface(s) for bottom part of cylinder **[10]**



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