

[6401]-1901
F.E
ENGINEERING MATHEMATICS - I
(2019 Pattern)(Semester - I) (107001)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Attempt Q.1, Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Assume suitable data, if necessary.
- 5) Use of electronic pocket calculator is allowed.

Q1) Write the correct option for the following MCQ's.

i) If $u = \frac{1}{x^2 + y^2}$ then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \dots\dots$ [2]

- a) 0 b) $-2u$
c) $2u$ d) none

ii) If $x = uv, y = \frac{u}{v}$ then $\frac{\partial(x,y)}{\partial(u,v)} = \dots\dots$ [2]

- a) $-\frac{2u}{v}$ b) uv
c) $\frac{v}{2u}$ d) $-\frac{v}{2u}$

iii) Rank of a matrix $A = \begin{bmatrix} 2 & 2 & 2 \\ 0 & -2 & 0 \\ 2 & 2 & 2 \end{bmatrix}$ is [2]

- a) 0 b) 1
c) 2 d) 3

iv) For the matrix $A = \begin{bmatrix} 1 & 0 & 0 \\ -1 & 2 & 0 \\ 1 & 0 & 3 \end{bmatrix}$ the eigenvalues of A^2 are

- a) 1,2,3 b) 1,4,9
c) -1, -2, -3 d) -1, -4, -9

P.T.O.

v) If $z = xy$ then $\frac{\partial^2 z}{\partial x \partial y} = \dots$ [1]

- a) x
c) 1
- b) y
d) 0

vi) If $A^{-1} = A^T$ then matrix A is _____ [1]

- a) Singular b) Non-singular
c) Orthogonal d) None

Q2) a) If $u = \tan^{-1}\left(\frac{x}{y}\right)$, then show that $u_{xy} = u_{yx}$. [5]

b) If $u = \ln(x) + \ln(y)$, find the value of $x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy} + xu_x + yu_y$. [5]

c) If $u = f(e^{y-z}, e^{z-x}, e^{x-y})$, find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. [5]

OR

Q3) a) If $ux + vy = 0$ and $\frac{u}{x} + \frac{v}{y} = 1$, then show that $\left(\frac{\partial u}{\partial x}\right)_y - \left(\frac{\partial v}{\partial y}\right)_x = \frac{x^2 + y^2}{y^2 - x^2}$ [5]

b) If $f(x, y) = x^2 + (x^2 + y^2)[\ln(x) - \ln(y)]$, then find the value of $xf'_x + yf'_y$ [5]

c) If $x = u + v + w$, $y = uv + vw + wu$, $z = uvw$ and F is a function of x, y, z show that $uF_u + vF_v + wF_w = xF_x + 2yF_y + 3zF_z$. [5]

Q4) a) If $x = r \cos \theta$, $y = r \sin \theta$, then find $\frac{\partial(r, \theta)}{\partial(x, y)}$ [5]

b) Examine for functional dependence : [5]

$u = \frac{x-y}{x+y}$, $v = \frac{x+y}{x}$. If functionally dependent find the relation between them.

c) Discuss maxima and minima of $f(x,y) = x^2 + y^2 + 6x + 12$. [5]

OR

Q5) a) Verify $JJ' = 1$ for the transformation $x = uv, y = \frac{u}{v}$. [5]

b) In calculating the volume of a right circular cone, errors of 2% and 1% are made in measuring the height and radius of base respectively. Find the error in the calculated volume. [5]

c) By using Lagrange's method, divide 24 into three parts such that the continued product of the first, square of the second and cube of the third is maximum. [5]

Q6) a) Show that the system [5]

$$3x + 4y + 5z = \alpha$$

$$4x + 5y + 6z = \beta$$

$$5x + 6y + 7z = \gamma$$

is consistent only when α, β, γ are in arithmetic progression.

b) Examine for linear dependence or independence, if dependent find the relation between them. $X_1 = (1, 1, 1, 3), X_2 = (1, 2, 3, 4), X_3 = (2, 3, 4, 7)$ [5]

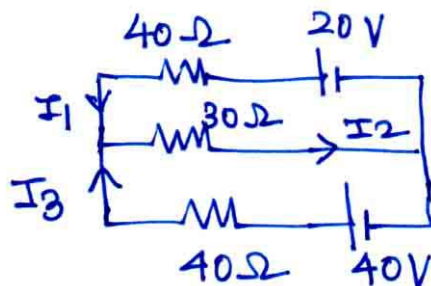
c) If $A = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} & a \\ \frac{2}{3} & \frac{1}{3} & b \\ \frac{2}{3} & \frac{-2}{3} & c \end{bmatrix}$ is orthogonal. Find a, b, c. [5]

OR

Q7) a) Examine the consistency of the linear system of the following equations. If consistent solve it $x + y + z = 3, x + 2y + 3z = 4, x + 4y + 9z = 6$. [5]

b) Examine for linear dependence or independence of the following vectors. If dependent, Find the relation among vectors $(1, 1, 1) (1, 2, 3) (2, 3, 8)$. [5]

c) Determine the currents in the network given in figure below [5]



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

b) Verify the Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & -2 \\ -2 & 0 & 1 \end{bmatrix}$ and use it to find A^{-1} . [5]

c) Find the modal matrix p such that $p^{-1}AP$ is diagonal matrix for

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix} \quad [5]$$

OR

Q9) a) Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$. [5]

b) Reduce the following quadratic form to the "sum of the squares form"
 $2x^2 + 9y^2 + 6z^2 + 8xy + 8yz + 6xz$. [5]

c) Verify the Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -3 \end{bmatrix}$ Hence find A^{-1} . [5]



Total No. of Questions : 9]

SEAT No. :

PD4025

[Total No. of Pages : 4

[6401]-1902

F.E.

ENGINEERING PHYSICS

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No. 1 is compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Assume suitable data if necessary.*
- 4) *Use of electronic calculator is allowed.*

Constants :-

- 1) Mass of electron = $m_e = 9.1 \times 10^{-31}$ kg
- 2) Charge on electron = $e = 1.6 \times 10^{-19}$ C
- 3) Planck's constant = $h = 6.63 \times 10^{-34}$ J.S

Q1) Write correct option of given questions with answer (one mark each) **[10]**

- a) The matter waves would be associated with _____ moving with speed comparable to the speed of light.
 - i) Electron
 - ii) Proton
 - iii) Neutron
 - iv) All of the above
- b) De Broglie hypothesis is applicable for
 - i) Matter particles
 - ii) Electromagnetic waves
 - iii) Mechanical waves
 - iv) None of the above
- c) Heisenberg's uncertainty principle is about the _____ of position and momentum of a particle.
 - i) Difference
 - ii) Addition
 - iii) Multiplication
 - iv) Division
- d) Which of the following represent correct ordering for band gap energy?
 - i) Metal > Semiconductor > Insulator
 - ii) Metal < Semiconductor < Insulator
 - iii) Metal < Semiconductor > Insulator
 - iv) Metal > Semiconductor < Insulator

P.T.O.

- e) Hall effect is true for
- Metals only
 - P-type semiconductors only
 - N type semiconductors
 - All of the above
- f) The relation between magnetic field strength (H), magnetization(M) and susceptibility(X) is
- $X = M/H$
 - $X = M + H$
 - $X = M \times H$
 - $X = H/M$
- g) The magnetism produced in an atom is because of
- Orbital motion of electron
 - Spin motion of electron
 - Spin motion of nucleus
 - Combined effect of a, b, c
- h) Below critical temperature, resistance of superconductor is _____ and it has _____ conductivity.
- Infinite, zero
 - Unity, Unity
 - Zero, Infinite
 - Infinite, infinite
- i) _____ are performed to estimate internal defects in the materials.
- Destructive testing
 - Non-Destructive testing
 - Both (i) & (ii)
 - None of (i) and (ii)
- j) Nanomaterials has at least one dimension in the range.
- 1 to 100 nm
 - 100 to 1000 nm
 - 1 to 10 μm
 - Greater than 10 μm

- Q2)** a) Derive the expression for the energy of a particle enclosed in an infinite potential well. [6]
- b) State and explain Heisenberg's uncertainty principle. [5]
- c) Calculate wavelength of matter waves associated with an electron having energy 10eV. [4]

OR

- Q3)** a) Derive schrodinger's time independent equation. [6]
- b) State and explain de Broglie hypothesis of matter waves. Write any two properties of matter waves. [5]
- c) Calculate minimum energy associated with an electron enclosed in a potential well of length 2AV. [4]

- Q4)** a) With a suitable diagram. Explain Hall effect. Derive expression for Hall Voltage. [6]
- b) Define efficiency of solar cell. State any four measures to improve efficiency of solar cells. [5]
- c) Calculate number of acceptor atoms that are required to be added to an intrinsic silicon to achieve a resistivity of 10 ohm-cm. [Given - mobility of holes $500\text{cm}^2/\text{V.S}$] [4]

OR

- Q5)** a) Derive the expression for conductivity of intrinsic and extrinsic semiconductors. [6]
- b) Define Fermi level in conductor. Using Fermi-Dirac distribution function. Calculate the probability of finding electrons at $T = 0\text{ K}$ for energy levels. [5]
- i) $E < E_f$
- ii) $E > E_f$
- c) A strip of copper of thickness $1.5 \times 10^{-4}\text{ m}$ is placed in a magnetic field of 1T acting along its thickness; A current of 10A is setup along its length. The voltage developed across width is $5\mu\text{V}$. Calculate concentration of charge carriers. [4]

- Q6)** a) Explain how the information is recorded and retrieved (read) in magnetic storage devices. [6]
- b) Explain in brief :
- i) Magnetic field strength (H)
- ii) Magnetization (M)

Write relation between them.

- c) The critical temperature for lead is $T_c = 7.18\text{K}$, critical magnetic field at 0 K, $H_c(0) = 6.5 \times 10^4\text{ A/M}$. Calculate critical magnetic field $H_c(T)$ at $T = 4.2\text{K}$. [4]

OR

- Q7)** a) State and explain meissner effect. Show that super conductors are perfect diamagnetic. [6]
- b) Define critical magnetic field. Differentiate between type I & type II super conductors. (Any two points). [5]
- c) Explain in brief : [4]
- i) Magnetic induction (B)
- ii) Magnetic permeability (μ)
- Q8)** a) Explain with a suitable diagram, how ultrasonic testing technique is used for flow defection. [6]
- b) What is Non Destructive Testing (NDT)? Write advantages of Non Destructive Testing over destructive testing (any four). [5]
- c) Explain applications of nanotechnology in medicine (targeted drug delivery). [4]

OR

- Q9)** a) Explain optical and electrical properties of nano particles. [6]
- b) What is nanotechnology? Explain why properties of nanoparticles are different than corresponding bulk materials. [5]
- c) A block of metal has a thickness of 0.5 cm. An ultrasonic pulse of velocity 5000 m/s is sent through the top of the block. After what time echo would be received from the bottom of the block. At some other location in the block. Echo is received from. Flow after $1.5\mu\text{s}$. Calculate location of the flow. [4]



Total No. of Questions : 8]

SEAT No. :

PD4026

[Total No. of Pages : 2

[6401]-1903

F.E.

**SYSTEMS IN MECHANICAL ENGINEERING
(2019 Pattern) (Credit System) (Semester -I/II) (102003)**

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) Assume suitable data if necessary.
- 3) Figures to the right indicate full marks.

- Q1) a)** Explain Hybrid Vehicle with neat diagram. **[10]**
b) Classify Automobile and Compare specification of two wheeler and LMV. **[8]**

OR

- Q2) a)** Classify Automobile and Compare specification of LMV and Heavy Motor Vehicle (HMV) **[10]**
b) Explain Electric Vehicle with neat diagram. **[8]**

- Q3) a)** Write a short note on Active safety and Passive safety in vehicles. **[10]**
b) Explain steering system with neat diagram. **[7]**

OR

- Q4) a)** Explain single plate clutch with neat diagram. **[10]**
b) Explain antilock braking system in vehicle with neat diagram. **[7]**

- Q5) a)** Explain with neat sketch the sand casting process. State its advantages and disadvantages. **[10]**
b) Explain water cooling system used in vehicle with neat diagram. **[8]**

OR

P.T.O.

Q6) a) Explain with neat sketch the forging process. State its advantages and disadvantages. **[10]**

b) Explain shielded metal arc welding process with labeled sketch. **[8]**

Q7) a) Explain with neat sketch electric arc welding. **[10]**

b) Write a short note on IOT. **[7]**

OR

Q8) a) Explain with neat sketch the working of water purifier. **[10]**

b) Explain the working of kitchen chimney. **[7]**

* * *

Total No. of Questions : 9]

SEAT No. :

PD4027

[6401]-1904

[Total No. of Pages : 4

F.E.

ENGINEERING CHEMISTRY

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt 2 or 3, 4 or 5 6 or 7 & 8 or 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) Multiple choice questions:

[10]

- a) Poly Phenylene Vinylene (PPV) shows the property of.
 - i) Bioluminescence
 - ii) Luminescence
 - iii) Chemiluminescence
 - iv) Electroluminescence
- b) P-doping of conducting polymer is done by
 - i) I_2
 - ii) Na
 - iii) Li
 - iv) $SnCl_2$
- c) Nanomaterials are the materials in which size of particles ranges from
 - i) 1 nm - 100 nm
 - ii) 1 cm - 100 cm
 - iii) 1 mm - 100 mm
 - iv) 1 m - 100 m
- d) Catalyst used in shift reaction of H_2 production is
 - i) FeO
 - ii) Ni
 - iii) CH_3ONa
 - iv) None of these
- e) The relation between Gross and Net calorific value is
 - i) $GCV = NCV$
 - ii) $GCV > NCV$
 - iii) $GCV < NCV$
 - iv) None of these
- f) The detector used in UV-Visible spectrophotometer is
 - i) Phototube
 - ii) Photomultiplier tube
 - iii) Photovoltaic cell
 - iv) All of these

P.T.O.

- g) If absorption of molecule is shifted to wards longer wave length due to solvent effect is called as
- i) Hypsochromic shift ii) Hypochromic shift
 - iii) Bathochromic shift iv) Hyperchromic shift
- h) Bending vibrations are characterised by
- i) Change in bond angle between two covalent bonds
 - ii) Change in bond lenght between two covalent bonds
 - iii) Change in geometry of molecule
 - iv) No any change
- i) Galvanising is coating of
- i) Fe on Sn ii) Zn on Fe
 - iii) Sn on Fe iv) Fe on Zn
- j) Which type of reaction occur in anodic areas
- i) Oxidation ii) Reduction
 - iii) Displacement iv) Addition

- Q2) a)** What are Biodegradable polymers? Give the structure of PHBV. Explain three factors responsible for biodegradation. Give its any two applications. **[6]**
- b) What are carbon nanotubes? Discuss the different types of carbon nanotubes with respect to their structure. Give any two applications. **[5]**
- c) Give the structure, any two properties and two applications of polycarbonate. **[4]**

OR

- Q3) a)** Explain the structure of Graphene with the help of diagram and mention three properties and three applications. **[6]**
- b) Define polymer composites. What is the role of matrix phase and disperse phase in composites. Give any two advantages. **[5]**
- c) What are nanomaterials. Classify any three on the basis of dimensions. **[4]**

- Q4)** a) Give construction with figure, working and give corrected formula for finding gross calorific value of a solid fuel by Bomb calorimeter. [6]
 b) Give the preparation on reaction of Biodiesel. State three advantages of biodiesel. [5]
 c) 1.5 gm of coal sample in kjeldhal's experiment, librated ammonia which was absorbed in 25/ml 0.1N H_2SO_4 . The resultant solution required 14ml of 0.1N NaOH for complete neutralisation of H_2SO_4 . In back titration. The reading of blank titration was 25ml. Find the percent of nitrogen in coal. [4]

OR

- Q5)** a) Explain in brief the process with diagram for distillation of crude petroleum. Give composition, boiling range and uses of any two fractions obtained. [6]
 b) What is Power alcohol? Give any three merits and three demerits of power alcohol. [5]
 c) The following data was obtained in Boy's Jas calorimeter experiment. [4]
 i) Volume of gas burat at STP = $0.12m^3$
 ii) Mass of cooling water = 32kg
 iii) Rise in temperature of water = $7.8^\circ C$
 iv) Mass of steam condensed = 0.09kg
 Calculate GCV and NCV of the fuel

- Q6)** a) Draw the block diagram of IR spectrophotometer. Explain its four components and give their function. [6]
 b) Explain the possible electronic transitions that occure in the molecule after absorption of UV radiations with suitable examples and labelled diagram. [5]
 c) Explain any four applications of UV-Visible spectroscopy. [4]

OR

- Q7)** a) i) State and give mathematical expression of Beers and Lambert's law of absorption. [4]
 ii) Define- [2]
 1) Auxochrome
 2) Hypsochromic shift
 b) What are the conditions of IR radiations by the molecule? Explain the fundamental modes of streching vibrations. [5]
 c) Give the principle of IR spectroscopy. Calculate the fundamental modes of vibrations for the following molecules. [4]
 i) NO
 ii) H_2O
 iii) C_2H_6

- Q8)** a) State Pilling Bedworth ratio and give its significance. Give the different types of oxide films with suitable example formed during the oxidation corrosion of metals. [6]
- b) What is principle of cathodic protection? Explain the method involved using sacrificial anode and give its two applications. [5]
- c) What are anodic and cathodic coatings? Which one is more protective and why? [4]

OR

- Q9)** a) Explain the mechanism of wet corrosion by hydrogen evolution and oxygen absorption with diagram and reactions. [6]
- b) Explain any five factors affecting the rate of corrosion related to metal. [5]
- c) Define electroplating. Give the electroplating reactions with respect to the metals like Ag, Ni and Cr. [4]



Total No. of Questions : 8]

SEAT No. :

PD4028

[6401]-1905

[Total No. of Pages : 4

First Year Engineering (All Branches)

BASIC ELECTRICAL ENGINEERING

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) a) For the Resonance in RLC Series circuit-Comment on reactance's, impedance, current & power factor. **[4]**

b) The R-L circuit when supplied by 180V, 50 Hz ac voltage, the voltage drop across the inductance is 150 V. The current drawn by the circuit is 5 A. Calculate: **[6]**

- i) Inductive Reactance
- ii) Inductance
- iii) Resistance
- iv) Impedance
- v) Voltage across Resistance and
- vi) P.F.

c) A voltage of $V = V \angle 0^\circ$ is applied across a R-L-C series circuit. Write the equation for impedance, current & comment on power factor --- when **[8]**

- i) $X_L > X_C$
- ii) $X_L < X_C$

Also draw the phasor diagram in each case.

OR

P.T.O.

- Q2) a)** Define and state the unit of **[4]**
- i) Admittance, susceptance, & conductance
 - ii) Impedance
- b) If $v = V_m \sin(\omega t)$ is applied across single phase circuit and current flowing through the circuit is $i = I_m \sin\left(\omega t + \frac{\pi}{2}\right)$. Draw the circuit diagram & derive the expression for average power consumed in the circuit. **[6]**
- c) A Pure resistance of 15Ω is connected in series with a pure inductor of 25mH. This series circuit is connected across 230V, 50-Hz supply. Find **[8]**
- i) The Inductive Reactance
 - ii) Impedance
 - iii) Current
 - iv) Power factor
 - v) Phase angle
 - vi) Voltage across Resistor
 - vii) Voltage across inductor
 - viii) Draw the phasor diagram
- Q3) a)** State the advantages of three phase systems over single phase system. **[3]**
- b) Derive the EMF Equation of single-phase transformer. **[6]**
- c) In a 3-phase Star-connected load, each phase has a an impedance of $(50+j32)\Omega$. This load is fed from three phase supply voltage of 400 V with frequency of 50Hz. Calculate: **[8]**
- i) Phase Voltage and Line Voltage;
 - ii) Phase Current and Line Current;
 - iii) Total Active Power, Reactive Power and Apparent Power consumed.

OR

- Q4)** a) State the different types of losses in the transformer. [3]
- b) A 80 KVA, 3200/400V, 50Hz, single phase transformer has 111 turns on the secondary winding. Calculate [6]
- Number of turns on primary side
 - Primary & Secondary full load current
 - Cross sectional area of the core if the maximum flux density is 1.2T
- c) Derive the relationship between the line current and phase current, line voltage and phase voltage, for a balanced three phase STAR connected load across three phase AC supply. Draw the circuit diagram & required phasor diagram. Assume phase sequence RYB and inductive load. [8]
- Q5)** a) Compare the ideal & practical voltage source by means of [4]
- definition
 - Symbol & V-I characteristics.
- b) Write the three steps to find current flowing through load resistance R_L using Thevenins Theorem for the circuit shown in Figure-5 (b). [6]

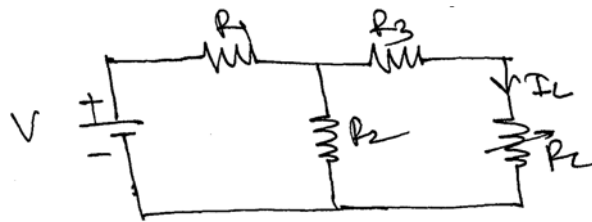


Figure-5 (b)

- c) Derive the formulae to convert DELTA connected resistances into equivalent STAR connected resistances. Draw the circuit diagram in each case. [8]

OR

- Q6)** a) State and Explain Kirchhoffs Laws. [4]
- b) Find the Resistance between terminal A and C. [6]

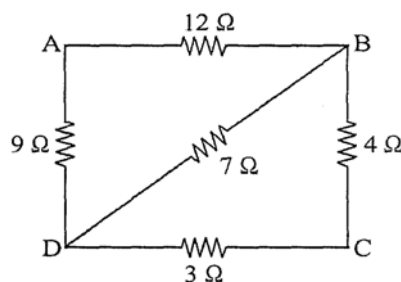


Figure-6 (b)

- c) Find the current flowing through $5\ \Omega$ by applying Super Position Theorem. [8]

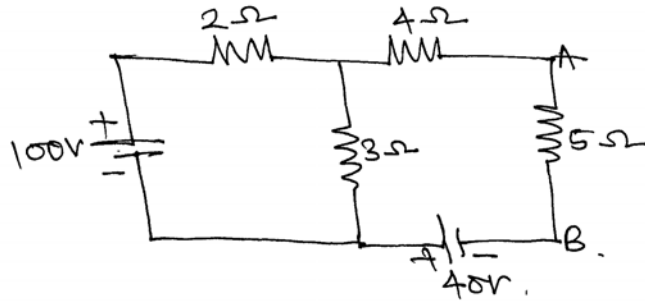


Figure 6 (c)

- Q7) a) Comment on effect of increase in temperature on Resistance of [3]

- i) metallic conductor
- ii) alloys &
- iii) insulators

- b) Explain the construction and working of Lead acid battery. [6]

- c) Derive the expression of insulation resistance of the single core cable. Draw the cut section diagram & label it. [8]

OR

- Q8) a) State the 3 applications of lithium ion battery. [3]

- b) With usual notations derive the expression [6]

$$\alpha_2 = \frac{\alpha_1}{1 + \alpha_1(t_2 - t_1)}$$

- c) Find the current flowing at the instant of switching 40 W , 240 V filament lamp. The temperature coefficient of resistance of filament is 5.5×10^{-3} .per degree Celsius at 20°C . The working temperature of lamp is 2000°C . Also find the working current & compare it with starting current. [8]

x x x

Total No. of Questions : 8]

SEAT No. :

PD4029

[6401]-1906

[Total No. of Pages : 2

F.E.

BASIC ELECTRONICS ENGINEERING

(2019 Pattern) (Credit System) (Semester - I/II) (104010)

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 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) $(10100.1011)_2$ to Decimal
 - ii) $(832.24)_{10}$ to Hexadecimal
 - iii) $(556.27)_8$ to Hexadecimal
 - iv) $(2C6.1B)_{16}$ to Octal
 - v) $(D43A.03)_{16}$ to Decimal
- b) Define Universal Logic Gates. Why they known as Universal Logic Gates?[6]
- c) Compare Microprocessor and Microcontroller. [6]

OR

Q2) a) State and prove De-Morgan's Theorems. [6]

- b) Explain in detail the working of a full adder with the help of a truth table, logic equations and diagram. [6]
- c) Explain different types of flip-flops and state one application of each.[6]

Q3) a) Explain Digital Multimeter with block diagram. [6]

- b) Explain Digital Storage Oscilloscope with block diagram. [6]
- c) Explain Auto Transformer and list its applications. [5]

OR

P.T.O.

- Q4)** a) Explain Function Generator with block diagram. [6]
b) Explain working of DC Power Supply with block diagram and waveforms. [6]
c) Explain how to convert Galvanometer to Analog Ammeter and how to use it as multi-range Ammeter? [5]

- Q5)** a) With the help of diagram, explain operation of LVDT. Write its advantages, disadvantages and applications. [6]
b) Explain RTD with its construction, working, advantages, disadvantages and applications. [6]
c) Explain working principle of strain gauge. Explain load cell. [5]

OR

- Q6)** a) Explain selection criteria of transducers. [6]
b) Explain Thermocouple with its construction, working, advantages, disadvantages and applications. [6]
c) Explain operation of Bio-sensor with one application. [5]

- Q7)** a) With the help of block diagram, explain basic communication system. [6]
b) Draw Block Diagram of AM Transmitter and explain. [6]
c) Draw diagram explain GSM architecture. [6]

OR

- Q8)** a) Explain need of modulation. What are the different techniques of modulation. [6]
b) Explain IEEE electromagnetic frequency spectrum and state allotment of frequency bands for different applications. [6]
c) Explain cellular communication system. [6]



[6401]-1907

F.E.

ENGINEERING MECHANICS

(2019 Pattern) (Credit System) (Semester - I/II) (101011)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

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

- Q1)** a) State and explain free body diagram with suitable sketch. [4]
- b) Determine the force in cable AB and AC as shown in Fig. 1 b, if the weight of crate is 550 N. [7]
- c) Determine the support reaction for a given beam loaded and supported as shown in Fig. 1 c. [7]

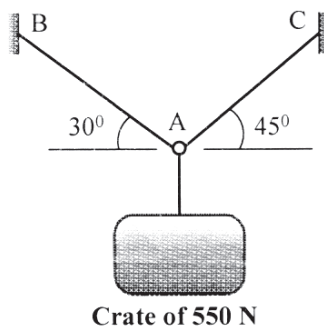


Fig. 1 b

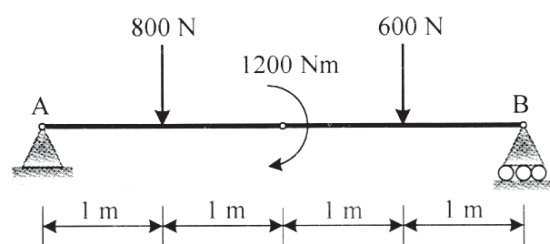


Fig. 1 c

OR

- Q2)** a) State and explain in brief resultant and equilibrant force. [4]
- b) A 3 m wooden beam weighing 540 N is supported as shown in Fig. 2 b. Find the reaction at A and tension in cable BC. [7]

P.T.O.

- c) Determine the resultant force of given parallel space force system as shown in Fig. 2 c. Also locate the position of resultant force with respect to origin O. [7]

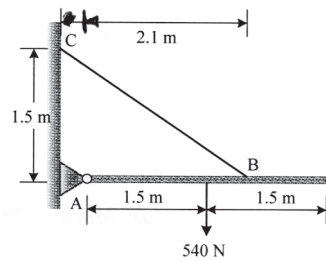


Fig. 2 b

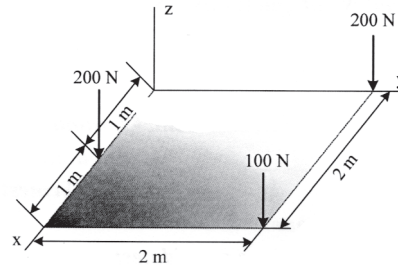


Fig. 2 c

- Q3) a) Differentiate pin jointed truss and cable with suitable sketch. [4]
 b) Determine the forces in the members of the pin jointed truss as shown in Fig. 3 b. [7]
 c) The cable segment supports the loading as shown in Fig. 3 c. Determine the component of reactions at A and B. Also find maximum tension in segment of the cable. [7]

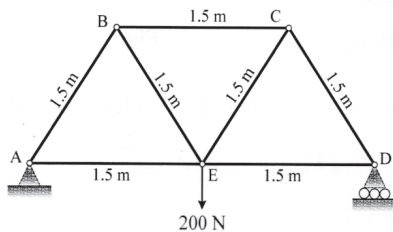


Fig. 3 b

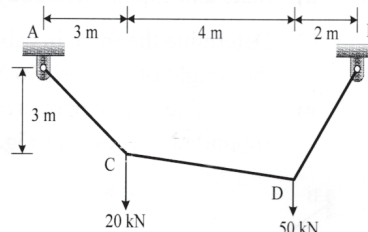


Fig. 3 c

OR

- Q4) a) Explain deficient, determinate and indeterminate truss. [4]
 b) The maximum tension is 100 N for the Cable profiles ABCD as shown in Fig 4 b. Determine the force P at B and C to keep the segment BC in horizontal position. [7]

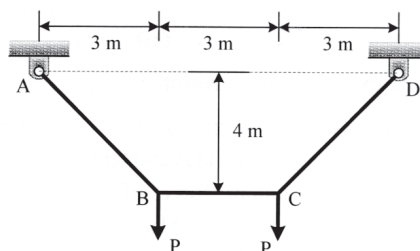


Fig. 4 b

- c) Determine the forces in the members BC, BE and AE of the truss as shown in Fig. 3 b. [7]

- Q5) a)** The motion of particle is defined by $x = t^3 - 6t^2 + 9t + 5$, where x is in meter and t in seconds. Find the time at which velocity is Zero. Also determine velocity and acceleration at $t = 5$ s. [5]
- b)** An outdoor track is 126 m in diameter. A runner increases her speed at a constant rate from 4.2 m/s to 7.2 m/s over a distance of 28.5 m. determine the total acceleration of the runner 2s after she begins to increase her speed. [6]
- c)** A cricket ball thrown by a fielder from a height of 2 m at an angle of 45° to the horizontal with an initial velocity of 25 m/s hit the wickets at the height of 0.6 m from the ground, find distance of fielder from the wickets. [6]

OR

- Q6) a)** A baseball is thrown downward from a 15 m tower with an initial speed of 5 m/s. Determine the speed at which it hits the ground and the time of travel. [5]
- b)** A particle moves in a circular path of radius 0.4 m. Calculate magnitude of acceleration of the particle if its speed is 0.6 m/s and it increasing at the rate of $a_t = 1.2 \text{ m/s}^2$. [6]
- c)** A golfer hits the golf ball from point A with an initial velocity of 50 m/s at an angle of 25° with the horizontal shown in Fig. 6 c. Determine the maximum horizontal distance $x_{\max}$ and maximum height $h_{\max}$ it attain. [6]

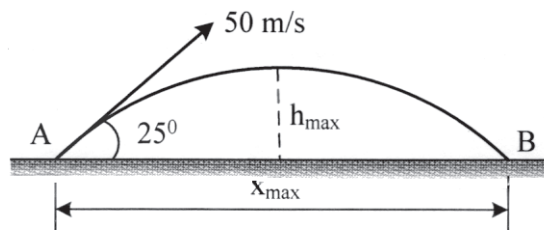


Fig. 6 c

- Q7) a)** A 150 kg car enters a curved portion of the road of radius 200 m travelling at a constant speed of 36 km/h. Determine the normal and tangential component of force at curved portion. [5]
- b)** A 2 kg stone is dropped from a height h and strike the ground with a velocity of 24 m/s. find the kinetic energy of the stone as it strikes the ground and the height h from which it was dropped using work energy method. [6]
- c)** A railroad car having a mass of 15 Mg is coasting at 1.5 m/s on a horizontal track. At the same time another car having a mass of 12 Mg is coasting at 0.75 m/s in the opposite direction. If the car meet and couple together, find the common speed of cars. [6]

OR

- Q8)** a) A tennis ball is dropped from a height 1600 mm and it rebounds to a height 1100 mm. Determine the coefficient of restitution. [5]
- b) A 50 kg crate shown in Fig. 8 b rests on a horizontal plane for which the coefficient of kinetic friction is $\mu_k = 0.3$. If the crate does not tip over when it is subjected to a 400 N towing force as shown, determine the velocity of the crate in 5 s starting from rest. [6]
- c) Determine the work done by all forces acting on the block of 18 kg as shown in Fig. 8 c as it moves 12 m upwards along the plane. Take coefficient of kinetic friction $\mu_k = 0.2$. [6]

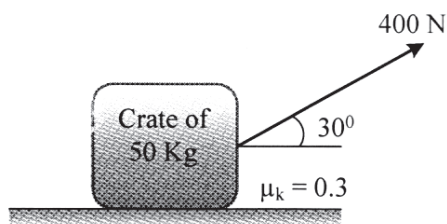


Fig. 8 b

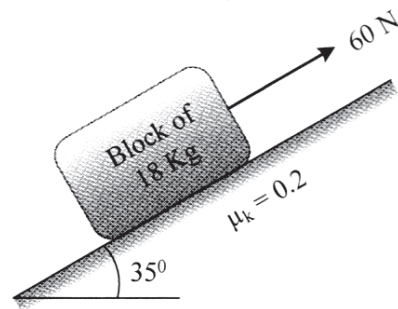


Fig. 8 c



Total No. of Questions : 8]

SEAT No. :

PD-4031

[Total No. of Pages : 3

[6401]-1908

F.E.

PROGRAMMING AND PROBLEM SOLVING
(2019 Pattern) (Semester - 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 wherever necessary.*
- 3) *Assume suitable data wherever necessary.*

- Q1)** a) Define a function with suitable function? Explain need for a function. [6]
- b) Differentiate between local and global variables. [6]
- c) Write a program using function to find largest of 3 numbers by passing numbers as arguments. [5]

OR

- Q2)** a) Explain the following types of function arguments with examples:[6]
- i) default arguments
 - ii) variable length arguments
- b) What are the modules and packages in python? Explain user defined module with suitable example. [6]
- c) Write a program to find square of a number using lambda function. [5]

- Q3)** a) Explain different ways of iterating a string. [6]
- b) Explain the following with suitable example. [6]
- i) ord() and chr() function
 - ii) in and not in operators on string

P.T.O.

- c) What is the output of the following statement for the given string?
S = "Learning Python is fun" [5]
- i) print(S[:10])
 - ii) print(S[::-1])
 - iii) print("Is" not in S)
 - iv) print(S[4])
 - v) print(S[0:10])

OR

- Q4)** a) Explain different ways of formatting a string. [6]
- b) Explain following string methods with example. [6]
- i) isspace()
 - ii) join()
 - iii) lower()
- c) Write a program to display a string and count characters in the string using a loop. [5]

- Q5)** a) What is programming paradigm? Explain the following Programming Paradigms in detail [6]
- i) Monolithic Programming
 - ii) Procedural Programming
- b) Explain the following concepts with example. [6]
- i) Object variable
 - ii) Class variable
- c) Write a python program to create a class Employee with the attributes Name, emp_id, and salary and display data of 4 employees. [6]

OR

- Q6)** a) Explain the following features : [6]
- i) Containership
 - ii) Inheritance
 - iii) Data Abstraction
- b) Explain class method and self-object with suitable example. [6]
- c) Write a program to create class Car with two attributes name and cost. Create two objects and display information. [6]

- Q7)** a) What is a file? Explain relative and absolute path of a file. [6]
- b) Explain the following file handling methods. [6]
- i) read(n)
 - ii) readlines()
 - iii) close()
- c) Explain the following file access modes [6]
- i) r
 - ii) w+
 - iii) ab+
 - iv) rb
 - v) a
 - vi) a+

OR

- Q8)** a) Explain any 3 directory methods with example. [6]
- b) Explain text and binary files with example. [6]
- c) Explain any 3 dictionary methods with example. [6]



Total No. of Questions : 9]

SEAT No. :

PD4032

[6401]-1909

[Total No. of Pages : 4

F.E.

ENGINEERING MATHEMATICS - II

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.1 is Compulsory.
- 2) Solve 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 :

a) $\int_0^{2\pi} \sin^6 t \, dt =$ [2]

i) $\frac{5\pi}{8}$

ii) $\frac{5\pi}{32}$

iii) $\frac{5}{4}$

iv) 0

b) The equation of asymptote parallel to x-axis to the curve represented by the equation $y(1+x^2) = x$ is [2]

i) $x = 0$

ii) $y = 0$

iii) $y = x$

iv) $x = 1, x = -1$

c) Centre (c) & radius (r) of the sphere $x^2 + y^2 + z^2 - 4x + 6y - 2z - 11 = 0$ is [2]

i) $c \equiv (2, 3, 1)$ & $r = 5$

ii) $c \equiv (2, 3, 1)$ & $r = \sqrt{14}$

iii) $c \equiv (2, -3, 1)$ & $r = 5$

iv) $c \equiv (2, -3, 1)$ & $r = \sqrt{14}$

P.T.O.

d) The value of the double integration $\int_0^1 \int_0^1 xy^2 \, dx dy$. [2]

i) $\frac{1}{4}$

ii) $\frac{1}{9}$

iii) $\frac{1}{2}$

iv) $\frac{1}{6}$

e) $\overline{n+1} =$ [1]

i) $(n+1)!$

ii) $(n-1)!$

iii) $(n+2)!$

iv) $n!$

f) The curve $r = 2a \sin \theta$ is symmetrical about [1]

i) Pole

ii) $\theta = 0$

iii) $\theta = \frac{\pi}{2}$

iv) $\theta = \frac{\pi}{4}$

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

b) Evaluate $\int_0^\infty x^2 e^{-h^2 x^2} \, dx$. [5]

c) Evaluate $\frac{d}{dx} \operatorname{erf}(ax^n)$. [5]

OR

Q3) a) If $I_n = \int_0^{\pi/2} \cos^n x \cos nx \, dx$, then prove that $I_n = \frac{1}{2} I_{n-1}$. [5]

b) Evaluate $\int_0^2 x(8-x^3)^{1/3} \, dx$. [5]

c) Show that $\int_0^\infty \frac{e^{-bx} \sin ax}{x} \, dx = \tan^{-1} \frac{a}{b}$. [5]

Q4) a) Trace the curve $x^2y^2 = a^2(u^2 - x^2)$. [5]

b) Trace the curve $r = a \sin 2\theta$. [5]

c) Trace the curve $x = a(t + \sin t)$, $y = a(1 + \cos t)$. [5]

OR

Q5) a) Trace the curve $y(x^2 + 4a^2) = 8a^3$. [5]

b) Trace the curve $r = a(1 - \cos \theta)$. [5]

c) Find the arc length of cardioide $r = a(1 + \cos \theta)$ which lies outside the circle $r + a \cos \theta = 0$. [5]

Q6) a) Prove that the sphere $x^2 + y^2 + z^2 + 2x - 4y - 2z - 3 = 0$ touch the plane $2x - 2y - z + 16 = 0$ and Find the point of contact. [5]

b) Find the equation of right circular cone with vertex at origin and axis as the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ & semivertical angle is 30° . [5]

c) Find the equation of right circular cylinder of radius '2', whose axis passes through (1, 2, 3) and has direction cosines proportional to 2, 1, 2. [5]

OR

Q7) a) Show that the sphere $x^2 + y^2 + z^2 - 10x - 10y - 2z + 2 = 0$ and $x^2 + y^2 + z^2 + 6x + 2y - 2z + 2 = 0$ touches externally. Also find the point of contact. [5]

b) Find the equation of right circular cone whose vertex at $(0, 0, 10)$ & whose intersection with XOY plane is a circle of radius '5'. [5]

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

Q8) a) Evaluate $\iint e^{-(x^2+y^2)} dx dy$ over the positive quadrant of the circle $x^2 + y^2 = a^2$. [5]

b) Find the area between the curve $y = (x-4)(x+2)$ and the x -axis. [5]

c) Find the centre of gravity of the area enclosed by the parabolas $y^2 = x$ and $x^2 = y$. [5]

OR

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

$$\int_0^\infty \int_y^\infty \frac{e^{-x}}{x} dx dy$$

b) Evaluate $\iiint \frac{dx dy dz}{1 + x^2 + y^2 + z^2}$ taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$ in the positive octant. [5]

c) Find the moment of inertia of one loop of the rose curve $r = a \cos 2\theta$ about initial line. (Given that density $\rho = \frac{8M}{a^2\pi}$, where M is Mass of the area). [5]



[6401]-1910

F.E.

ENGINEERING GRAPHICS

(2019 Pattern) (102012) (Semester - I/II)

Time : 2½ Hours]

[Max. Marks : 50

Instructions to the candidates:

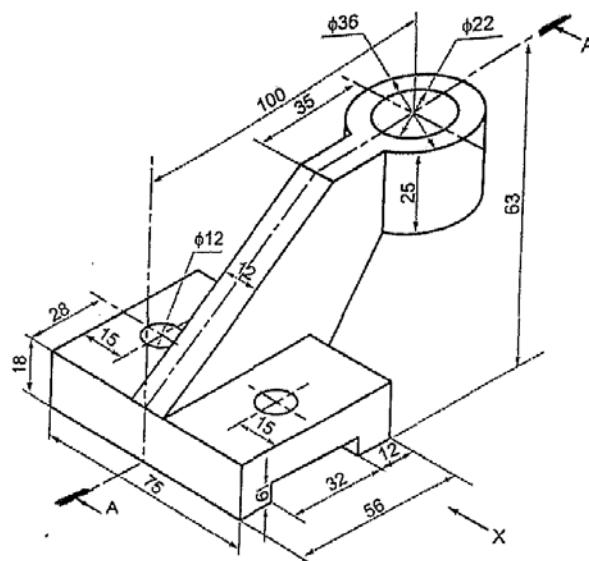
- 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Assume suitable data, if necessary.
- 3) Retain all the construction lines.

Q1) Draw an ellipse by rectangular method if the major axis and minor axis are 100mm and 70mm respectively. **[8]**

OR

Q2) Draw Involute of a circle having 50 mm diameter and String length is equal to the circumference of circle. **[8]**

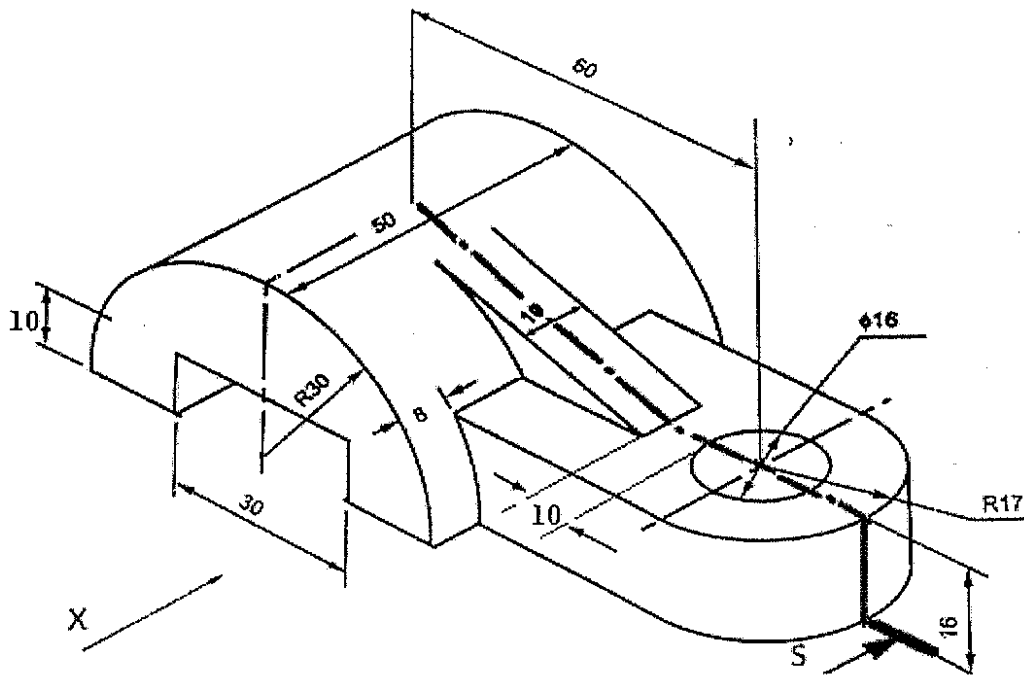
Q3) Figures shows a pictorial view of an object. By using first angle method of projection, draw sectional Front View in the direction of X, Top View and Left-Hand Side View. Give dimensions in all views. **[16]**



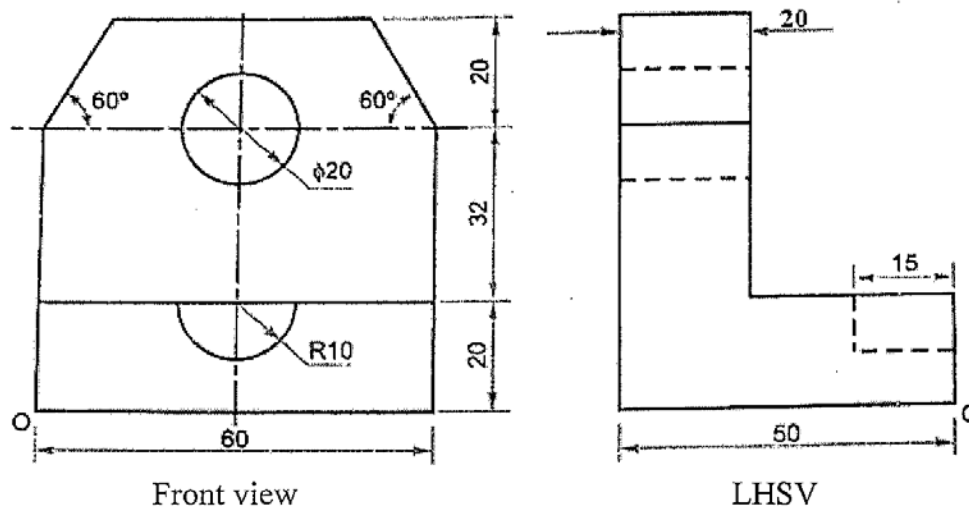
OR

Q4) Figure shows the pictorial view of an object. By first angle method of projection draw : [16]

- a) Sectional Front View in the X direction shown by S
- b) Top View
- c) Right-Hand Side View

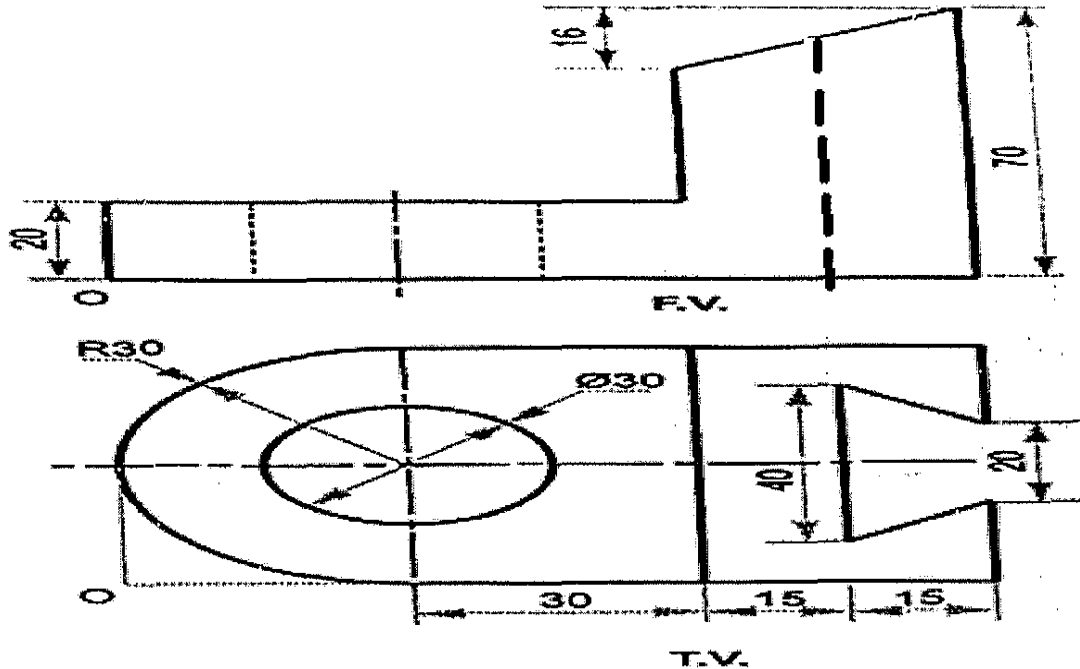


Q5) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. [16]



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) Draw the development of surface of the cone having base diameter 50 mm and axis height 70 mm. If it is cut by cutting plane which bisects the axis of the cone and inclined at 45° with HP. [10]

OR

- Q8) Draw the development of lateral surface of pentagonal prism of base side 35 mm & axis height 80 mm, has its one side of base is parallel to VP and corner is nearer to observer. It is cut by a cutting plane which is inclined at 30° to the HP and bisecting the axis of cylinder. [10]



[6401]-2401

F.E.

BSC-101-BES : ENGINEERING MATHEMATICS - I
(2024 Credit Pattern) (Semester - I)

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 Q.10 or Q.11.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Assume suitable data, if necessary.
- 5) Use of electronic pocket calculator is allowed.

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

- a) Stationary point for the function $x^2 + y^2 + 6x + 12$ to be minimized is _____ [2]
- i) (1, 0) ii) (3, 0)
iii) (-3, 0) iv) (0,0)
- b) In the expansion of $\log(1 + e^x)$ in ascending powers of x , the coefficient of ' x ' is _____ [2]
- i) 1 ii) $\frac{1}{2}$
iii) $\frac{1}{4}$ iv) 0
- c) If $u = \frac{x^2 + y^2}{x + y}$ then the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ is _____ [2]
- i) u ii) $2u$
iii) 0 iv) $3u$
- d) If $A = \begin{bmatrix} 2 & -1 & -1 \\ 1 & 2 & 1 \\ 4 & -7 & -5 \end{bmatrix}$ then the rank of A is _____ [2]
- i) 3 ii) 2
iii) 1 iv) 0

P.T.O.

e) If A is an $n \times n$ matrix with eigen values $\lambda_1, \lambda_2, \dots, \lambda_n$ the determinant of A is given by [1]

- i) $\lambda_1 + \lambda_2 + \dots + \lambda_n$
- ii) the largest eigen value of A.
- iii) the smallest eigen value of A.
- iv) $\lambda_1, \lambda_2, \dots, \lambda_n$

f) If A is 3×3 matrix with eigen values 2, 3 and 4, which of the following matrices is a diagonal matrix D in the diagonalization of A? [1]

i) $\begin{bmatrix} 2 & 3 & 4 \\ 0 & 0 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

ii) $\begin{bmatrix} 0 & 2 & 3 \\ 4 & 0 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

iii) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

iv) $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 2 & 3 & 4 \end{bmatrix}$

Q2) a) Verify Lagrange mean value theorem for the function $f(x) = \log x$ in the interval $[1, e]$. [4]

b) Find the fourier series for the function $f(x) = x$ in the interval $[-\pi, \pi]$.

c) Using Taylor's series expand $x^3 + 7x^2 + x - 6$ in ascending powers of $(x - 3)$. [4]

OR

Q3) a) Expand the function $\sqrt{1 + \sin x}$ up to the term containing x^4 . [4]

b) Using Lagrange mean value theorem, prove that

$$\frac{b-a}{\sqrt{1-a^2}} < \sin^{-1} b - \sin^{-1} a < \frac{b-a}{\sqrt{1-b^2}}. \quad [4]$$

c) If $f(x) = x^2$, $0 < x < 2$ then find the half range cosine series. [4]

OR

Q4) a) If $u = \tan^{-1}\left(\frac{x}{y}\right)$ verify $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$. [4]

b) If $u = \sin^{-1} \sqrt{x^2 + y^2}$ then prove that $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \tan^3 u$. [4]

c) If $z = f(x, y)$, where $x = e^u + e^{-v}$, $y = e^{-u} - e^v$, then prove that

$$\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x \frac{\partial z}{\partial x} - y \frac{\partial z}{\partial y}$$
 [4]

OR

Q5) a) If $x = r \cos \theta$, $y = r \sin \theta$ [4]

Show that $\left[x \left(\frac{\partial x}{\partial r} \right)_\theta + y \left(\frac{\partial y}{\partial r} \right)_\theta \right]^2 = x^2 + y^2$

b) If $u = \operatorname{cosec}^{-1} \sqrt{\frac{x^{1/2} + y^{1/2}}{x^{1/3} + y^{1/3}}}$, then show that [4]

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{\tan u}{12} \left(\frac{13}{12} + \frac{\tan^2 u}{12} \right).$$

c) If $u = f(x^2 - y^2, y^2 - z^2, z^2 - x^2)$, prove that $\frac{1}{x} \frac{\partial u}{\partial x} + \frac{1}{y} \frac{\partial u}{\partial y} + \frac{1}{z} \frac{\partial u}{\partial z} = 0$. [4]

Q6) a) Examine the functional dependence, if so find the relation between them

$$u = \frac{x+y}{1-xy}; \quad v = \tan^{-1} x + \tan^{-1} y$$
 [4]

b) If $x = \cos \theta - r \sin \theta$, $y = \sin \theta + r \cos \theta$ then find $\frac{\partial r}{\partial x}$. [4]

c) Discuss the maxima and minima of the function $f(x, y) = x^2 + 4y^2 - 4x - 8y + 20$. Also find the extreme value. [4]

Q7) a) Given $u = x^2 - y^2$, $v = 2xy$ where $x = r \cos \theta$, $y = r \sin \theta$. [4]

find $\frac{\partial(u, v)}{\partial(r, \theta)}$.

b) If the kinetic energy of a body is given by $T = \frac{mv^2}{2}$ and m changes from 49 to 49.5, v changes from 1600 to 1590 then find the change in kinetic energy. [4]

c) Find the points on the surface $z^2 = xy + 1$ nearest to origin, by using Lagrange's method. [4]

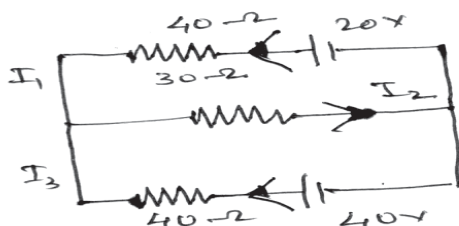
- Q8) a)** Determine values of k , for which following system have non-trivial solution $5x + 2y - 3z = 0$, $3x + y + z = 0$, $2x + y + kz = 0$. [4]
- b)** Examine for linear dependency of following set of vectors. If dependent, find relation between them $X_1 = (3, 1, 1)$, $X_2 = (2, 0, -1)$, $X_3 = (1, 1, 2)$. [4]

c) Show that $A = \begin{bmatrix} 1/\sqrt{2} & 0 & 1/\sqrt{2} \\ 0 & 1 & 0 \\ 1/\sqrt{2} & 0 & -1/\sqrt{2} \end{bmatrix}$ is orthogonal matrix and hence write A^{-1} .

[4]

OR

- Q9) a)** Examine for consistency and if consistent then solve $x + y + z = 1$, $x + 2y + 4z = 2$, $x + 4y + 10z = 4$. [4]
- b)** Examine for linear dependency of following set of vectors. If dependent find relation between them, $X_1 = (3, 1, -4)$, $X_2 = (2, 2, -3)$, $X_3 = (0, -4, 1)$. [4]
- c)** Determine the currents in the network given in the figure. [4]



- Q10)a)** Find eigen values and eigen vectors of matrix $A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$ [6]

- b)** Express the quadratic form $Q(x) = 2x^2 + 9y^2 + 6z^2 + 8xy + 8yz + 6zx$ to canonical form by congruent transformation. Write the corresponding linear transformation. [6]

OR

- Q11)a)** Find modal matrix p to reduce $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ to its diagonal form. [6]

- b)** By using Cayley-Hamilton theorem, find the inverse of the matrix

$$A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}, \text{ if it exists}$$

Also find A^4 .

[6]

* * *

Total No. of Questions : 11]

SEAT No. :

PD-4035

[Total No. of Pages : 4

[6401]-2402

F.E.

**BSC-102-BES : ENGINEERING PHYSICS
(2024 Pattern) (Semester - I/II)**

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, and Q.10 or Q.11.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable data, if necessary.*

Physical Constants :

- Mass of electron $m_e = 9.1 \times 10^{-31} \text{kg}$
- Charge on electron, $e = 1.6 \times 10^{-19} \text{ C}$
- Planck's constant, $h = 6.63 \times 10^{-34} \text{ J-sec}$

Q1) Choose the correct answer and rewrite it.

[10]

- i) Carbon dioxide laser emits wavelength in _____
 - a) Visible region
 - b) Ultraviolet region
 - c) Infrared region
 - d) None of the Above
- ii) In optical fiber, acceptance cone is _____ the acceptance angle
 - a) Equal
 - b) Double
 - c) Half
 - d) One Third
- iii) The mater waves are _____
 - a) Electromagnetic waves
 - b) Mechanical Waves
 - c) ultrasonic waves
 - d) Neither Electromagnetic nor Mechanical Waves

P.T.O.

- iv) Wave function Ψ of a particle is
 - a) a real quantity
 - b) a complex quantity
 - c) an imaginary quantity
 - d) none of these
- v) The points of constructive interference of light are,
 - a) Always bright
 - b) May be bright or dark
 - c) Always dark
 - d) Neither bright nor dark
- vi) The Plane-polarized light, vibrations of particles in medium are in the direction to direction propagation of light.
 - a) Parallel
 - b) perpendicular
 - c) Antiparallel
 - d) None
- vii) The energy band gap size for semiconductors is in the range__ eV.
 - a) 1-2
 - b) 2-3
 - c) 3-4
 - d) > 4
- viii) The Frequency range for ultrasonic is
 - a) less than 20Hz
 - b) 20 Hz to 20 KHz
 - c) Greater Than 20 KHz
 - d) None of the above
- ix) The minimum magnetic field required to destroy superconductivity is called _____
 - a) Critical magnetic field
 - b) Applied magnetic field
 - c) External magnetic field
 - d) None
- x) Nanotechnology studies for the size of particles
 - a) 100-1000 nm
 - b) more than 100 nm
 - c) 1-100 nm
 - d) None

Q2) a) With the help of an energy level diagram, explain the construction and working of CO₂ laser. [6]

b) Differentiate between step index and graded index fibers. (Any three points) [3]

c) Calculate the numerical aperture and acceptance angle of an optical fiber having $n_1 = 1.48$ and $n_2 = 1.45$ [3]

OR

- Q3)** a) What is attenuation in optical fibers? Discuss in brief the various internal and external factors responsible for attenuation. [6]
- b) State characteristics of a laser. Explain any one of them in brief. [3]
- c) What is stimulated emission? Explain its significance in the production of lasers. [3]

- Q4)** a) Starting from de Broglie equation, derive Schrodinger's Time Independent wave equation. [6]
- b) State de Broglie hypothesis. Derive the equation of de Broglie wavelength by analogy with radiation. [3]
- c) Lowest energy of an electron trapped in potential well is 38 eV. Calculate the width of well. [3]

OR

- Q5)** a) For a particle trapped in a one-dimensional rigid box, derive the equation for its energy. [6]
- b) Differentiate between classical and quantum computing (any three). [3]
- c) Compute the wavelength of the De Broglie waves associated with a proton moving at 5% of the velocity of light. Proton has 1836 times the mass of one electron. (Given: $m_e = 9.1 \times 10^{-31} \text{kg}$, $c = 3 \times 10^8 \text{m/s}$). [3]

- Q6)** a) Explain interference in thin parallel film in the reflected system with a neat & labelled diagram. Calculate the total path difference. Obtain the condition of maximum and minimum. [6]
- b) Differentiate between positive and negative crystal. [3]
- c) Obtain the intensity of light transmitted by the analyzer if the angle between the polarizer and analyzer is 45° . [3]

OR

- Q7)** a) What is double refraction? Explain Huygens' theory of double refraction. [6]
- b) Explain the application of interference as an antireflection coating. [3]
- c) The wedge-shaped film with a refractive index of 1.5, is illuminated by the light of wavelength $5890 \text{\AA}$. If the angle of the wedge is 30 seconds, Calculate the fringe width. [3]

- Q8)** a) With the help of a neat, labelled diagram, explain the Hall effect. Derive the equation of Hall voltage and Hall coefficient. [6]
- b) What are ultrasonic waves? State characteristics of ultrasonic wave. (any four) [3]
- c) An ultrasonic pulse is sent through a steel block, an echo is recorded after 1.512 microseconds, calculate the thickness of steel block if the velocity of ultrasonic waves is 5900 m/s. [3]

OR

- Q9)** a) What is an echo sounding technique? Using this technique explain the method for flaw detection using ultrasonic waves. [6]
- b) Define Fermi level for metal. Write the formula for Fermi-Dirac distribution function and explain terms involved in it. [3]
- c) In a semiconductor with a Hall coefficient of $145 \text{ cm}^3/\text{C}$ having a width of 2 cm and a thickness 0.2 cm with a magnetic field induction of 2T along the smaller dimension with a current of 150 mA. Calculate hall voltage. [3]

- Q10)a)** Explain the process of manufacturing nanoparticles using Physical Vapor Deposition. State advantages and limitations of this method. [6]
- b) What is Critical magnetic field? Write its equation and explain the terms involved in it. A superconductor has a critical temperature of 3.7 K. At 0 K the critical magnetic field is 0.0306 Tesla. What is the critical magnetic field at temperature 2 K. [6]

OR

- Q11)a)** Explain the Meissner effect. What is the cause of the Meissner effect? Show that superconductors exhibit perfect diamagnetism. [6]
- b) Explain electrical and optical properties of nanoparticles. [6]



Total No. of Questions : 11]

SEAT No. :

PD-4036

[Total No. of Pages : 4

[6401]-2403

F.E.

BSC-103-BES : ENGINEERING CHEMISTRY
(2024 Pattern) (Semester - I)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.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, Q.No.8 or Q.No.9, Q.No.10 or Q.No.11.*
- 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) Multiple Choice Questions :

- i) Temporary hardness is also known as _____. [1]
 - a) Non Carbonate hardness
 - b) Carbonate hardness
 - c) Total hardness
 - d) None alkaline hardness
- ii) EDTA method is used to determine hardness of water by _____ titration. [1]
 - a) Precipitation
 - b) Redox
 - c) Acid base
 - d) Complexometric
- iii) The rate in decrease of intensity of radiation is directly proportional the concentration of fixed path length of solution is the statement of _____. [1]
 - a) Beer's Law
 - b) Lamberts Law
 - c) Beer-Lamberts Law
 - d) None of these
- iv) When absorption maxima shifts towards longer wavelength, known as _____ shift. [1]
 - a) Hypsochromic
 - b) Hyperchromic
 - c) Hypochromic
 - d) Bathochromic

P.T.O.

- v) Which among the following is an example of Quantum dots? [1]
 a) K b) Cdse
 c) A_5F_5 d) Se
- vi) The oxidising reagent for P-doping is _____. [1]
 a) Iodine vapours b) $FeCl_2$
 c) Lithium metal d) Sodium naphthalide
- vii) Boys gas calorimeter is used for determination of GCV of _____. [1]
 a) Solid fuel b) Non volatile liquid
 c) Gaseous fuel d) None of above
- viii) Reaction taking place on the anodic areas is _____. [1]
 a) Oxidation b) Reduction
 c) Neutralisation d) Addition
- ix) Kjeldahls method is used for determination of _____ from coal. [1]
 a) Hydrogen b) Nitrogen
 c) Sulphur d) Carbon
- x) Which of the film is protective? [1]
 a) Non porous b) Porous
 c) Volatile d) None of the above

- Q2)** a) Explain the causes of scales in boiler. Give two disadvantages and two methods of prevention. [6]
 b) Define reverse Osmosis. Give its two advantages & two limitations. [3]
 c) 25 ml of hard water sample required 11.2 ml 0.01 MEDIA to reach the end point. 25 ml of the same water sample after boiling and filtration required 7.9 ml of the same EDTA to reach the end point. Calculate total, temporary and permanent hardness of water. [3]

OR

- Q3)** a) Explain Zeolite process for softening of water with figure, process, ion exchange and regeneration reaction, two advantages. [6]
 b) State the causes of foaming when it takes place in boiler and give remedial measures for its prevention. [3]
 c) 25 ml water sample requires 3.7ml of 0.01 $NHCl$ up to phenolphthalein end point and 7.4 ml upto methyl orange end point during the titration. Calculate types and amount of alkalinity present in water. [3]

- Q4)** a) Explain pH metric titration curve between strong acid and strong base. Give the reaction, titration curve and calculations. [6]
- b) Explain any three applications of UV-visible spectroscopy. [3]
- c) Give the composition of the membrane of the ion selective electrode used to detect [3]
- i) H^+
 - ii) F^-
 - iii) Cl^-

OR

- Q5)** a) Draw block diagram of Double beam UV-visible spectrophotometer. Explain its any four components and give their function. [6]
- b) Give the construction with neat, labeled diagram and representation of calomel electrode. [3]
- c) Define : [3]
- i) Cell constant
 - ii) Specific conductance
 - iii) Equivalent conductance
- Q6)** a) What is conducting polymer? Give structural requirement for conducting polymer. Explain doping reactions and given two applications. [6]
- b) What are quantum dots? Give any two types of quantum dots and its two applications. [3]
- c) What are carbon nanotubes? Give their types and two applications. [3]

OR

- Q7)** a) Explain the structure of Graphene with diagram and mention its four properties and two applications. [6]
- b) Define Biodegradable polymer. Discuss any two factors responsible for biodegradation of polymer. [3]
- c) Give the structure of polycarbonate. Mention its two properties and two applications. [3]

- Q8)** a) What is power alcohol? Give the procedure and reaction for preparation of ethanol. Give its two advantages and two disadvantages. [6]
- b) Give any three characteristics of an ideal fuel. [3]
- c) 1.2 gm of coal sample was heated in silica crucible in an electric oven at 110°C for 1 hr. The residue weighed 1.16 gm. The crucible was ignited to a constant weight of 0.09 gm. In another experiment 1.2 gm of sample was heated in a silica crucible covered with vented lid of 950°C for 7 min. After cooling the residue weighed 0.80 gm. Calculate % m, % VM and % Ash content. [3]

OR

- Q9)** a) Describe the construction and working of Bomb calorimeter with diagram for determination of GCV of fuel. State the formula to calculate GCV. [6]
- b) Explain the production of hydrogen by steam reforming of hydrocarbon (methane) with reaction conditions. [3]
- c) 0.24 gm of coal sample on complete combustion gave 0.792 gm of CO₂ and 0.0216 gm of H₂O. Calculate carbon and hydrogen percentage. [3]
- Q10)** a) Explain the mechanism of Dry corrosion with figure give the reaction and types of oxide film formed in Mg, Cr. [6]
- b) i) Define Electroplating. Give its two application and two disadvantages. [3]
- ii) Explain the cathodic protection by sacrificial anode for corrosion control and prevention. [3]

OR

- Q11)** a) Define wet corrosion. Give conditions for wet corrosion. Explain hydrogen evolution mechanism of wet corrosion with suitable example. [6]
- b) i) Discuss any three factors affecting rate of corrosion. [3]
- ii) What are anodic and cathodic coatings? Which is more protective? [3]



Total No. of Questions : 10]

SEAT No. :

PD-4037

[Total No. of Pages : 2

[6401]-2404

F.Y (Engineering)

ESC-101-ETC : BASIC ELECTRONICS ENGINEERING

(2024 Pattern) (Semester - I)

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) Assume suitable data, if necessary.
- 4) Use of electronic pocket calculator is allowed.

- Q1) a) Draw and Explain V-I Characteristics of PN junction Diode. [5]
b) Explain Impact of Electronics on Industry and Society. [5]
c) Write a short note on Active and Passive Components. [4]

OR

- Q2) a) Draw & Explain Circuit diagram of Half Wave Rectifier with waveforms. [5]
b) Explain construction & operation of Light Emitting Diode (LED). [5]
c) Draw and explain Diode as a Switch. [4]

- Q3) a) Draw and explain operation of Enhancement Type N channel MOSFET. [5]
b) Draw and Explain Output Characteristics of common emitter mode. [5]
c) Explain N-well method of VLSI CMOS manufacturing. [4]

OR

- Q4) a) Explain with a circuit diagram a Single Stage Common Emitter Amplifier. [5]
b) Compare BJT and MOSFET. [5]
c) Determine the dc current gain β (Beta) and Calculate value of I_C for BJT, if $I_B = 20 \mu A$ and $I_E = 2mA$. [4]

P.T.O.

- Q5) a)** Draw and Explain D flip flop with the help of Truth Table. [5]
b) State and prove De-Morgan's Theorem. [5]
c) Solve [4]
 i) Convert $(1101.101)_2$ into Decimal
 ii) Convert $(35.567)_{10}$ into Binary

OR

- Q6) a)** Explain the full Adder with the help of Block Diagram, Truth Table & Logic Expression. [5]
b) Draw and explain block diagram of Microprocessor. [5]
c) Draw and Explain JK flip flop with the help of Truth Table. [4]

- Q7) a)** Draw and explain the functional block diagram of an Operational amplifier (OP-AMP)? [5]
b) Draw and Explain Block Diagram of Digital Storage Oscilloscope (DSO). [5]
c) Define with typical & ideal values for IC 741, the following Operational amplifier (OP-AMP) parameters? [4]
 i) CMRR
 ii) Bandwidth

OR

- Q8) a)** Draw & Explain Block Diagram of Digital Multimeter (DMM). [5]
b) For the Non - Inverting amplifier using op-amp if $R_F = 10\text{ K}\Omega$, $R_1 = 1\text{ K}\Omega$, $V_{cc} = \pm 12\text{V}$, $V_i = 100\text{mv}$. Calculate Voltage gain & Output voltage. [5]
c) Explain Op amp application as an Inverting amplifier with the help of waveform. [4]

- Q9) a)** Draw & Explain block diagram of IoT based Data Acquisition System.[5]
b) With the help of block diagram, explain operation of Electronic Communication System. [5]
c) Compare Thermocouple and RTD. [4]

OR

- Q10)a)** Explain wired and wireless communication media. [5]
b) Explain the principle of operation, construction and working of LVDT.[5]
c) Draw and Explain detail architecture of GSM system. [4]



[6401]-2405

F.E.

**ESC-102-ELE : BASIC ELECTRICAL ENGINEERING
(2024 Pattern) (Semester - I)****Time : 2½ Hours]****[Max. Marks : 70****Instructions to the candidates:**

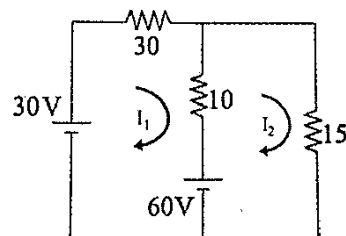
- 1) All questions are compulsory.
- 2) Attempt any one from each sub question.
- 3) Figures to the right indicate full marks.
- 4) Neat diagrams must be drawn wherever necessary.
- 5) Assume suitable additional data, if necessary.
- 6) Use of non-programmable calculator is allowed.

Q1) a) Attempt any One : [6]

- i) Derive the expressions for conversion of a delta connected resistive network into an equivalent star connected resistive network.
- ii) Define the following terms related with DC network
 - 1) Active Network
 - 2) Passive network
 - 3) Linear Network
 - 4) Non-Linear network
 - 5) Unilateral Network
 - 6) Bilateral network

b) Attempt any One : [8]

- i) State Kirchhoff's laws and find current flowing through 15Ω using loop current analysis method



- ii) State Superposition theorem and find current flowing through 15Ω resistance in above network, using Superposition theorem.

P.T.O.

- Q2) a) Attempt any One : [6]**
- i) Compare Magnetic and Electric Circuit clearly mentioning similarities and dissimilarities.
 - ii) Derive the expression for dynamically induced emf with suitable diagram.
- b) Attempt any One : [8]**
- i) Define MMF and Reluctance, An iron ring with mean circumference of 80 cm, cross sectional area of 15 cm^2 and relative permeability of 2000 wound with 160 turns coil. If the coil carries a current of 2.5 amp, then calculate MMF, magnetic field strength, reluctance, flux and flux density.
 - ii) State Flemings right hand rule. Two coils with 1250 and 1600 turns are placed side by side such that 60 % of the flux produced by first coil links with second coil. A magnetic flux of $60 \mu\text{Wb}$ and $80 \mu\text{Wb}$ is produced by each coil, when a current of 5A flows through them separately. Calculate self-inductance of each coil, mutual inductance and 'coefficient of coupling'.
- Q3) a) Attempt any One : [6]**
- i) Define average value and derive the expression for average value of sinusoidal current in terms of its maximum value.
 - ii) Obtain the expression for instantaneous power in case of purely inductive circuit and by using this expression, prove that this circuit never consumes power.
- b) Attempt any One : [8]**
- i) Define RMS value. A sinusoidal voltage with frequency of 50 Hz has RMS value of 200 V. Write the expression for its instantaneous value and find its instantaneous value at $t = 1.78 \text{ mSec}$ and time required to reach 100 V for first time from $t = 0$.
 - ii) Define inductive and capacitive reactance. A voltage of 230 volt is applied across inductance of 350mH and capacitance of $25\mu\text{F}$ independently. Calculate RMS and maximum value of current flowing through each element.

- Q4) a) Attempt any One : [6]**
- i) Derive the expression for average power in case of R-C series circuit. Draw voltage, current and power waveforms.
 - ii) Derive the relation between line current and phase current for three phase delta connected balanced R-L load.
- b) Attempt any One : [8]**
- i) Draw impedance triangle for R-L and R-C series circuit. Resistance of 15Ω , inductance of 200mH and capacitance of $150\ \mu\text{F}$ are connected in series across 230V , $50\ \text{Hz}$ single phase supply. Calculate impedance, current, power factor and power consumed.
 - ii) Define phase sequence and balanced load. Three phase star connected balanced load with impedance of $9+j12\ \Omega$ per phase is connected across 440V , $50\ \text{Hz}$ three phase supply. Calculate phase voltage, phase current, line current, active power and reactive power.
- Q5) a) Attempt any One : [6]**
- i) Draw torque-armature current, speed-armature current characteristics for DC Shunt and series motor. Give two applications of each motor.
 - ii) Explain the working principle of three phase Induction motor with suitable diagram. State two applications of squirrel cage and slip ring induction motor.
- b) Attempt any One : [8]**
- i) Define kVA rating of transformer. A $25\ \text{kVA}$, $50\ \text{Hz}$ single phase transformer has 500 turns on primary side and 50 turns on secondary side. A voltage of $3000\ \text{volt}$ is applied across primary winding. Calculate primary and secondary full load currents and cross-sectional area of core, if maximum flux density is $1.8\ \text{tesla}$.
 - ii) State, how eddy current and hysteresis loss can be minimized in case of single- phase transformer. 150kVA , $11000\text{V}/230\text{V}$, $50\ \text{Hz}$ single phase transformer has iron losses of $1400\ \text{watt}$ and full load copper losses of $1600\ \text{watt}$. Calculate the efficiency of transformer for full load at 0.707 power factor and for half of full load at 0.8 power factor.



Total No. of Questions : 10]

SEAT No. :

PD-4039

[Total No. of Pages : 4

[6401]-2406

F.E.

ESC-103-MEC : ENGINEERING GRAPHICS
(2024 Pattern) (Semester - I/II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Attempt Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9 or Q.10.*
- 2) *Figures to the right indicate full marks.*
- 3) *State clearly the assumptions made, if any.*
- 4) *Use of non-programmable calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

Q1) The end point P of line PQ is 25 mm above HP while its point Q is 15 mm in front of VP. Its plan and elevation makes 40° and 35° with XY respectively. Draw the projection, if the projector distance between the end points is 60 mm. Find inclination made by the line with HP and VP. [12]

OR

Q2) A line AB 70 mm long is inclined at an angle 30° to HP. Its end point A is 10 mm above HP and 15 mm in front of VP. Elevation length of the line is 45 mm. Draw the projections of line. [12]

Q3) An equilateral triangle of 60 mm side is resting on HP on one of its side. Then its surface is inclined with HP at an angle of 40° . Draw the projections of plane, if the resting side is inclined to VP at an angle of 30° . [12]

OR

Q4) A pentagonal plane of side 40 mm is resting on HP on its corner and the edge opposite to the corner makes an angle of 25° with VP. Surface of the plane, is inclined at 40° to HP. Draw the projections of the plane. [12]

P.T.O.

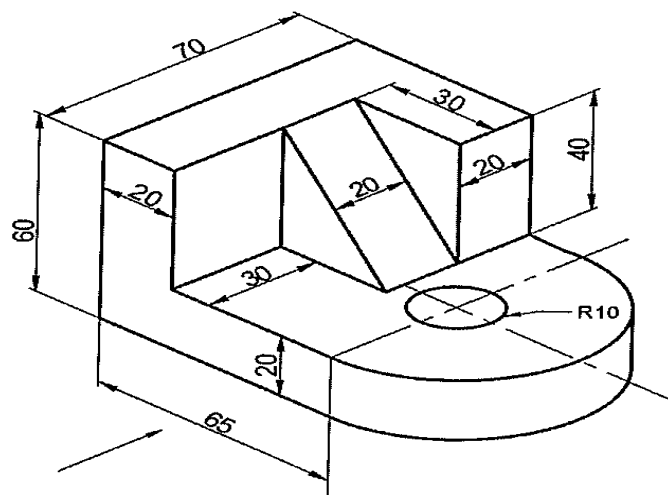
- Q5)** a) Draw the ellipse by focus directrix method if the distance from focus to directrix is 60 mm and the eccentricity ratio is $\frac{2}{3}$. [7]
- b) Draw the development of lateral surfaces of pentagonal prism of base side 30 mm and axis height 80 mm. [7]

OR

- Q6)** a) Draw the involute of circle of diameter 50mm. [7]
- b) Draw the development of lateral surface of cone of base diameter 50 mm and axis height 70 mm. [7]

Q7) Fig. shows a pictorial view of an object. Using first angle method of projection draw: [16]

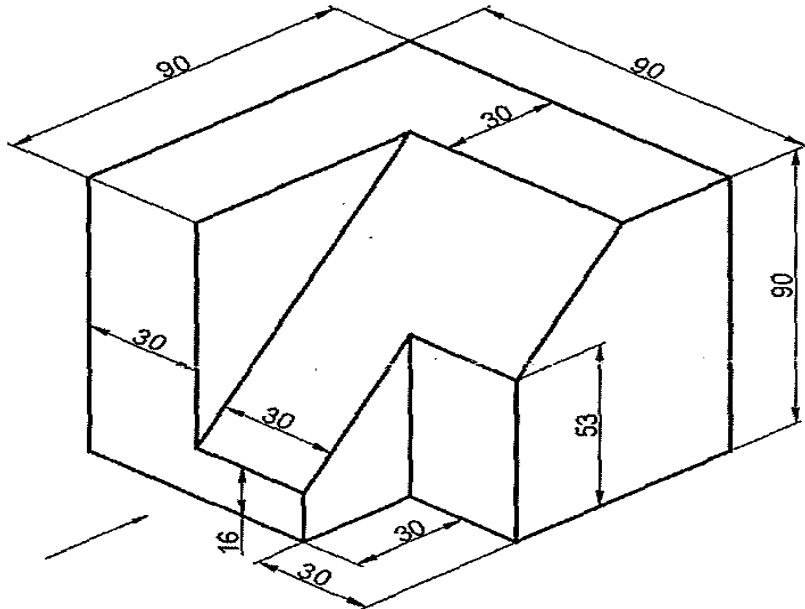
- a) Front View [5]
- b) Top View [5]
- c) Right Hand Side View [5]
- d) Give Dimensions [1]



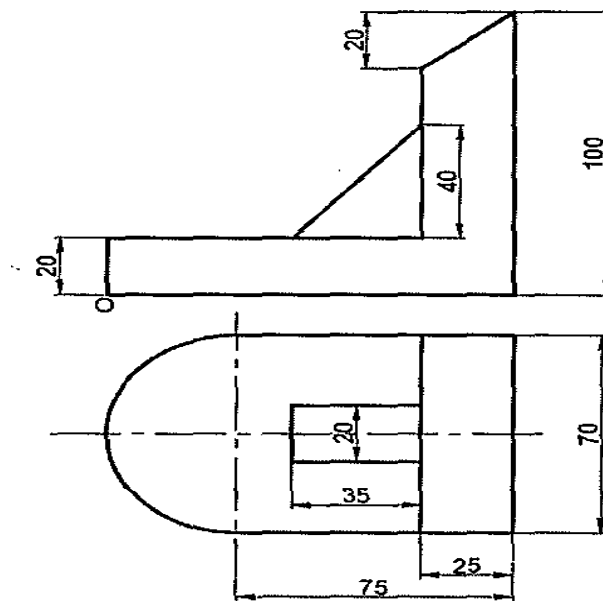
OR

Q8) Fig. shows a pictorial view of an object. Using first angle method of projection draw: [16]

- a) Front View [5]
- b) Top View [5]
- c) Right Hand Side View [5]
- d) Give Dimensions [1]

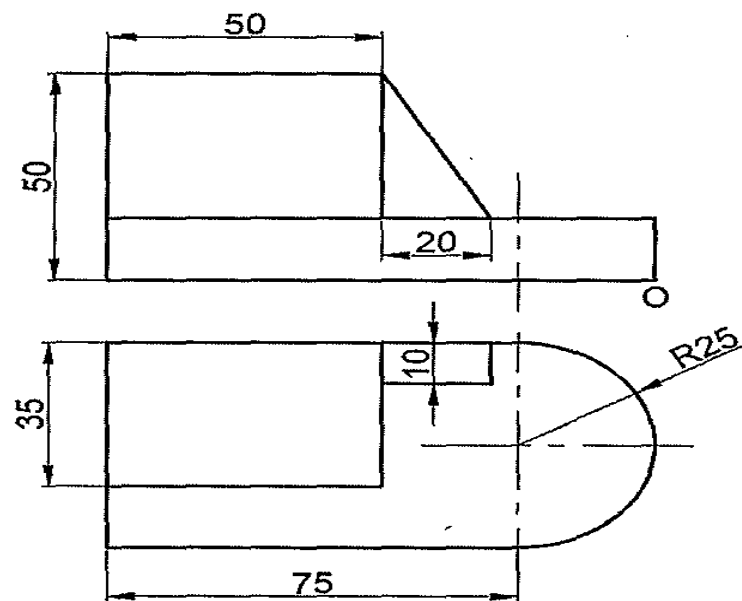


Q9) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view. [16]



OR

Q10) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view. [16]



Total No. of Questions : 6]

SEAT No. :

PD-4040

[Total No. of Pages : 6

[6401]-2407

F.E

**ESC-104-CVL : ENGINEERING MECHANICS
(2024 Pattern) (Semester - I)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *All questions are compulsory.*
- 2) *Neat sketches must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*
- 5) *Use of electronic pocket calculator is allowed.*
- 6) *Use of cell phone is prohibited in the examination hall.*

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

[5 × 2 = 10]

- i) The resultant magnitude of four forces 50 N, 100 N, 110 N and 180 N are acting along sides AB, BC, CD, and DA of a square ABCD is ____
 - a) 180 N
 - b) 100 N
 - c) 50 N
 - d) 110 N
- ii) A simply support beam of span 1 m is loaded with uniformly varying load of 10 N/m to 20 N/m from left to right end, find the reaction at left end support.
 - a) 6.67 Upward
 - b) 6.67 Downward
 - c) 8.33 Downward
 - d) 8.33 Upward
- iii) Find the maximum force P required to move a block of mass 800 N resting on a rough floor having $\mu_s = 0.25$.
 - a) 800 N
 - b) 200 N
 - c) 600 N
 - d) 400 N
- iv) A car is travelling along a rectilinear motion with initial velocity of 40 m/s undergoes an acceleration of 4 m/s², find the velocity after 10s.
 - a) 40 m/s
 - b) 60 m/s
 - c) 0 m/s²
 - d) 80 m/s
- v) The pendulum bob has a mass 10 kg and is released from rest when $\theta = 0$ with horizontal. If the length of cord is 1 m, determine the velocity of the bob at $\theta = 30^\circ$.
 - a) 4.12 m/s
 - b) 4.23 m/s
 - c) 3.13 m/s
 - d) 9.81 m/s

P.T.O.

Q2) Solve any two of the following :

- Find the resolve components of the force 300 N acting along the axis u and v as shown in **Fig. 2 a**. [6]
- Determine the magnitude F and the angle θ of force F as shown in **Fig. 2 b** so that the resultant of the three forces acting on the point O is zero. [6]

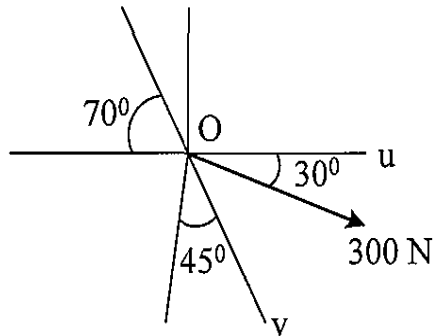


Fig. 2 a

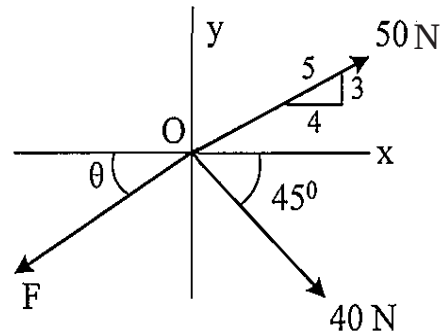


Fig. 2 b

- A 150×300 mm plate is subjected to four forces as shown in **Fig. 2c**. Determine the resultant of the four forces with respected to point F. [6]
- Locate the centroid of the shaded plane lamina with respect to origin O as shown in **Fig. 2 d**. [6]

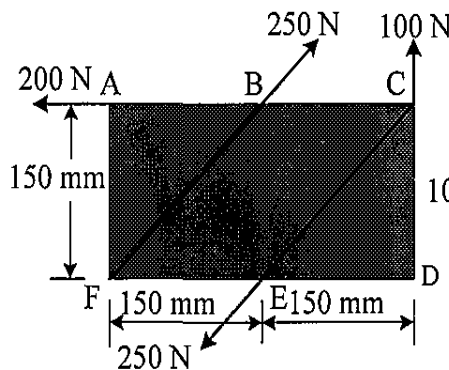


Fig. 2 c

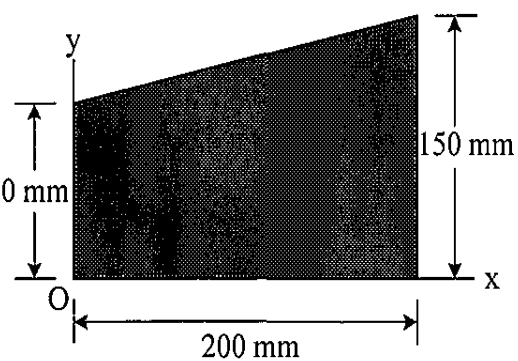


Fig. 2 d

Q3) Solve any two of the following :

- A 1.5 m cable placed around a crate as shown in **Fig. 3 a**. If the mass of the crate is 300 kg, determine the tension in the cable. [6]

- b) The wall crane is supported by smooth collar at B and pin at A as shown in **Fig. 3 b**. Determine the components of reaction at A and the horizontal reaction at B. [6]

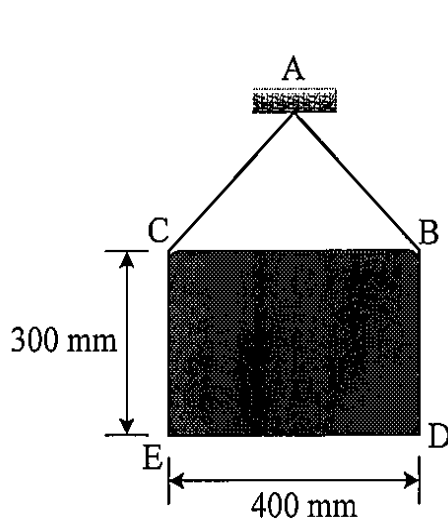


Fig. 3 a

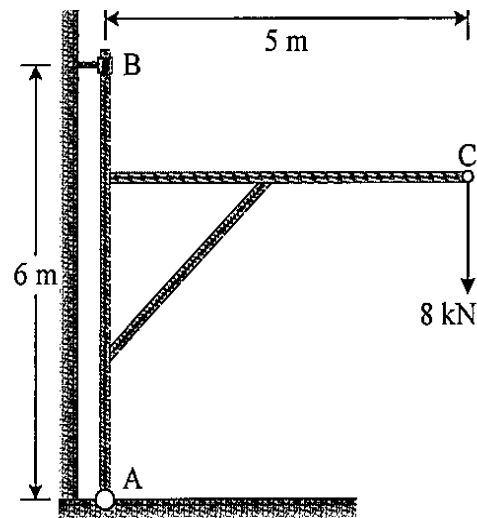


Fig. 3 b

- c) A cylinder of mass 100 kg rest between the inclined plane as shown in **Fig. 3 c**. Determine the normal reaction at A and B. [6]
- d) Determine the support reaction at A and B for the simply supported beam loaded and supported as shown in **Fig. 3 d**. [6]

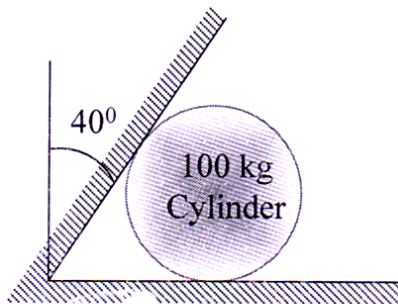


Fig. 3 c

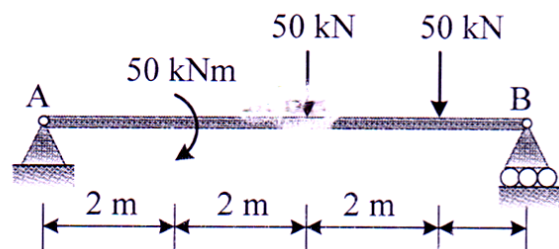


Fig. 3 d

Q4) Solve any two of the following :

- a) Determine the horizontal force P needed to just start moving the 30 kg block up the plane as shown in **Fig. 4 a**. Take $\mu_s = 0.25$ [6]

- b) A flexible cable which supports the 100 kg block is passed over a fixed circular drum shown in **Fig. 4 b** subjected to a force P to maintain equilibrium. If the coefficient of friction between the cable and drum is $\mu_s = 0.3$, determine the range of P . [6]

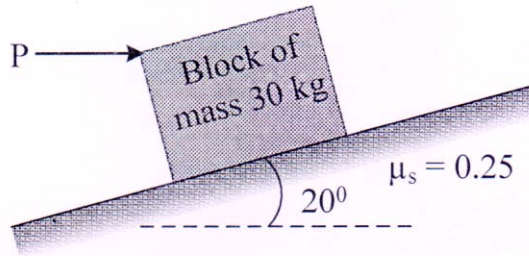


Fig. 4 a

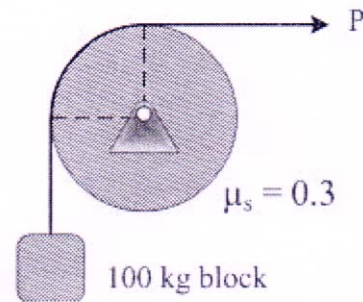


Fig. 4 b

- c) The 15 m ladder has a uniform weight of 80 N and rest against the smooth wall at B shown in **Fig. 4 c**. If the coefficient of statics friction at A is $\mu_A = 0.4$. Determine the smallest angle θ at which the ladder will not slip. [6]
- d) Determine the forces in each member of the truss in terms of external loading as shown in **Fig. 4 d**. [6]

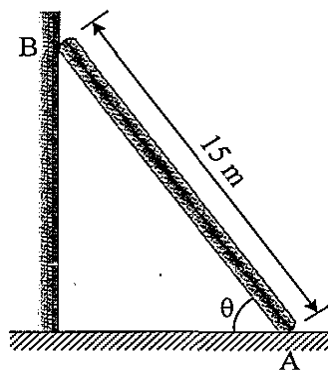


Fig. 4 c

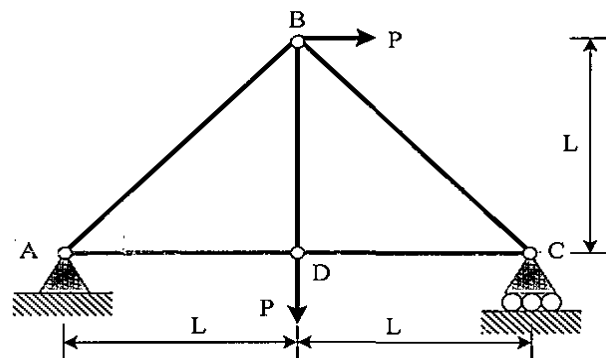


Fig. 4 d

Q5) Solve any two of the following :

- a) A motorist enters a freeway at 36 kmph and accelerate uniformly to 90 kmph. From the odometer in the car, the motorist knows that she traveled 0.2 km while accelerating. Determine a) the acceleration of the car and b) the time required reach 90 kmph. [6]
- b) The velocity of a particle is given by $v = 20t^2 - 100t + 50$, where v is in m/s and t is in seconds. Determine the velocity of particle when acceleration is zero. [6]

- c) Water flows from a drain spout with an initial velocity of 0.75 m/s at an angle of 75° with the vertical as shown in **Fig. 5 c**. Determine the range of values of the distance d for which the water will enter the trough BC. [6]

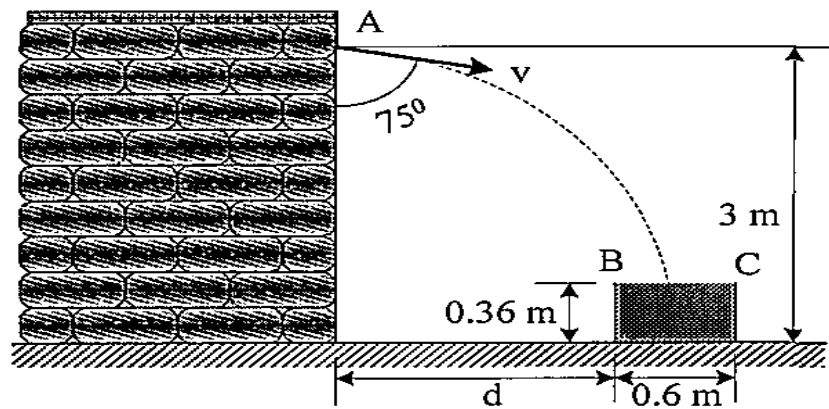


Fig. 5 c

- d) The truck travels at a speed of 4 m/s along a circular road that has a radius of 50 m . For a short distance from $s = 0$, its speed is then increased by $a_t = (0.05s) \text{ m/s}^2$, where s is in meters. Determine the speed and magnitude of its acceleration when it has moved $s = 10 \text{ m}$. [6]

Q6) Solve any two of the following :

- a) The initial velocity of the block at A is 9 m/s . The coefficient of kinetic friction between the block and the plane is $\mu_k = 0.30$ as shown in **Fig. 6 a**. Find the time it takes for the block to reach at B with zero velocity. [6]



Fig. 6 a

- b) A ball has a mass of 30 kg is thrown upward with a speed of 15 m/s . Determine the time and distance traveled by the ball before stopping. Use impulse momentum principle. [6]

- c) A woman having a mass of 70 kg stands in an elevator which has a downward acceleration of 4 m/s^2 starting from rest. Determine work done by her weight and the work of the normal force which the floor exerts on her when the elevator descends 6 m. [6]
- d) Disk A has a mass of 250 g and is sliding on a smooth horizontal surface with an initial velocity of 2 m/s. It makes direct collision with disk B, which has a mass of 175 g and is originally at rest as shown in **Fig 6 d**. If both disks are of the same size and the collision is perfectly elastic, determine the velocity of each disk just after collision. [6]

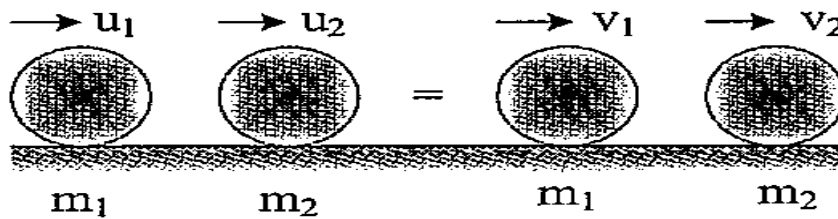


Fig 6 d



Total No. of Questions : 10]

SEAT No. :

PD4041

[Total No. of Pages : 2

[6401]-2408

F.E.

ESC-105-COM:FUNDAMENTALS OF PROGRAMMING LANGUAGES
(2024 Credit Pattern) (Semester - I/II)

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, Q.9 or Q.10.*
- 2) *Figure to the right indicates full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable data, if necessary.*

- Q1)** a) List the data types in C and provide one example of each. [3]
b) Define flowchart. Explain the symbols used in a flowchart. [3]
c) List the different C tokens and provide an example for each type. [4]
d) Explain symbolic constant with example. [4]

OR

- Q2)** a) Define the following terms: Constant and Variable. [3]
b) Define the following Storage classes in C: auto, extern and static. [3]
c) Explain the keywords in C programming and give examples of reserved keywords. [4]
d) Create a simple flowchart to depict the steps involved in calculating the area of a rectangle. [4]

- Q3)** a) What is arithmetic operator? Explain with example. [3]
b) List all the logical operators in C and provide an example of each. [3]
c) Explain conditional (ternary) operator (? :) in C. [4]
d) Explain with an example the usage of shorthand assignment operators. [4]

OR

- Q4)** a) What is special operator in C. Explain with an example. [3]
b) List any three bitwise operators in C and provide an example of each. [3]
c) Discuss the increment and decrement operator in C. [4]
d) Explain Operator Precedence in C? [4]

P.T.O.

- Q5)** a) Explain the difference between an if statement and an if-else statement with examples. [4]
b) Create a program that uses a switch statement to perform basic arithmetic operations (addition and subtraction) based on user input. [5]
c) Write a Program in C to print the first 10 even numbers using for loop. [5]

OR

- Q6)** a) Explain the syntax and usage of the goto statement in C with example. [4]
b) Explain break statement in loops with an example. [5]
c) Explain while loop with an example that prints numbers from 1 to 10. [5]

- Q7)** a) Explain how to declare and initialize a one-dimensional array in C, with an example. [4]
b) Compare the strcpy() and strncpy() functions. Give suitable example. [5]
c) Write a program to concatenate two strings using the strcat() function. [5]

OR

- Q8)** a) Explain how to declare and initialize a two-dimensional array in C, with an example. [4]
b) Explain the string functions- strcpy, strlen, strcmp, strncmp, strcat. [5]
c) Write a C Program to Check if a Given String is Palindrome. [5]

- Q9)** a) Explain built-in functions and user-defined functions in C programming. [4]
b) What is structure? Explain C syntax of structure declaration with example. [5]
c) Write a program to declare a structure for an employee with members for name, age and gender. Initialize the structure and print the values. [5]

OR

- Q10)** a) How do we define and call a function in C. [4]
b) How do you access structure members in C? Explain with an example. [5]
c) Write a C program for addition and subtraction of 2 numbers, using function. [5]



Total No. of Questions : 11]

SEAT No. :

PD-5274

[Total No. of Pages : 4

[6401]-2409

F.E.

BSC-151-BES : ENGINEERING MATHEMATICS - II
(2024 Pattern) (Semester - II)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 is compulsory. Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9, Q.10 or Q.11.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

Q1) Write the correct option.

a) The value of $\int_0^{\pi/2} \sin^4 x dx$ is [2]

i) $\frac{\pi}{2}$

ii) $\frac{3\pi}{8}$

iii) $\frac{3\pi}{16}$

iv) $\frac{\pi}{4}$

b) First loop of the curve $r = a \sin 3\theta$ is along [2]

i) $\theta = \frac{\pi}{4}$

ii) $\theta = 0$

iii) $\theta = \frac{\pi}{2}$

iv) $\theta = \frac{\pi}{6}$

P.T.O.

c) Area bounded by the curves $y = x^2$ and $y = x$ is **[2]**

i) $\frac{1}{6}$

ii) $\frac{1}{2}$

iii) $\frac{1}{3}$

iv) $\frac{1}{12}$

d) Integrating factor of the linear differential equation $\frac{dy}{dx} - \frac{y}{x} = \frac{-1}{x^2}$ is [2]

i) $\log x$

$$\text{ii)} \quad \frac{1}{x}$$

$$\text{iii)} \quad -\frac{1}{\lambda}$$

iv) χ

e) Maximum current $i_{\max}$ of R-L circuit is **[1]**

$$\text{i)} \quad \frac{E}{R}$$

ii) $\frac{R}{E}$

iii) ER

$$\text{iv)} \quad \frac{-E}{R}$$

f) The orthogonal trajectory of a family of curve that intersect each curve of the family at angle **[1]**

i) $\theta = 0^\circ$

ii) $\theta = 180^\circ$

iii) $\theta = 90^\circ$

iv) $\theta = 60^\circ$

Q2) a) Evaluate $\int_0^1 \frac{x^8}{\sqrt{1-x^2}} dx$ [4]

b) Evaluate $\int_0^{\infty} x^7 e^{-2x^2} dx$ [4]

c) Prove that $\int_0^1 \frac{x^a - 1}{\log x} dx = \log(1+a)$ $a \geq 0$ [4]

OR

Q3) a) Evaluate $\int_0^{\infty} \frac{x^2}{(1+x^2)^{7/2}} dx$ [4]

b) Evaluate $\int_0^1 x^3 (1-x)^5 dx$ [4]

c) Prove that $\int_0^{\infty} \frac{e^{-x} - e^{-ax}}{x \sec x} dx = \frac{1}{2} \log \left(\frac{a^2 + 1}{2} \right), a > 0$ [4]

Q4) a) Trace the curve $xy^2 = a^2(a-x)$ [4]

b) Trace the curve $r = a(1 + \cos \theta)$ [4]

c) Find the equation of sphere passing through the circle $x^2 + y^2 + z^2 = 4, z = 0$ meeting the plane $x + 2y + 2z = 0$ in a circle of radius 3. [4]

OR

Q5) a) Trace the curve $r = a \sin 2\theta$ [4]

b) Find the equation of the cone with vertex at $(1, 2, -3)$, semi-vertical angle $\cos^{-1} \frac{1}{\sqrt{3}}$ and the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z+1}{-1}$ as axis of the cone. [4]

c) Find the equation of right circular cylinder of radius 2 whose axis is given by $\frac{x-1}{2} = \frac{y+2}{3} = \frac{z-4}{6}$ [4]

Q6) a) Change the order of integration

$$\int_0^5 \int_{2-x}^{2+x} f(x, y) dx dy$$
 [6]

b) Find the volume bounded by the cylinder $x^2 + y^2 = 4$ and the plane $y + z = 4$ and $z = 0$ [6]

OR

Q7) a) Find the area of one loop of the curve $r = a \cos 2\theta$ [6]

b) Find the centre of gravity of the area bounded by $y^2 = x$ and $x + y = 2$. [6]

- Q8)** a) Solve $(2x - y) dx = (x - y) dy$ [4]
 b) Solve $(x - y^2) dx + 2xy dy = 0$ [4]
 c) Solve $\frac{dy}{dx} = y \tan x - y^2 \sec x$ [4]

OR

- Q9)** a) Solve $x^2 y dx - (x^3 + y^3) dy = 0$ [4]
 b) Solve $x \frac{dy}{dx} + y = x^3 y^6$ [4]
 c) Solve $e^y \frac{dy}{dx} + e^{x+y} = e^{2x}$ [4]

- Q10)** a) A body originally at 80°C cools to 60°C in 20 minutes and the temperature of air being 40°C . What will be the temperature of the body after 40 minutes [4]
 b) A body of mass m falling from rest is subjected to the force of gravity and an air resistance proportional to the square of the velocity (KV^2). If it falls through a distance ' x ' and possesses a velocity ' v ' at that instant, prove that $\frac{2kx}{m} = \log\left(\frac{a^2}{a^2 - v^2}\right)$ where $mg = ka^2$ [4]
 c) A resistance of 100Ω , an inductance of 0.5 henry are connected in series with a battery of 20 volts. Find the current in a circuit as a function of t . [4]

OR

- Q11)** a) A circuit consistant of resistance ' R ' ohm and a condensor of ' c ' farads connected to a constant e.m.f. If $\frac{q}{c}$ is the voltage of the condensor at time ' t ' after closing the circuit. Show that the voltage at time t is $E(1 - e^{-t/Rc})$. [4]
 b) A bullet is fired into a sand tank. It's retardation is proportional to square root of it's velocity. Show that the bullet will come to rest in time $\frac{2\sqrt{V}}{K}$ where V is initial velocity. [4]
 c) A pipe 10 cm in diameter contains a steam at 100°C . It is covered with asbestos 5 cm thick for which $K = 0.006$ and the outside temperature is at 30°C . Find the amount of heat lost per hour from a meter long pipe. [4]



Total No. of Questions : 10]

SEAT No. :

PD-5300

[Total No. of Pages : 3

[6401]-2410
F.E. (BOS-IT)
(PCC-151-ITT): Programming and Problem Solving
(2024 Credit Pattern) (Semester - I/II)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidate:

- 1) *Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Assume suitable data if necessary.*

- Q1)** a) What are the types of problems? Explain in detail. [3]
- b) Explain brief history of python programming language and list different software developed in python. [3]
- c) Describe object oriented programming features. [4]
- d) Define problem solving. Write down steps of problem solving process.[4]

OR

- Q2)** a) Describe flowchart and symbols in detail. [3]
- b) Write down the applications of python programming languages. [3]
- c) Explain the python programming features. [4]
- d) Describe TOP-DOWN design approach in detail. [4]

P.T.O.

- Q3)** a) List down all the advanced data types in python & Explain any two. [3]
- b) Describe the following terms with examples (any three): [3]
- i) break ii) continue iii) pass iv) range
- c) Implement a program in python to check whether a number entered by user is positive, negative, or zero [4]
- d) Explain decision control statements in python in detail. [4]

OR

- Q4)** a) Explain different arithmetic operators with suitable example [3]
- b) Write down the difference between for loop and while loop. [3]
- c) Develop a python program to check whether a given number is even or odd. [4]
- d) What is the dictionary data type? Explain any 3 operations of the dictionary data type. [4]
- Q5)** a) Compare Regular functions and lambda functions in python with suitable examples. [4]
- b) Describe the use of the return statement in functions with example. [5]
- c) Develop an algorithm & program to concatenate two strings using + operator. [5]

OR

- Q6)** a) Analyze the difference between ord () and chr () functions with examples. [4]
- b) Explain the concepts of variable scope (local and global) and lifetime in python with suitable code examples. [5]
- c) Implement program to reverse a string using user defined function. [5]

- Q7)** a) Describe the purpose & use of file handling. [4]
- b) Differentiate between mutable and immutable data types with focus on dictionaries in python. Provide examples. [5]
- c) Implement a program to append data to an already existing file. [5]

OR

- Q8)** a) Explain different types of files in detail. [4]
- b) Explain key directory methods: mkdir (), rmdir (), listdir (), and chdir () with syntax and usage example. [5]
- c) Develop a program to print the absolute path of a file using OS. path. join. [5]
- Q9)** a) Differentiate between class variables and object variables with an example. [4]
- b) Analyze the significance of garbage collection in python how does python handle object destruction? [5]
- c) Describe classes and objects in detail. [5]

OR

- Q10)** a) Explain the role of __init__ () and __del__ () methods in object lifecycle. [4]
- b) Distinguish between public and private members of a class with proper examples. [5]
- c) Describe data abstraction & Encapsulation in detail. [5]

