

Total No. of Questions : 9]

SEAT No. :

P6485

[Total No. of Pages : 4

[5868]-101

F.E. (Semester- I & II)

ENGINEERING MATHEMATICS - I

(2019 Pattern) (107001)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q. 1 is compulsory.*
- 2) *Attempt Q2 or Q3, Q4 or Q5, Q6 or Q7, Q8 or Q9.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

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

- a) If eigen value of a square matrix A is zero then. [1]
i) A is non-singular ii) A is orthogonal
iii) A is singular iv) None of these
- b) If $u = y^x$ then $\frac{\partial u}{\partial x}$ is equal to [1]
i) 0 ii) xy^{x-1}
iii) $y^x \log y$ iv) None of these
- c) The orthogonal transformation $x = py$ transforms the quadratic form $Q = x_1^2 + 3x_2^2 + 3x_3^2 - 2x_2x_3$ to the canonical form $Q' = y_1^2 + 2y_2^2 + y_3^2$.
The rank of quadratic form is [2]
i) 2 ii) 3
iii) 1 iv) 0
- d) $u = \sec^{-1} \left[\frac{x^2 + y^2}{xy^2} \right]$. Find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ [2]
i) $-\tan u$ ii) $-\cot u$
iii) $\tan u$ iv) $\cot u$

P.T.O.

- e) If $u = x^2 - y^2$ and $v = 2xy$ then the value of $\frac{\partial(u, v)}{\partial(x, y)}$ is [2]
- i) $4(x^2 + y^2)$
 - ii) $-4(x^2 + y^2)$
 - iii) $4(x^2 - y^2)$
 - iv) 0
- f) A system of linear equations $Ax = B$, where B is a null (zero) matrix is [2]
- i) Always consistent
 - ii) Consistent only if $|A| = 0$
 - iii) Consistent only if $|A| \neq 0$
 - iv) Inconsistent if $\rho(A) < \text{No. of variables}$

Q2) a) If $z = \tan(y + ax) + (y - ax)^{3/2}$ find value of $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}$. [5]

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

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = (1 - 4 \sin^2 u) \sin 2u \quad [5]$$

c) If $u = f(x^2 - y^2; y^2 - z^2; z^2 - x^2)$ find value of $\frac{1}{x} \frac{\partial u}{\partial x} + \frac{1}{y} \frac{\partial u}{\partial y} + \frac{1}{z} \frac{\partial u}{\partial z}$ [5]

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 $u = \sin^{-1}(\sqrt{x^2 + y^2})$ then find value of $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ [5]

c) If $u = f(r, s)$ where $r = x^2 + y^2; s = x^2 - y^2$ then show that

$$y \frac{\partial u}{\partial x} + x \frac{\partial u}{\partial y} = 4xy \frac{\partial u}{\partial r}. \quad [5]$$

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

- b) Examine for functional dependence $u = \frac{x-y}{1+xy}, v = \tan^{-1} x - \tan^{-1} y$ and if dependent find the relation between them. [5]
- c) Discuss maxima and minima of $f(x,y) = x^2 + y^2 + 6x + 12$ [5]
OR

Q5) a) Prove $JJ' = 1$ for $x = u \cos v, y = u \sin v$. [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) Find maximum value of $u = x^2 y^3 z^4$ such that $2x + 3y + 4z = a$ by Langrange's method. [5]

Q6) a) Investigate for what values of μ & λ the equations $x+y+z = 6, x+2y+3z = 10, x+2y+\lambda z = \mu$ have i) No solution ii) Infinitely many solutions. [5]

- b) Examine for linear dependence and independence the vectors $(1,1,3), (1,2,4), (1,0,2)$. If dependent, find the relation between them. [5]

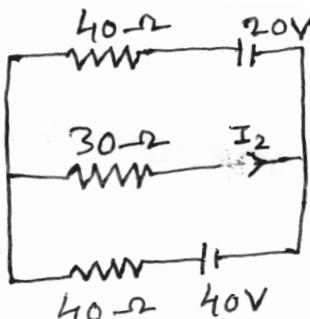
c) Verify whether matrix $A = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$ is orthogonal or not. [5]

OR

Q7) a) Solve the system of equations $x+y+2z = 0, x+2y+3z=0, x+3y+4z=0$. [5]

- b) Examine following vectors for linear dependence and independence $(1,-1,1), (2,1,1), (3,0,2)$. If dependent, find the relation between them. [5]

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



Q8) a) Find the eigen values of the matrix $A = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$. [5]

Find eigen vector corresponding to the highest eigen value.

b) Verify cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$. Hence find A^{-1} if it exists. [5]

c) Find the modal matrix p which diagonalises $A = \begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix}$. [5]

OR

Q9) a) Find the eigen values of $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$. [5]

Find eigen vector corresponding to the highest eigen value.

b) Verify cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ [5]

c) Reduce the quadratic form $Q = x_1^2 + 2x_2^2 + x_3^2 + 2x_2x_3 - 2x_3x_1 + 2x_1x_2$ to canonical form by congruent transformations. [5]



Total No. of Questions : 09]

SEAT No. :

P6486

[Total No. of Pages : 4

[5868]-102
F.E. (Semester - II)
Engineering Physics
(2019 Pattern) (Paper - II) (107002)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No. 1 is compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.*
- 5) *Assume suitable data, if necessary.*

Physical Constants :-

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

Q1) Write the correct option with answer for the following : [10]

i) The wavelength λ associated with a particle of mass m moving with velocity v is given by

a) $\lambda = \frac{h}{mv}$ b) $\lambda = \frac{mv}{h}$

c) $\lambda = \frac{hv}{m}$ d) $\lambda = \frac{m}{hv}$

ii) The equation of motion of matter wave was derived by

- a) Heisenberg b) Bohr
c) De Broglie d) Schrodinger

iii) In metals the band gap energy / forbidden energy gap is

- a) 0 eV b) 0.7 eV
c) 1.12 eV d) > 5 eV

P.T.O.

- iv) A solar cell work on the principle of
- Photoelectric effect
 - Photoluminescence effect
 - Photovoltaic effect
 - Photocombustion effect
- v) The relative permeability can be expressed by
- $\mu_r = 1 + \mu_0$
 - $\mu_r = 1 + x$
 - $\mu_r = \frac{x}{\mu_0}$
 - $\mu_r = \mu_0 + \mu_a$
- vi) Superconductivity is the phenomenon in which _____ of materials suddenly disappears below critical temperature.
- Capacitance
 - Conductivity
 - Inductance
 - Resistance
- vii) Ultrasonic waves have frequency
- Less than 20 Hz
 - 20 Hz to 20 kHz
 - Greater than 20 kHz
 - None of the above
- viii) In nanomaterials which of the following statement is correct.
- Surface to volume ratio is very small
 - Surface to volume ratio is large
 - Surface to volume ratio is 1 (unity)
 - None of the above

- Q2)** a) Derive an equation for energy of a particle enclosed in 1D rigid box or in an infinite potential well. [6]
- b) What is wave function Ψ ? Write mathematical conditions of well behaved wave function. [5]
- c) An electron is accelerated by a potential difference of 10 kV. What is De Broglie wavelength associated with this electron. [4]

OR

- Q3)** a) Starting from De Broglie hypothesis, derive Schrodinger's time independent wave equation. [6]
- b) State Heisenberg's Uncertainly principle. Explain it using the concept of narrow and broad wave packet. [5]
- c) Lowest energy of an electron in a potential well is 38 eV. Calculate the width of well. [4]

- Q4)** a) Derive an expression for conductivity of intrinsic, and extrinsic semiconductors. [6]
- b) What is fermi level in a semiconductor? With the neat labelled diagram, draw the position of fermi level in N Type & P Type semiconductor at 0° K. [5]
- c) A copper strip 2.0 m wide, 1.0 mm thick is placed in a magnetic field of 1.5T. If a current of 200 A is set up in the strip, calculate the Hall voltage that appears across the strip. [5]

Assume $R_H = 6 \times 10^{-7} \text{ m}^3/\text{C}$.

OR

- Q5)** a) State Hall effect. Derive an equation of Hall voltage. [6]
- b) Define fermi level in conductors and semiconductors. Draw the position of fermi level in intrinsic, N - type & P - type semiconductors. [5]
- c) Calculate the number of acceptors to be added to germanium sample to obtain the resistivity of $10\Omega\text{m}$. [4]

- Q6)** a) Explain the following terms in superconductivity : [6]
- Critical Magnetic field.
 - Meissner effect
- b) Define : [5]
- Magnetic induction (B)
 - Magnetic field strength (H)
 - Magnetization (M) and state the relation between B, M & H.
- c) Explain DC & AC Josephson effect in brief. [4]

OR

- Q7)** a) Differentiate between Diamagnetism, paramagnetism and ferromagnetism. (Any Three points) [6]
- b) What is superconductivity? Distinguish between Type I and Type II superconductors. (any four points) [5]
- c) The transition temperature for lead is 7.2 K. However at 5K it loses the superconductivity property if subjected to magnetic field of $3.3 \times 10^4 \text{ A/m}$. Find the maximum value of magnetic field which will allow the metal to retain its superconductivity at 0K. [4]

- Q8)** a) What is echo sounding technique? Using this technique explain non destructive testing for the measurement of thickness of metal sheet using ultrasonic waves. [6]
- b) What are nanoparticles? What is nanotechnology? Explain the optical property of nanoparticle. [5]
- c) Distinguish between Destructive and Non Destructive testing (any two points) [4]

OR

- Q9)** a) What are applications of nanoparticles? Explain any two applications of nanoparticles in brief. [6]
- b) Explain in brief Acoustic Emission Technique of NDT and its application. [5]
- c) Explain electrical property of nanoparticles. [4]



Total No. of Questions : 9]

SEAT No. :

P6487

[Total No. of Pages : 4

[5868]-103

**F.E. (Semester - I & II)
ENGINEERING CHEMISTRY
(2019 Pattern) (Paper - II) (107009)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Questions No. 1 is compulsory. 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.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.*
- 5) *Assume suitable data if necessary.*

Q1) Multiple choice questions -

- i) PPV shows _____ fluorescence on application of electric field and can be used in _____. [2]
A) blue, sutures B) yellow-green, organic LEDs
C) red, eye-wear lenses D) violet, drug - delivery
- ii) C atoms in graphene show _____ hybridisation. [1]
A) sp^3 B) sp
C) sp^2 D) sp^3d^2
- iii) Power alcohol is advantageous because it _____. [1]
A) decreases octane number B) burns clean
C) increases calorific value D) increases cetane number
- iv) Units of calorific value are _____. [1]
A) Cal/g B) Cal/m
C) Joules D) Kg/m^3

P.T.O.

Q2) a) What are biodegradable polymers? Explain three factors responsible for biodegradation. Give two properties and two uses of biodegradable polymer. [6]

b) What are nanomaterials? Discuss in brief two properties and applications of nanomaterials. [5]

c) Give the structure and three properties and applications each of polycarbonate. [4]

OR

- Q3)** a) What are carbon nano-tubes? Discuss the different types of carbon nanotubes with respect to their structure. [6]

b) Explain the structure of graphene with the help of diagram and mention its two properties and two applications. [5]

c) What are conducting polymers? State the structural requirements for a polymer to be conducting and give any three applications of conducting polymers. [4]

Q4) a) What is proximate analysis of coal? Give the procedure and formula for determination of each constituent. [6]

b) Explain the production of hydrogen by steam reforming of coke and methane with reaction conditions. [5]

c) The following data was obtained in a Boy's gas Calorimeter experiment -

Volume of gas burnt at STP = 0.1m³

Mass of cooling water = 30 kg

Rise in temperature of cooling water = 8.1°C

Mass of steam condensed = 0.08 kg

Calculate GCV and NCV of the fuel [4]

OR

Q5) a) Give the principle and explain the process of fractional distillation of crude oil with labelled diagram. Give the composition and boiling range of any one fraction obtained during refining. [6]

b) Give the preparation reaction of biodiesel. State four advantages and two limitations of biodiesel. [5]

c) 1.0g of coal sample on complete combustion increased the weight of U-tube containing CaCl₂ by 0.5g and tube containing KOH by 2.4g. Calculate % of C and H in the given coal sample. [4]

Q6) a) Draw block diagram of IR spectrophotometer. Explain its any four components and give their function. [6]

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

c) Explain any four applications of IR spectroscopy. [4]

OR

Q7) a) Draw block diagram of single beam UV-vis spectrophotometer. Explain its four components and give their function. [6]

b) Give the principle of IR spectroscopy. Explain fundamental modes of bending vibrations. [5]

- c) Define the following terms - [4]
- Chromophore
 - Hypsochromic shift
 - Auxochrome
 - Hypochromic shift

- Q8)** a) Explain hydrogen evolution and oxygen absorption mechanism of wet corrosion. [6]
- b) What is electroplating? Explain the process with diagram and reactions. Give applications of electroplating. [5]
- c) What are anodic and cathodic coatings? Which are better and why? [4]

OR

- Q9)** 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) Explain any five factors affecting the rate of corrosion. [5]
- c) What is the principle of cathodic protection? Explain any one method of cathodic protection. [4]



[5868]-104**F.E.**

SYSTEMS IN MECHANICAL ENGINEERING
(2019 Pattern) (Semester - II) (102003)

Time : 2½ Hours**[Max. Marks : 70****Course Outcome :**

- CO 3 : List down the types of road vehicles and their specifications.
- CO 4 : Illustrate various basic parts and transmission system of a road vehicle.
- CO 5 : Discuss several manufacturing processes and identify the suitable process.
- CO 6 : Explain various types of mechanism and its application.

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) Define Vehicle Specification. Explain following Engine specification. [7]
- i) Power of Engine
 - ii) Cylinder Capacity
 - iii) Type of Transmission
- b) Explain Electric Vehicle with neat diagram. [7]
- c) Draw four stroke S I Engine diagram and labeled engine component on it. [4]

OR

- Q2)** a) Write short note on hybrid vehicle. Name any one example. [7]
- b) Classify Automobile, Compare specification of two wheeler and L MV (two points). [7]
- c) Write short note cost analysis of Vehicle. [4]

- Q3)** a) Explain ABS system with neat diagram. [7]
- b) Draw and Explain layout of an Automobile. [7]
- c) Draw neat diagram of Single Plate Clutch. [3]

OR

P.T.O.

- Q4)** a) Explain water cooling used in vehicle with neat diagram. [7]
b) Explain Rear Engine Rear Wheel Drive System with neat diagram. [7]
c) Draw neat diagram of Drum Brake. [3]

- Q5)** a) Define and casting process. Write any two advantages, disadvantages and application each. [7]
b) Define sheet metal operation. Explain punching and blanking with neat diagram. [7]
c) Write short note on CNC Machine. [4]

OR

- Q6)** a) Define Machining operation. Explain turning and drilling operation principal with neat diagram. [7]
b) Explain Shielded metal arc welding with neat diagram. Write any one application. [7]
c) Write short note on IOT. [4]

- Q7)** a) Explain working of washing machine with neat diagram. [7]
b) Explain working of Solar Heater with neat diagram. [7]
c) Draw neat diagram of Water Tap. [3]

OR

- Q8)** a) Explain with neat diagram working of vacuum cleaner. [7]
b) Explain brake paddle with neat diagram. [7]
c) If Refrigerator is used to maintain temperature of 4°C by removing 60kJ/sec of heat from inside with help of compressor of capacity 30kW. Compute COP of refrigerator. [3]



Total No. of Questions : 8]

SEAT No. :

P6489

[Total No. of Pages : 4

[5868]-105

F.E. (All Branches)

**103004 : BASIC ELECTRICAL ENGINEERING
(2019 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.
- 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) Define and state the unit of admittance, conductance & susceptance.
Also draw the admittance triangle for inductive circuit. [4]**

b) Obtain the expression for current and power, when voltage $v = V_m \sin \omega t$ is applied across purely resistive circuit. Also draw the waveform for voltage, current & power on common X-axis. [6]

**c) The series circuit having resistance 5Ω , inductance 0.1 H and capacitance $150 \mu\text{F}$ is connected to 1-phase, 200 V , 50 Hz AC supply.
Calculate- [8]**

- | | |
|---------------------------------|--------------------------------|
| i) Inductive reactance X_L | ii) Capacitive reactance X_C |
| iii) Net reactance X | iv) Impedance Z |
| v) Current drawn by the circuit | vi) Power factor |
| vii) Active power P | viii) Reactive power Q |

OR

Q2) a) Define and state the unit of active, reactive and apparent power in case of single phase circuit. Draw the power triangle. [4]

b) Derive the expression for resonant frequency and comment on impedance, current and power factor in case of series resonance circuit. [6]

c) Derive the expression for power, when voltage $v = V_m \sin \omega t$ is applied across R-L series circuit. Also draw the waveform for voltage, current & power on common X-axis. [8]

P.T.O.

- Q3)** a) What is phase sequence? State it's any two applications. [3]
- b) State the relation between : [6]
- Phase voltage and line voltage
 - Phase current and line current in case of balanced delta connected 3-ph load. Using above relations, obtain the expressions for 3-ph active power and 3-ph reactive power.
- c) A 80 kVA, 1000/250 V, 1-ph 50 Hz transformer has iron loss of 1000 W and copper loss 400 W, when its primary draws current of 50A. Calculate [8]
- Efficiency at full load and power factor = 0.8 lag.
 - Efficiency at half load and power factor = 1 lag.

OR

- Q4)** a) What are the losses in the transformer? State the parts in which they take place. [3]
- b) Derive the EMF equation of single phase transformer. [6]
- c) Three identical impedances each of $6+j8 \Omega$ are connected in star across 3-ph, 415 V, 50 Hz ac supply. Determine [8]
- Line voltage
 - Phase voltage
 - Phase current and line current
 - 3-ph active, reactive and apparent power

- Q5)** a) Define the practical voltage source & explain it by means of [4]
- Symbol of representation
 - Value of internal resistance
 - Graphs between V and I
- b) Derive the equations to convert Delta connected resistive circuit into equivalent Star circuit. [6]

- c) For the circuit given in fig 5c, write down the steps to find current through PQ using Superposition Theorem. [8]

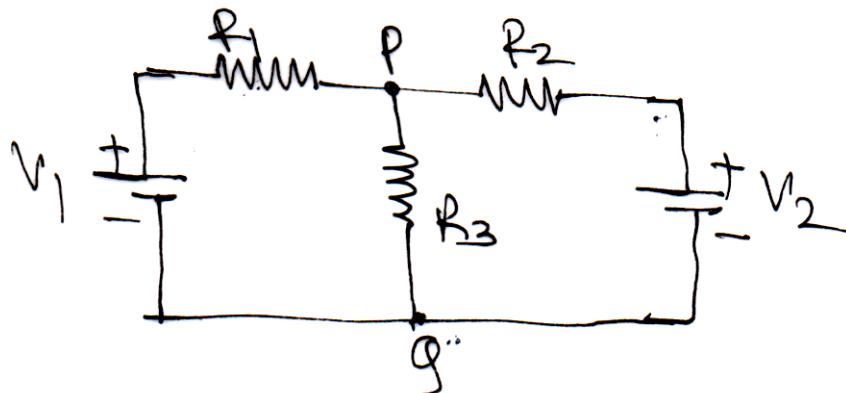


Figure 5c

OR

- Q6)** a) State and explain KCL & KVL [4]
 b) Calculate the current flowing through $6\ \Omega$ (AB) for the circuit shown in fig 6b, using Kirchhoff's Laws. [6]

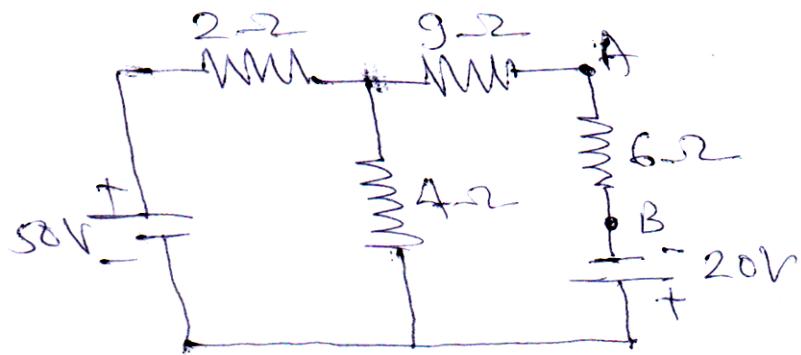


Figure 6b

- c) Calculate the current flowing through $6\ \Omega$ (AB) for the circuit shown in question 6b, using Thevenin's Theorem. [8]
- Q7)** a) Define resistivity of the material & state the factors on which it depends. [3]
 b) Explain construction and working principle of Lithium Ion battery and state its any two applications. [6]
 c) Derive an expression for insulation resistance of a single core cable. Draw the necessary diagram. Also comment on insulation resistance when [8]

- i) Two cables are connected in series and
- ii) In parallel

OR

Q8) a) Write the name of materials used for anode, cathode and electrolyte in case of Lead Acid Battery. State it's any three applications. [3]

b) If α_1 and α_2 are the RTC of a conducting material at $t_1^0\text{C}$ and $t_2^0\text{C}$

$$\text{respectively prove that } \alpha_2 = \frac{\alpha_1}{1 + \alpha_1(t_2 - t_1)} \quad [6]$$

c) A water pump lifts 12000 litre of water to a height of 15 m per minute. The efficiency of motor and pump is 75% & 80% respectively. Calculate [8]

- i) Input power to motor in kW
- ii) Daily energy consumption if pump is used 04 hrs a day
- iii) Monthly electricity bill as per above daily uses for the month of 30 days at the rate of 10 Rs/unit.



[5868]-106
F.E.

BASIC ELECTRONICS ENGINEERING
(2019 Pattern) (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) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 5) Assume suitable data if necessary.

Q1) a) Convert [6]

- i) $(2BA.OC)_{16}$ to Octal.
- ii) $(462.27)_8$ to Hexadecimal

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

c) Draw and explain block diagram of microprocessor. [5]

OR

Q2) a) Perform the following arithmetic operations. [5]

- i) $(110011 - 111001)$ using 2's compliment method.
- ii) $(111011.11 + 100100.01)$

b) State and prove Demorgan's Theorems. [6]

c) Draw and explain block diagram of microcontroller. [6]

Q3) a) Explain principle of operation and block diagram Digital Multimeter. [6]

b) Explain working of Auto-Transformer List its applications. [6]

c) Explain operation of DC Ammeter with suitable diagram. Explain circuit or multi-range Ammeter. [6]

OR

Q4) a) Draw block diagram of function generator and explain functions of each block. [6]

b) Explain Digital storage oscilloscope. List its applications. [6]

c) Explain operation of DC voltmeter with suitable diagram. Explain circuit of multi-range voltmeter. [6]

- Q5)** a) Draw construction of LVDT and explain its operation. Write its advantages, disadvantages and applications. [6]
b) Explain RTD with its construction, working, advantages, disadvantages and applications. [6]
c) Explain operation of Bio-sensor with one application. [5]

OR

- Q6)** a) What are different types of transducers? Give one example of each type. [5]
b) Explain working principle of strain guage. Explain load cell. [6]
c) Explain Thermocouple with its construction, working, advantages, disadvantages and applications. [6]

- Q7)** a) Explain different types of cables used in electronic communication. [6]
b) Draw and explain block diagram of FM transmitter. [6]
c) Draw and explain block diagram of GSM. [6]

OR

- Q8)** a) With the help of block diagram, explain operation of communication system. [6]
b) Explain IEEE electromagnetic frequency spectrum and state allotment of frequency bands for different applications. [6]
c) Explain block diagram of AM transmitter (High Power). [6]



Total No. of Questions : 9]

SEAT No. :

P6995

[Total No. of Pages : 4

[5868]-107

F.E. (Semester - I & II)

**110005 : PROGRAMMING AND PROBLEM SOLVING
(2019 Pattern) (Common)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question one is compulsory.*
- 2) *Solve Q2 or Q3, Q4 or Q5, Q6 or Q7, Q8 or Q9.*
- 3) *Neat diagrams must be wherever necessary.*
- 4) *Assume suitable data wherever necessary.*

Q1) i) Which one of the following is the correct way of calling a function?

- | | |
|--------------------|----------------------|
| a) f_name() | b) call f_name() |
| c) return f_name() | d) function f_name() |
- ii) What is the correct file extension for Python files?
- | | |
|--------|---------|
| a) .pt | b) .pyt |
| c) .py | d) .cpp |

iii) Which function is used to convert a numeric value to a character.

- | | |
|------------|-------------|
| a) ord() | b) chr() |
| c) input() | d) output() |

iv) Which is the default access mode in the open () function for files in Python?

- | | |
|------|-------|
| a) w | b) r |
| c) a | d) w+ |

v) Which method can be used to return a string in upper case letters?

- | | |
|----------------|------------------|
| a) toupper() | b) upper() |
| c) uppercase() | d) touppercase() |

P.T.O.

- vi) Which method is automatically executed when an object of a class is created?
- a) `_init_()` b) `_call_()`
c) `_repr_()` d) `_del_()`
- vii) You can use Python for
- a) Application programming b) Web programming
c) Artificial intelligence d) All of these
- viii) Which of the following keyword is used in user defined function header in Python?
- a) `define` b) `def`
c) `function` d) `fun`
- ix) What does `open()` function return?
- a) function b) variable
c) file object d) none of these
- x) Which of the following is the correct way of closing a file?
- a) `close(file)` b) `close("file")`
c) `file.closed()` d) `file.close()`

- Q2)** a) Define a function. Explain function definition and function call with suitable example. [6]
- b) What is a lambda function? Explain with a suitable example. [5]
- c) What are the good Python programming practices? [4]

OR

- Q3)** a) Explain the following types of function arguments with examples:[6]
- i) Required arguments
ii) Keyword arguments
- b) What do you mean by local and global variables? Explain it with example. [5]
- c) Write a program to swap two numbers using a function. [4]

Q4) a) Explain the following string operations with suitable example. [6]

- i) Concatenation
- ii) Appending
- iii) String repetition

b) Explain indexing and slicing operation on string with suitable example. [5]

c) Write a program to count the number of characters and words in the given string. [4]

s = “Welcome to the world of python programming”

OR

Q5) a) Explain following string methods with example. [6]

- i) strip()
- ii) index()
- iii) isdigit()

b) What is a string? Explain with example iterating strings. [5]

c) Explain ord() and chr() functions with suitable examples. [4]

Q6) a) Explain any three programming paradigms. [6]

b) Define a class in Python. Explain __init__ method with suitable example. [5]

c) Explain the concept of a class and an object in OOP. [4]

OR

Q7) a) Explain the following features of Object Oriented Programming. [6]

- i) Data encapsulation
- ii) Data abstraction
- iii) Polymorphism

- b) Explain class variables and object variable with suitable example. [5]
- c) Write a program to create a class ‘Employee’ with two attributes. Display the details of two employees. [4]

- Q8)** a) What is a file? Explain different access modes for opening files. [6]
- b) What is a dictionary? How to create, access and modify dictionary elements. [5]
- c) Explain relative and absolute path of a file. [4]

OR

- Q9)** a) Explain any three methods for reading and writing files. [6]
- b) Explain different directory methods with suitable examples. [5]
- c) Write a program to read first 10 characters from the file and display it. [4]



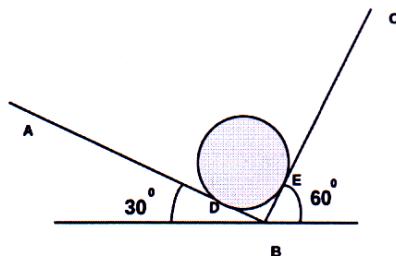
[5868]-108

F.E. (All) (Semester I & II)
ENGINEERING MECHANICS (101011)
(2019 Pattern)

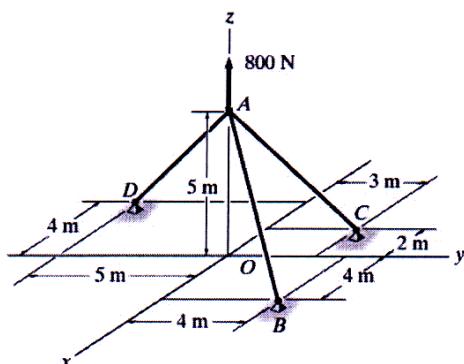
Time : 2½ Hours]**[Max. Marks : 70****Instructions to the candidates:**

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

- Q1)** a) A ball of weight $W = 53.4 \text{ N}$ rests in a right angled trough as shown in Fig. 1a. Determine the forces exerted on the sides of the trough at D & E. Assume all surfaces are perfectly smooth. [6]

**Fig. 1a**

- b) Three rods meeting at point A as shown in Fig. 1b. Find magnitude of the tension developed in each rod AB, AC and AD. [6]

**Fig. 1b**

- c) Determine the support reaction of beam loaded and supported as shown in Fig.1c. [6]

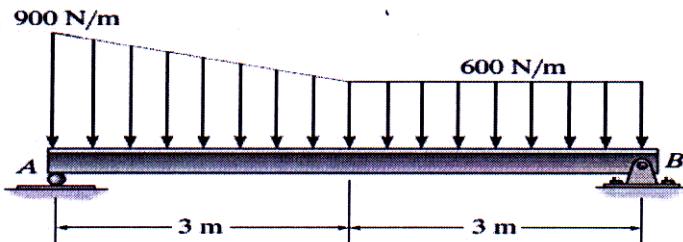


Fig. 1c

OR

- Q2)** a) A joist of length 4m and weighing 200N is raised by pulling a rope shown in Fig. 2a. Determine the tension T induced in the rope and reaction at end A of joist. [6]

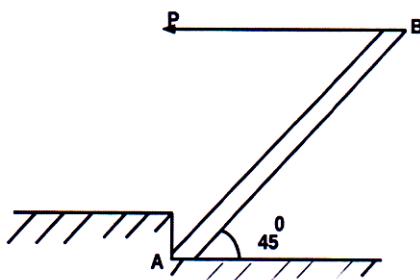


Fig. 2a

- b) The rectangular $3\text{m} \times 10\text{m}$, steel plate subjected to four forces, as shown in Fig.2b. Determine the resultant force in magnitude and direction w.r.to 'O'. [6]

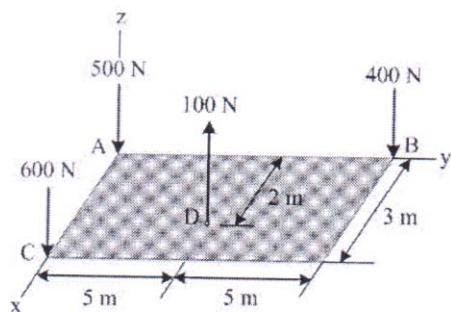


Fig. 2b

- c) The I joist supports 20 kN and 40 kN on beam AB of span 7.5 m, as shown in Fig. 2c. Determine the support reactions at hinge B and roller D. [6]

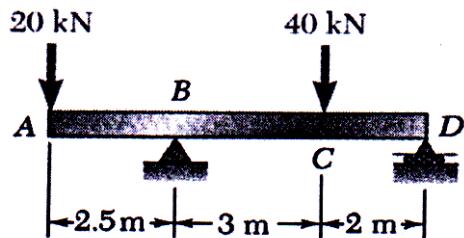


Fig. 2c

- Q3)** a) Determine the forces in all members of a truss loaded and supported as shown in Fig. 3a. [6]

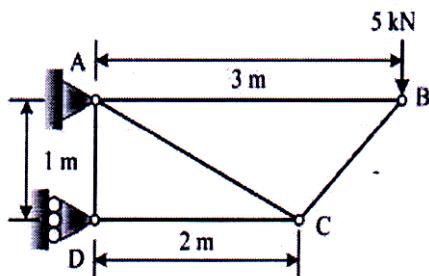


Fig. 3a

- b) Cable ABCD is loaded and supported as shown in the Fig. 3b. If $d_c = 0.75$ m and $d_b = 1.125$ m, determine the component of reaction at A & maximum tension in the cable. [5]

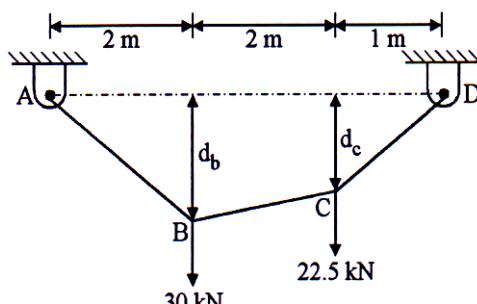


Fig. 3b

- c) Determine the components of all forces acting on member ABE for the frame loaded with 2400N at D of the frame as shown in Fig. 3c. [6]

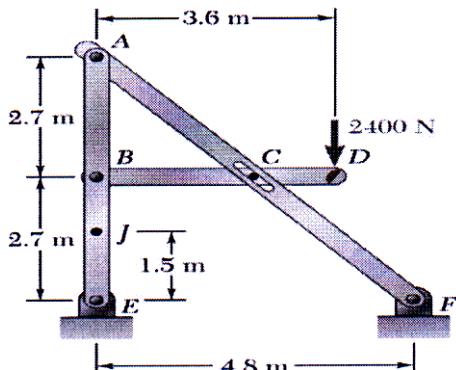


Fig. 3c

OR

- Q4)** a) Determine the forces in the members AB, AC and DC of the truss loaded and supported as shown in the Fig. 3a. Use method of section. [6]

b) Cable ABCDE supports two loads 6kN and 10 kN at B and C, as shown in Fig.4b. If the ' h_B ' = 1.8 m, determine ' h_C ' and reaction components at A and D. [5]

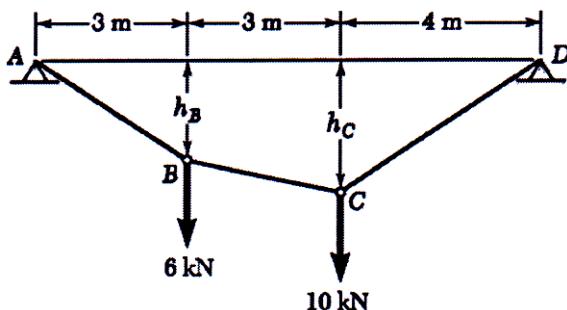


Fig. 4b

- c) Determine the pin reactions at A, B and roller D for the frame members ABC and BD meeting at B as shown in Fig. 4c. [6]

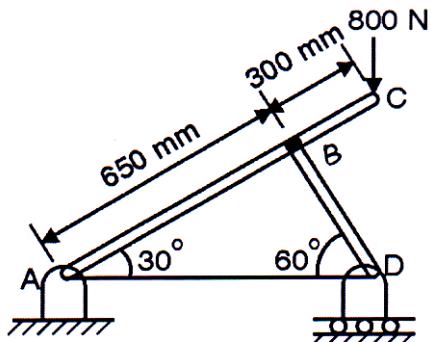


Fig. 4c

- Q5)** a) The acceleration of particle in rectilinear motion is given by $a = (3t^2 + 2)$. Initial velocity and displacements are 2m/s & 3m respectively. Find Position, velocity & acceleration of the particle at $t = 2\text{s}$. [6]
- b) A projectile fired from the edge of a 150 m high cliff with an initial velocity of 180 m/s at an angle of elevation of 30° with the horizontal. Neglecting air resistance find : [6]
- The greatest elevation above the ground reached by the projectile;
 - Horizontal distance from the gun to the point, where the projectile strikes the ground
- c) A car starts from rest and with constant acceleration achieves a velocity of 15 m/s when it travels a distance of 200 m. Determine the acceleration of the car and the time required to attain the velocity. [6]

OR

- Q6)** a) A ball is thrown vertically upward with an initial speed of 80m/s from the base of 50m high tower. Determine the distance 'h' by which the ball clear the top of tower. Also determine the time of travel when it reaches to base again. [6]
- 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 increases her speed. [6]
- c) A stone is dropped from the top of a tower 50 m high, At the same time another stone is thrown up from the foot of the tower with a velocity of 25 m/s. At what distance from the top & after how much time the two stones cross each other? [6]

- Q7)** a) A 30 kg block is dropped from a height of 2 m onto the 10 kg pan of a spring scale as shown in Fig. 7a. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of the spring is $k = 20 \text{ kN/m}$. [6]

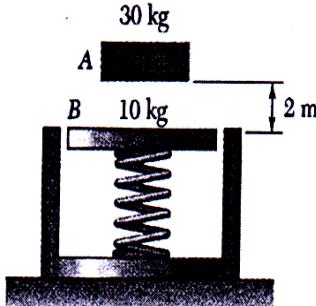


Fig. 7a

- b) The bottle rests at a distance of 1 m from the center of the horizontal platform as shown in Fig. 7b. If the coefficient of static friction between the bottle and the platform is $\mu_s = 0.3$ determine the maximum speed that the bottle can attain before slipping. Assume the angular motion of the platform is slowly increasing. [5]

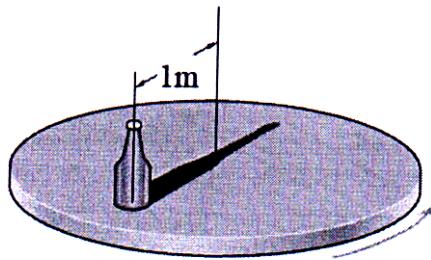


Fig. 7b

- c) A ball is dropped from a height $h_0 = 2 \text{ m}$ on a smooth floor. Knowing that the height of the first bounce is $h_1 = 1.2 \text{ m}$, determine (i) coefficient of restitution, and (ii) expected height h_2 after the second bounce. [6]

OR

- Q8)** a) Ball 'A' of 20 N and initial velocity 6 m/s rightwards collides with ball 'B' of 10 N and initial velocity 8 m/s leftwards before impact. If the coefficient of restitution is 'e' is 0.6, then determine the velocities of balls 'A' and 'B' after impact. [5]
- b) Calculate the velocity v of the 50-kg crate, as shown in Fig. 8b, when it reaches the bottom of the chute at B, if it is given an initial velocity of 4 m/s down the chute at A. The coefficient of kinetic friction is 0.30. [6]

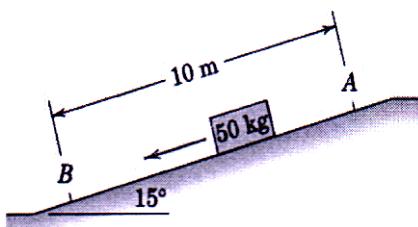


Fig. 8b

- c) The 2kg pendulum bob 1.5m, is released from rest when it is at A as shown in Fig.8c. Determine the speed of the bob, using work energy principle, when it passes at a position 60 degrees down from A. [6]

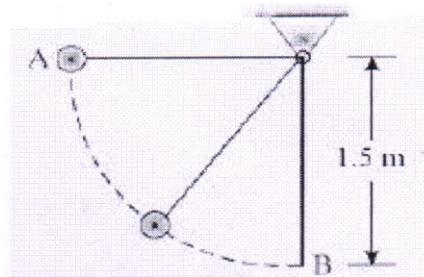


Fig. 8c

ANSWER

[5868]-109

First Year Engineering
ENGINEERING MATHEMATICS - II
(2019 Pattern) (Semester - I & III) (107008)

Time : 2½ Hours]**/Max. Marks : 70****Instructions to the candidates:**

- 1) *Q.No. 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 whenever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of electronic pocket calculator is allowed.*
- 6) *Assume suitable data if necessary.*

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

a) $\int_0^{\frac{\pi}{2}} \cos^6 x =$ [2]

i) $\frac{5}{16}$ ii) $\frac{5\pi}{32}$
 iii) $\frac{16\pi}{10}$ iv) $\frac{5\pi}{48}$

b) The curve $y^2(x-a) = x^2(2a-x)$ is [2]

i) Symmetric about X - axis and net passing through origin
 ii) Symmetric about Y - axis and net passing through origin
 iii) Symmetric about X - axis and passing through origin
 iv) Symmetric about Y - axis and passing through origin

c) The value of double integral $\iint_{0,0}^{1,1} \frac{1}{\sqrt{1-x^2}\sqrt{1-y^2}} dx dy$ is [2]

i) $\frac{\pi}{2}$ ii) $\frac{\pi^2}{2}$
 iii) $\frac{\pi^2}{4}$ iv) $\frac{\pi^2}{16}$

d) The Centre (C) and radius (r) of the sphere $x^2 + y^2 + z^2 - 2y - 4z - 11 = 0$ are [2]

- i) $C \equiv (0, 1, 2); r = 4$
- ii) $C \equiv (0, -1, -2); r = 2$
- iii) $C \equiv (0, 2, 4); r = 4$
- iv) $C \equiv (0, 1, 2); r = 2$

e) The number of loops in the rose curve $r = a \cos 4\theta$ are [1]

- i) 2
- ii) 4
- iii) 6
- iv) 8

f) $\iint_R dx dy$ represents [1]

- i) Volume
- ii) Centre of gravity
- iii) Moment of inertia
- iv) Area of region R

Q2) a) If $I_n = \int_{\pi/4}^{\pi/2} \cot^n \theta d\theta$ prove that $I_n = \frac{1}{n-1} - I_{n-2}$. [5]

b) Show that $\int_0^1 x^{m-1} (1-x^2)^{n-1} dx = \frac{1}{2} \beta\left(\frac{m}{2}, n\right)$. [5]

c) Prove that $\int_0^1 \frac{x^a - 1}{\log x} dx = \log(1+a), a \geq 0$. [5]

OR

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

b) Show that $\int_0^\infty e^{-h^2 x^2} dx = \frac{\sqrt{\pi}}{2h}$. [5]

c) Show that [5]

$$\int_a^b e^{-x^2} dx = \frac{\sqrt{\pi}}{2} [erf(b) - erf(a)]$$

OR

- Q4)** a) Trace the curve $x^2y^2 = a^2(y^2 - x^2)$. [5]
 b) Trace the curve $r = a(1 - \sin \theta)$. [5]
 c) Find the whole length of the loop of the curve $3y^2 = x(x-1)^2$. [5]

OR

- Q5)** a) Trace the curve $y^2(2a-x)=x^3$. [5]
 b) Trace the curve $r=a\cos 2\theta$. [5]
 c) Trace the curve $x^{2/3}+y^{2/3}=a^{2/3}$. [5]

- Q6)** a) Prove 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 and find the co-ordinates of the point of contact. [5]
 b) Find the equation of right circular cone whose vertex is $(1, -1, 2)$, axis is the line $\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-2}{-2}$ and the semi-vertical angle 45° . [5]
 c) Find the equation of right circular cylinder of radius a whose axis passes through the origin and makes equal angles with the co-ordinate axes. [5]

OR

- Q7)** a) Show that the plane $x - 2y - 2z - 7 = 0$ touches the sphere $x^2 + y^2 + z^2 - 10y - 10z - 31 = 0$. Also find the point of contact. [5]
 b) Find the equation of right circular cone with vertex at origin, axis the Y-axis and semi-vertical angle 30° . [5]
 c) Find the equation of right circular cylinder of radius $\sqrt{6}$ whose axis is the line $\frac{x}{1} = \frac{y}{-1} = \frac{z}{1}$. [5]

Q8) a) Change the order of integration and evaluate $\int_0^\pi \int_x^\pi \frac{\sin y}{y} dx dy$. [5]

b) Find the area of one loop of $r = a \sin 2\theta$. [5]

c) Find the moment of inertia of one loop of the lemniscate $r^2 = a^2 \cos 2\theta$ about initial line. Given that $\rho = \frac{2m}{a^2}$, m is the mass of loop of lemniscate. [5]

OR

Q9) a) Evaluate $\iint_1 y dx dy$ over the region enclosed by the parabola $x^2 = y$, and the line $y = x + 2$. [5]

b) Evaluate $\iiint x^2 yz dx dy dz$, throughout the volume bounded by the plane $x = 0, y = 0, z = 0$ $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$. [5]

c) Find the y -coordinate of the centre of gravity of the area bounded by $r = a \sin \theta$ and $r = 2a \sin \theta$. Given that the area bounded by these curves is $\frac{3\pi a^2}{4}$. [5]

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Total No. of Questions : 8]

SEAT No. :

P6996

[Total No. of Pages : 3

[5868]-116

F.Y. Engineering (Semester - I & II)
ENGINEERING GRAPHICS
(2019 Pattern) (102012)

Time : 2½ Hours]

[Max. Marks : 50

Instructions to the candidates:

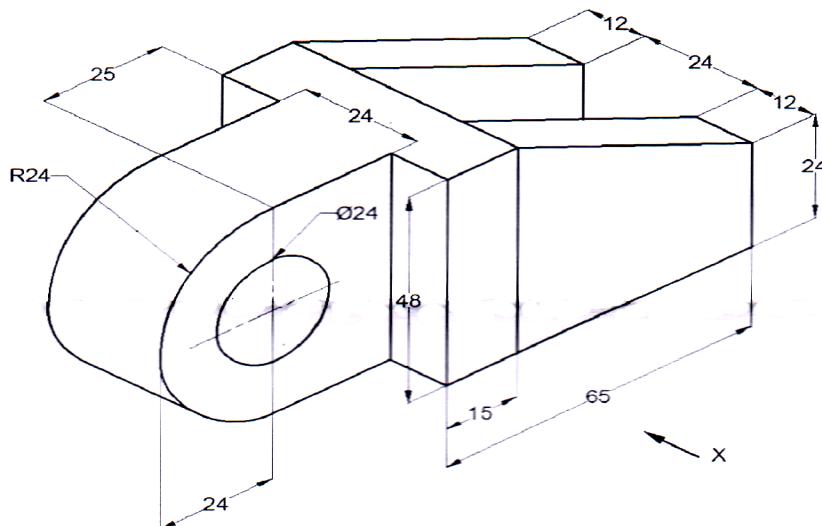
- 1) Solve Q1 or Q2, Q3 or Q4, Q5 or Q6 and Q7 or Q8.
- 2) Assume suitable data, if necessary.
- 3) Retail all the construction lines.

Q1) Draw a curve traced out by a moving point in such a way that its distance from focus is 21 mm and eccentricity is $\frac{3}{5}$. [8]

OR

Q2) A straight rod AB of 60 mm length revolves one complete revolution with a uniform motion in a clockwise direction when hinged about A. During this period a point P moves along the rod from B to A and reaches back to B with a uniform linear motion. Draw the locus of point P. Name the Curve. [8]

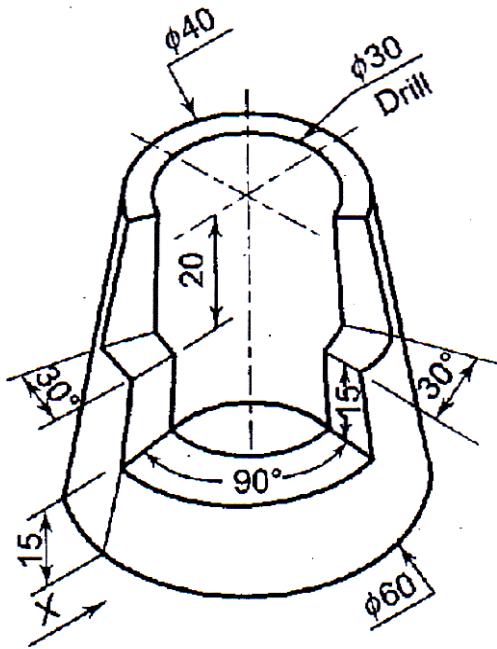
Q3) Figure shows a pictorial view of an object. By using first angle method of projection draw, Sectional Front View along symmetry looking in the direction of X. Top View and LHSV. Give dimensions in all views. [16]



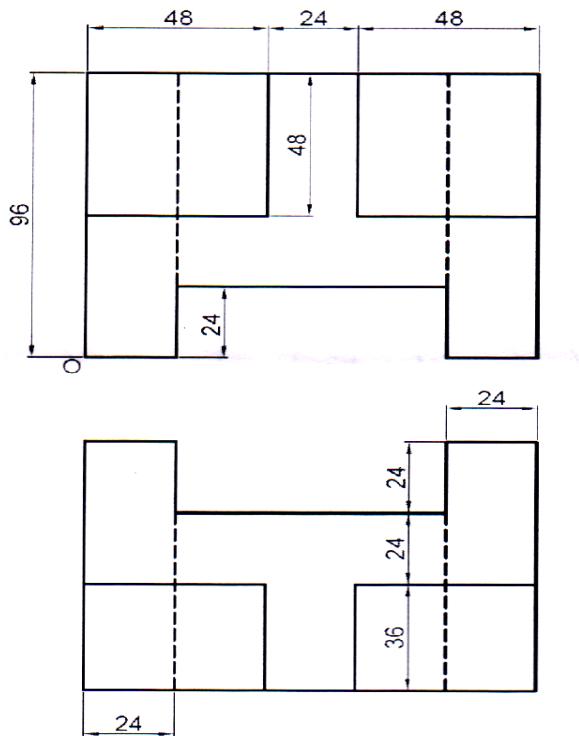
P.T.O.

OR

- Q4)** 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 RHSV. Give dimensions in all views. [16]

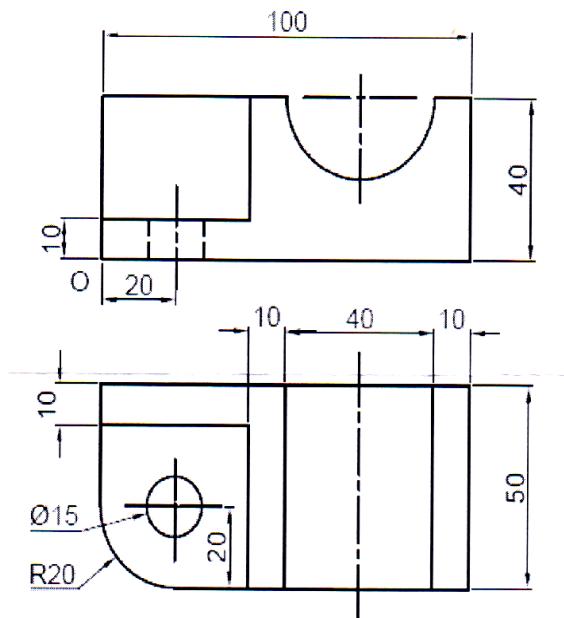


- Q5)** Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. [16]



OR

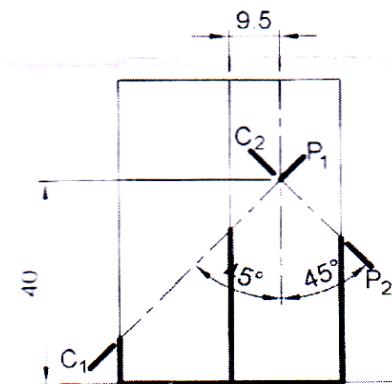
- Q6)** Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. [16]



- Q7)** A square pyramid edge of the base 40 mm axis length 70 mm stands with its base on HP with two sides of the base parallel to VP. It is cut by an AIP inclined at 60° to the HP and passing through a point on the axis 40 mm from base. Draw the development of surfaces of pyramid. [10]

OR

- Q8)** Figure shows the FV of a square prism, base side 30 mm and axis 60 mm long, resting on its base on HP such that each of its base edges are equally inclined to VP. The prism is cut by two cutting planes C₁-P₁ and C₂-P₂ as shown in figure. Draw the development of remaining surface of square Prism. [10]



Total No. of Questions : 8]

SEAT No. :

P6493

[5868] - 120

[Total No. of Pages : 3

F.E.

ENGINEERING MATHEMATICS - I
(2015 Pattern) (Semester - I & II) (Credit System) (107001)

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates:

- 1) Attempt 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) Use electronic pocket calculator is allowed.

Q1) a) Reduce the following matrix in to normal form and hence find its rank.

$$\begin{bmatrix} 4 & 2 & -1 & 2 \\ 1 & -1 & 2 & 1 \\ 2 & 2 & -2 & 0 \end{bmatrix} \quad [4]$$

b) Find eigen values and eigen vector corresponds to lowest eigen value.

$$\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix} \quad [4]$$

c) A square lies above real axis in Argand diagram and two of its adjacent vertices are origin and the point $3+5i$. Find the complex numbers representing other two vertices. [4]

OR

Q2) a) Verify Cayley - Hamilton theorem for the matrix

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} \text{ hence find } A^{-1}. \quad [4]$$

b) Separate in to real and immaginary parts of $\cos^{-1}\left(\frac{3i}{4}\right)$. [4]

c) Solve $x^6-1=0$ using DeMoivre's theorem. [4]

P.T.O.

Q3) a) Solve any ONE. [4]

i) Test for convergence the series

$$\sum_{n=1}^{\infty} \frac{10n+4}{n^3}.$$

ii) Test for convergence the series

$$1 - \frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{3}} - \frac{1}{4\sqrt{4}} + \dots$$

b) Expand $e^x \cos x$ in ascending powers of x up to the term containing x^4 .

[4]

c) Find the n^{th} derivative of $y = \frac{x}{(x-1)^2}$. [4]

OR

Q4) a) Solve any ONE. [4]

i) Evaluate $\lim_{x \rightarrow 0} \frac{\log \sin 2x}{\log \sin x}$.

ii) Evaluate $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x + c^x}{3} \right)^{\frac{1}{x}}$.

b) Using Taylor's theorem, expand $x^3 - 2x^2 + 3x + 1$ in ascending powers of $(x-1)$. [4]

c) If $y = a \cos(\log x) + b \sin(\log x)$, prove that

$$x^2 y_{n+2} + (2n+1)x y_{n+1} + (n^2 + 1)y_n = 0.$$

[4]

Q5) Solve any TWO.

a) Find the value of n for which $z = t^n e^{-r^2/4t}$ satisfies the partial differential

equation $\frac{\partial z}{\partial r} = \frac{1}{r^2} \left[\frac{\partial}{\partial r} (r^2 z_r) \right]$. [6]

b) If $u = x^3 f\left(\frac{y}{x}\right) + \frac{1}{y^3} \phi\left(\frac{x}{y}\right)$ show that

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} + x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 9u.$$

[7]

- c) If $u = f(r, s)$ where $r = x^2 + y^2$, $s = x^2 - y^2$ show that $y \frac{\partial u}{\partial x} + x \frac{\partial u}{\partial y} = 4xy \frac{\partial u}{\partial r}$. [6]

OR

Q6) Solve any TWO.

- a) If $u = 2x + 3y$, $v = 3x - 2y$ prove that $(u_x)_y \cdot (x_u)_v = (v_y)_x \cdot (y_v)_u$. [6]
- b) If $u = \tan^{-1}\left(\frac{x^3 + y^3}{x + y}\right)$ show that

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \sin 2u[1 - 4 \sin^2 u] \quad [7]$$

- c) If $u = x^2 - y^2$, $v = 2xy$ and $z = f(u, v)$ show that

$$x \frac{\partial z}{\partial x} - y \frac{\partial z}{\partial y} = 2\left(\sqrt{u^2 + v^2}\right)z_u. \quad [6]$$

Q7) a) If $u^3 + v^3 = x + y$, $u^2 + v^2 = x^3 + y^3$ then show that

$$\frac{\partial(u, v)}{\partial(x, y)} = \frac{1}{2} \frac{y^2 - x^2}{uv(u - v)} \quad [4]$$

- b) Determine whether the following functions are functionally dependent. If functionally dependent, Find the relation between them
 $u = \sin x + \sin y$; $v = \sin(x + y)$. [4]
- c) Find stationary values of the function $f(x, y) = x^3 + 3xy^2 - 3x^2 - 3y^2 + 7$, Also find the maximum value. [5]

OR

Q8) a) If $u + v^2 = x$, $v + w^2 = y$, $w + u^2 = z$, find $\left(\frac{\partial u}{\partial x}\right)$. [4]

- b) If period of simple pendulum is $T = 2\pi\sqrt{\frac{l}{9}}$, Find the percentage error in T due to possible error upto 1% in l and 2.5% in g . [4]
- c) Use Lagrange's method to find the maximum value of $u = x^2y^3z^4$, such that $2x + 3y + 4z = 9$. [5]



Total No. of Questions : 8]

SEAT No. :

P6494

[5868] - 121

[Total No. of Pages : 2

F.E.

ENGINEERING CHEMISTRY

(2015 Pattern) (Semester - I & II) (Credit System) (107009)

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates:

- 1) Attempt 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) Black figures to the right indicate full marks.
- 4) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 5) Assume suitable data, if necessary.

Q1) a) Explain with procedure, chemical reaⁿ & calculation for determination of total hardness of water sample by EDTA method. [6]

b) Explain conductometric titration curve in case of strong acid and weak base with chemical reaction. [3]

c) Define reference electrode. Draw neat labelled diagram of calomel electrode with cell representation. [3]

OR

Q2) a) Explain procedure, titration curve and reaction involved in potentiometric titration of Fe^{+2} Vs Ce^{+4} . Write the formulae for calculation of emf of the cell before and after equivalence point of titration. [6]

b) Write merits and demerits of greener and traditional synthesis of adipic acid. [3]

c) A zeolite softener was completely exhausted & regenerated by passing 80 litres of NaCl containing 150 gm/lit. of NaCl. How many litres of water sample containing hardness 600 ppm can be softened by this softener? [3]

Q3) a) Define glass transition temperature. Discuss any five factors affecting T_g value of polymer. [6]

b) What is biodiesel? Write its advantages and disadvantages. [3]

c) 0.5 gm of coal sample on complete combustion was found to increase the weight of U-tube containing CaCl_2 by 0.25 gm & U-tube containing KOH by 1.3 gm. calculate % of carbon & hydrogen in coal sample. [3]

OR

P.T.O.

- Q4)** a) Explain Bomb calorimeter with principle, construction, working and neat labelled diagram. State formula to calculate GCV. [6]
b) Distinguish betⁿ Natural Rubber and vulcanised Rubber. [3]
c) Define the following terms with suitable example. [3]
i) Polymer
ii) Monomer
iii) Functionality of Monomer

- Q5)** a) Explain production of hydrogen by steam reforming of methane & coke. [6]
b) Explain isotopes of carbon with applications. [4]
c) Differentiate between Diamond & Graphite. [3]

OR

- Q6)** a) What are carbon nanotubes (CNTs)? Give their types with any four applications. [6]
b) Give any four methods of storage of hydrogen. [4]
c) Write structure, synthesis and applications of Silane. [3]

- Q7)** a) Discuss electrochemical corrosion by hydrogen liberation and oxygen absorption mechanism. [6]
b) What is principle of cathodic protection? Explain it with any one method. [4]
c) State Pilling-Bedworth ratio. Give its significance with suitable example. [3]

OR

- Q8)** a) Explain any six factors affecting corrosion. [6]
b) State the principle of electroplating. Explain it with diagram & reaction involved. [4]
c) Explain galvanisation with neat labelled diagram. [3]



Total No. of Questions : 8]

SEAT No. :

P6495

[5868] - 122

[Total No. of Pages : 2

F.E.

ENGINEERING PHYSICS

(2015 Credit Pattern) (Semester - I & II) (107002)

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates:

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

Constants:

- 1) $h = 6.63 \times 10^{-34} \text{ J-S} = \text{Planck's constant.}$
- 2) $e = 1.6 \times 10^{-19} \text{ C} = \text{electronic charge.}$
- 3) $c = 3 \times 10^8 \text{ m/s} = \text{velocity of light.}$
- 4) $m_e = 9.1 \times 10^{-31} \text{ kg} = \text{mass of electron}$

- Q1)** a) Explain formation of Newton's rings prove that in Newton's rings by reflected light the diameter of bright ring are proportional to the square root of odd natural number. [6]
- b) A plane transmission grating has 5000 lines/cm. Find out highest order of spectrum observed it incident light $\lambda = 6000 \text{ A}^\circ$. [3]
- c) Find the echo time of ultrasonic pulse which is travelling with the velocity 1500 m/s in mild steel. The correct thickness measured by gauss meter is 525m. [3]

OR

- Q2)** a) What is reverberation? Give sabine formula for reverberation time. What are the factors affecting reverberation time? Explain how it can be optimized by controlling these factors. [6]
- b) Calculate the natural frequency of vibrations for a quartz plate of thickness 5.5mm ($Y = 8 \times 10^{10} \text{ N/M}^2$ and $\rho = 2650 \text{ kg/m}^3$) [3]
- c) Explain with a suitable diagram how the principle of interference is used to test optical flatness of surface. [3]

P.T.O.

- Q3)** a) Explain construction and working of He-Ne laser. [6]
b) What is Fermi energy level? Write the formula for the Fermi Dirac probability distribution function. [3]
c) Write four applications of solar cell. [3]

OR

- Q4)** a) What is photovoltaic effect Explain the construction and working of solar cell. Also I-V characteristics of solar cell and define fill factor. [6]
b) Calculate the number of acceptors to be added in germanium sample to obtain the resistivity of 100 ohm-cm (Given $\mu_h = 1700 \text{ cm}^2/\text{V-Sec}$). [3]
c) What is difference between normal photography and holography? Which principle is most useful to record hologram? [3]

- Q5)** a) State and explain Heisenberg uncertainty principle illustrate it by an experiment of diffraction at single slit. [6]
b) State De-Broglie hypothesis of matter waves. Derive the expression for matter waves for an accelerating particle in terms of kinetic energy. [4]
c) Calculate the wavelength associated with 1 MeV proton? [3]

OR

- Q6)** a) Derive Schrödinger time independent wave equation. [6]
b) Explain wave function. Give the physical significance of ψ^2 . [4]
c) An electron is bound by potential which closely approaches an infinite square well of width 2.5 Å° . Calculate the lowest three permissible energies (in electron volts) the electron can have. [3]

- Q7)** a) Explain the phenomenon of super conductivity. Explain Type - I and Type - II super conductors. [6]
b) Explain the synthesis of metal nanoparticle by colloidal route method. [4]
c) Critical temperature of superconductor with isotopic mass = 200 is 5°K . Calculate the critical temperature of the superconductors when isotopic Mass = 196. [3]

OR

- Q8)** a) Explain any two properties of nanoparticles. [6]
b) State and explain Meissner effect. [4]
c) Explain any three applications in Nanotechnology. [3]



Total No. of Questions : 8]

SEAT No. :

P6496

[5868] - 123

[Total No. of Pages : 2

F.E.

BASIC ELECTRONICS ENGINEERING
(2015 Pattern) (Semester - I & II) (104012) (Credit System)

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates:

- 1) Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Figures to the right side indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Assume suitable data if necessary.

- Q1)** a) Draw the output characteristic of BJI in CE configuration. Indicate all three regions of operation with application of each region. [6]
- b) Compare performance of HWR center tapped FWR and Bridge Rectifier. [6]

OR

- Q2)** a) Describe Zener Diode as Voltage Regulator with suitable diagram. [6]
- b) Draw and explain Drain & transfer characteristic of N-channel MOSFET. [6]

- Q3)** a) Draw the circuit diagram of IC 555 as an Astable Multivibrator and explain it. Give the output frequency formula. [6]
- b) Draw the schematic diagram and explain working of 4:1 MUX and 1:4 DEMUX. [6]

OR

- Q4)** a) Explain OP-AMP as differentiator with ckt diagram. [6]
- b) Implement full adder using gates, truth table and give expression for SUM and CARRY. [6]

- Q5)** a) Classify Transducers. Compare Active and Passive Transducers. [6]
- b) Draw the constructional diagram of SCR and explain its operation with characteristic. [7]

OR

P.T.O.

- Q6)** a) Explain with a neat diagram the construction and working of LVDT. [7]
b) Compare SCR and TRIAC. [6]

- Q7)** a) What is need of Modulation. Draw and explain block diagram of AM.[7]
b) Explain the working principle of OFC with suitable diagram. Give its advantages and applications. [6]

OR

- Q8)** a) Explain communication system with proper diagram and explain each block. [6]
b) Draw and explain FM modulation technique. Give its modulation index. [7]



Total No. of Questions : 8]

SEAT No. :

P6497

[Total No. of Pages : 3

[5868] - 124

F.E. (All Branches)

**BASIC ELECTRICAL ENGINEERING
(2015 Pattern) (Semester - I & II) (103004)**

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to right indicate full marks.
- 4) Use of Non-Programmable Scientific Calculators is allowed.
- 5) Assume suitable data if necessary.

Q1) a) Distinguish between statically (mutually) and dynamically induced emf. [6]

- b) A resistance element having cross-sectional area of 25mm^2 and length of 10m takes a current of 4 amps from 230V supply at temperature of 20°C. Find:
 - i) Resistivity of the material and
 - ii) Current it will take when temp. rises to 80°C. Assume $\alpha_{20} = 0.0003/\text{°C}$. [6]

OR

Q2) a) If α_1 and α_2 are RTC's of material at t_1 °C & t_2 °C respectively, then prove that $\alpha_1 - \alpha_2 = \alpha_1 \alpha_2 (t_2 - t_1)$. [6]

- b) Two coils have a mutual inductance of 0.3 H. If the current in first coil is varied from 5 A to 2A in 0.4 sec. Calculate:
 - i) The average emf induced in the second coil and
 - ii) Rate of change of flux linked with the second coil having 200 turns.

Q3) a) Drive an emf equation for a single phase transformer. [6]

- b) Derive an expression of RMS value of the sinusoidal varying current, in terms of peak value. [7]

OR

P.T.O.

- Q4)** a) Compare core type and shell type 1-ph transformer. [6]
- b) The instantaneous values of two emfs are $e_1 = 30 \sin(\omega t)$ volts and $e_2 = 20 \sin(\omega t - \pi/4)$ volts. Find the expression for the instantaneous value of [7]
- i) $e_1 + e_2$ and
 - ii) $e_1 - e_2$

- Q5)** a) Derive the expression for power, when voltage $v = V_m \sin \omega t$ is applied across R-L series circuit. Draw the circuit diagram and phasor diagram. [6]
- b) Two impedances $Z_1 = 5 + j7 \Omega$ and $Z_2 = 10 - j5 \Omega$ are connected in parallel across 200V, 50 Hz ac supply. Determine
- i) Branch currents
 - ii) Power consumed by each branch and
 - iii) Total power of the circuit [7]

OR

- Q6)** a) An inductor of 0.0127 H is connected in series with a resistor of 3Ω across an AC supply which is given by $v = 141.42 \sin(100\pi t)$ volts. Calculate
- i) Inductive reactance, Impedance
 - ii) RMS value of current flowing in the circuit.
 - iii) Write the expression for the instantaneous current
 - iv) Determine the power factor [6]
- b) Derive the relationship between the phase values and line values of current and voltage, for a balanced three phase star connected inductive load across three phase supply. Draw the circuit diagram and phasor diagram. Assume phase sequence RYB. [7]

- Q7)** a) Derive formula to convert DELTA connected resistive network into its STAR connected equivalent circuit. [6]

- b) Determine the current through 6Ω resistor connected across AB in the circuit of Fig. 7(b) by using Thevenin's theorem. [6]

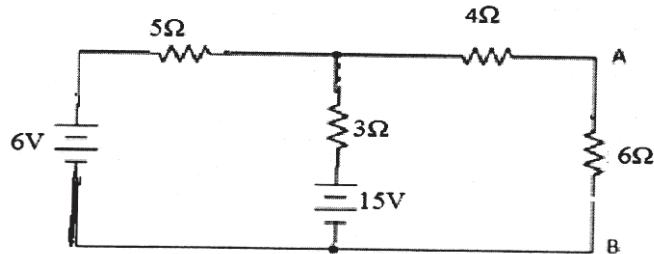


Fig 7 (b)

OR

- Q8) a) State and explain Kirchhoff's Laws. [6]
b) Find current flowing through 4Ω using Kirchhoff's loop analysis for the network shown in Q7(b). [6]



Total No. of Questions : 8]

SEAT No. :

P6498

[5868] - 125

[Total No. of Pages : 2

F.E.

BASIC CIVIL & ENVIRONMENTAL ENGINEERING
(2015 Pattern) (101005) (Semester - I & II)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn whenever necessary.
- 3) Figures to the right indicate full marks.

- Q1)** a) Write a note on various types of loads on a structure. [4]
b) Explain in brief the practical application of Structural Engineering. [4]
c) Write a brief note on recycling of materials in construction industry. [4]

OR

- Q2)** a) What is Precast concrete? State any two application. [4]
b) Define Transportation Engineering. Highlight the importance of Transportation Engineering in today's era. [4]
c) How will you correlate the importance of Environmental Engineering and development activities? Explain. [4]

- Q3)** a) The following readings were taken on a continuously sloping ground with a dumpy level and 4 m leveling staff. The readings are 1.0, 2.0, 1.0, 2.0, 3.0. Rule out a field book page and find R.L.'s of staff stations using collimation plane method, if the R.L. of first staff station is 500,000 m above MSL. Apply usual checks. [6]
b) Comment on the statement 'In coming future the disposal of e-waste would be the biggest problem'. [4]
c) Enlist any four natural resources. Explain the necessity of conserving natural resources. [3]

OR

P.T.O.

- Q4)** a) Define contour, state its uses and characteristics. [5]
b) What is solid waste management? Explain steps involved in it. [4]
c) State various factors to be considered by engineers for sustainable development. [4]

- Q5)** a) What is prospect? Draw sketches to show how prospect can be achieved. [4]
b) State and explain any 4 guidelines used for achieving green building. [5]
c) State briefly the planning principle ‘Sanitation’. [4]

OR

- Q6)** a) A plot owner himself proposed G+1 construction with 150 sq.m construction on each floor on a plot of $14 \times 19\text{m}$. find ground coverage and F.S.I. proposed. If margins from all sides are 2 m and F.S.I. = 1 are must as per byelaws, state the reasons whether plan will be sanctioned or not. [5]
b) Write a note on necessity of bye-laws. [4]
c) How do you maintain Privacy of building? What are the various ways of achieving it. [4]

- Q7)** a) Explain four causes and sources of Air Pollution. [4]
b) Briefly explain various uses of solar energy in Indian context. [4]
c) Explain in brief the control of Noise Pollution. [4]

OR

- Q8)** a) Write a short note on Acid Rain. [4]
b) Write short note on Geothermal energy. [4]
c) Explain with sketches working of a biogas plant. [4]



Total No. of Questions : 8]

SEAT No. :

P6499

[5868] - 126

[Total No. of Pages : 3

F.E.

ENGINEERING GRAPHICS-I
(2015 Pattern) (Semester - I & II) (102006)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
- 2) *Use only half imperial size drawing sheet as answer book.*
- 3) *Retain all construction lines.*
- 4) *Assume suitable data if necessary.*

Q1) The point ‘A’ of 65 mm long Line ‘AB’ is in HP and 15 mm in front of VP. The line is inclined to HP and VP at 40° and 35° respectively. Draw the projections of line AB and locate its traces. [12]

OR

Q2) An isosceles triangle, base 50 mm and altitude 80 mm, is resting in VP on its base. Its surface is inclined to VP so that the corner opposite to resting side is 50 mm in front of VP. Draw the projections if its resting side is inclined to HP at an angle of 45° . Find inclinations made by the plane with HP and VP. [12]

Q3) A triangular prism side of base 30mm and axis height 50mm is kept on HP on edge of its base in such a way that its axis makes 45° with HP. Draw the projections of prism when longer edge opposite to base edge on HP is inclined at 30° with the VP. [13]

OR

Q4) a) Draw an Archimedean spiral for one convolution given that Diameter is 120 mm. [7]
b) Draw the development of lateral surface of hexagonal prism of base side 23 mm and axis height 69 mm. [6]

P.T.O.

Q5) Figure 1 shows a pictorial view of an objects. By using first angle method of projections, draw; [13]

- i) front view in the direction X [4]
- ii) Left hand side view [4]
- iii) Top view [4]
- iv) Overall Dimensions [1]

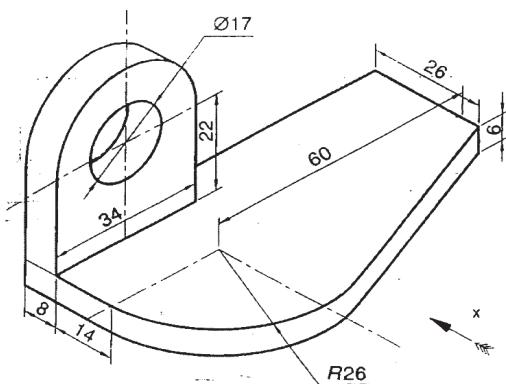


Figure 1

OR

Q6) Figure 2 shows a pictorial view of an object. By using first angle method of projections, draw; [13]

- i) Sectional front view, along symmetry of the objects [4]
- ii) Right hand side view [4]
- iii) Top view [4]
- iv) Dimensions [1]

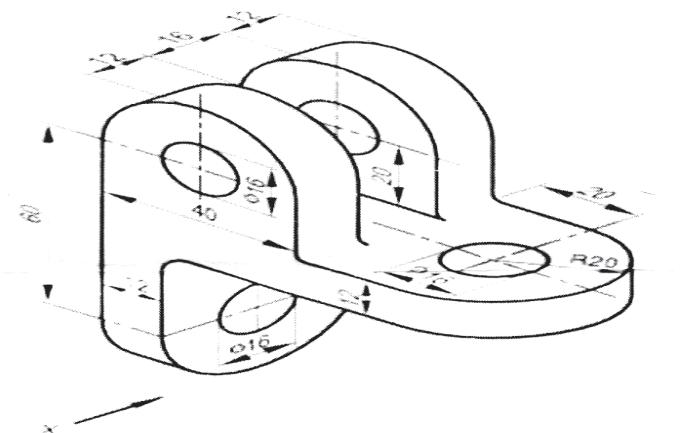


Figure 2

Q7) Figure 3 shows front view and end view of a bracket. Draw isometric view and show overall dimensions. [12]

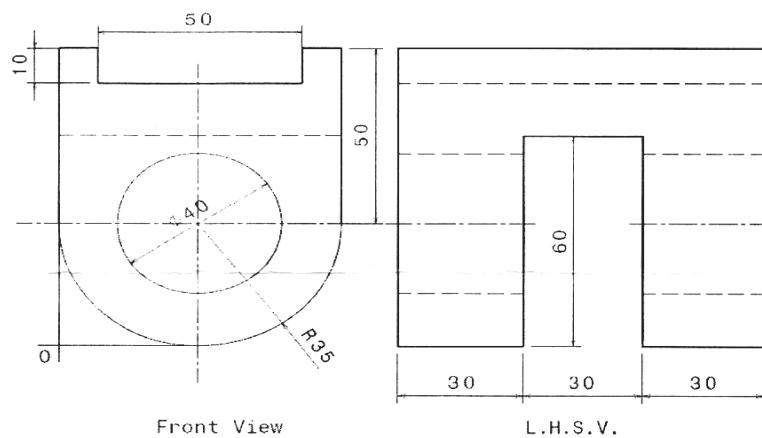


Figure 3

Q8) Figure 4 shows front view and end view of an object. Draw isometric view and show overall dimensions. [12]

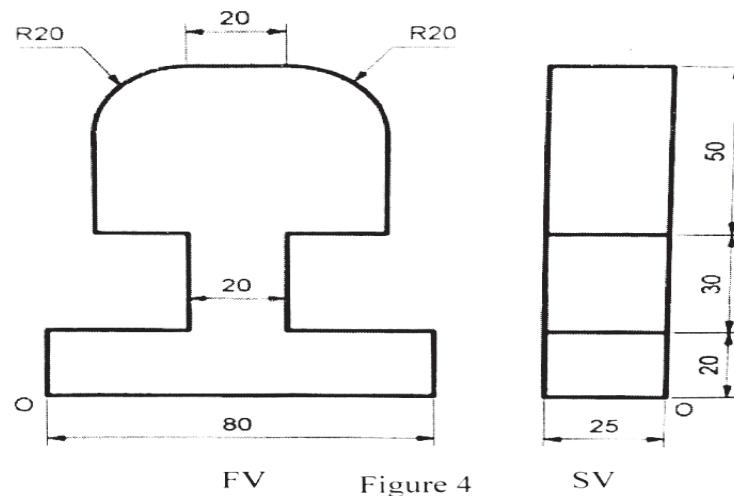


Figure 4



Total No. of Questions : 8]

SEAT No. :

P6500

[5868]-127

[Total No. of Pages : 4

F.E.

ENGINEERING MATHEMATICS - II

(Credit System) (2015 Pattern) (Semester - I & II) (107008)

Time : 2 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 and Q.7 or Q.8.
- 2) Neat diagram must be drawn whenever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic pocket calculator allowed.
- 5) Assume suitable data, if necessary.

Q1) a) Solve the following differential Equations.

i) $x \cos x \cos y + \sin y \frac{dy}{dx} = 0$ [4]

ii) $\cos y - x \sin y \frac{dy}{dx} = \sec^2 x$ [4]

b) When a switch is closed in a circuit containing a battery E, a resistance R and an inductance L, the current i build up at a rate given by $L \frac{di}{dt} + Ri = E$.

Find i as a function of t . How long will it be, before the current has reached 90% of its maximum value, if $E = 6$ volts, $R = 100$ ohms & $L = 0.1$ henry? [4]

OR

Q2) a) Solve $(1+y^2) + (x - e^{-\tan^{-1} y}) \frac{dy}{dx} = 0$ [4]

P.T.O.

- b) Solve the following:
- i) If the temperature of surrounding is 25°C and the body cools from 100°C to 75°C in one minute. What will be its temperature at the end of 3 minutes? [4]
 - ii) A steam pipe 20 cm in diameter is protected with a covering 6cm thick for which the coefficient of thermal conductivity is $k = 0.0003$ cal/cm deg. sec. steady state. Find the heat lost per hour through a meter length of the pipe, if the surface of the pipe is at 200°C and the outer surface of the covering is at 30°C . [4]

Q3) a) Find the half range sine series of the function $f(x) = x - x^2$, in the interval $(0,1)$. [5]

b) Show that $\int_0^\infty \frac{x^8(1-x^6)}{(1+x)^{24}} dx = 0$ [3]

c) Solve any one: [4]

- i) Trace the curve $y^2(2a-x) = x^3$
- ii) Trace the curve $x = a \cos^3 t, y = a \sin^3 t$

OR

Q4) a) Find the length of the cardioid $r = a(1 + \cos \theta)$. [4]

b) If $y = \int_0^x f(t) \sin a(x-t) dt$, show that $\frac{d^2y}{dx^2} + a^2 y = a f(x)$. [4]

c) If $I_n = \int_0^{\pi/4} \frac{\sin(2n-1)x}{\sin x} dx$, then prove that, $n(I_{n+1} - I_n) = \sin\left(\frac{n\pi}{2}\right)$, and hence find I_3 . [4]

Q5) a) Find the equation of the sphere which passes through the point A(-1,0,0) and touches the plane $2x - y - 2z - 4 = 0$ at the point B(1,2,-2). [5]

b) Find the equation of right circular cone with vertex at (0, 3, 0), axis as y -axis and equation of one of the generators of cone is $x = y = z$. [4]

c) The axis of the right circular cylinder of radius 2 is $\frac{x-1}{2} = \frac{y}{3} = \frac{z-3}{1}$.

Find its equation. [4]

OR

Q6) a) Find the equation of the sphere through the circle $x^2 + y^2 + z^2 = 1$, $2x + 3y + 4z = 5$ and which intersects the sphere $x^2 + y^2 + z^2 + 3x - 3y + 3z - 56 = 0$ orthogonally. [5]

b) Find the equation of a right circular cone with vertex at origin, the line $x = y = 2z$ as the axis and semi-vertical angle 30° . [4]

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

Q7) Attempt any Two:

a) Find the area bounded by $y^2 = 4x$ and $y = x - 8$. [6]

b) Evaluate $\int_0^\infty dx \int_0^\infty dy \int_0^\infty \frac{dz}{(1+x^2+y^2+z^2)^2}$. [7]

c) Find the moment of inertia of the area enclosed by $r = a(1 + \sin \theta)$ about the line $\theta = 0$. [6]

OR

Q8) Attempt any Two:

- a) By transforming to polar form evaluate $\iint_R \frac{x^2 y^2}{(x^2 + y^2)} dx dy$ where R is annulus between $x^2 + y^2 = 4, x^2 + y^2 = 9$. [6]
- b) Evaluate $\iiint xyz dxdydz$ over the tetrahedron formed by $x=0, y=0, z=0$ and $x+y+z=1$. [7]
- c) Find the centre of gravity of one loop of $r=a\cos 2\theta$. [6]

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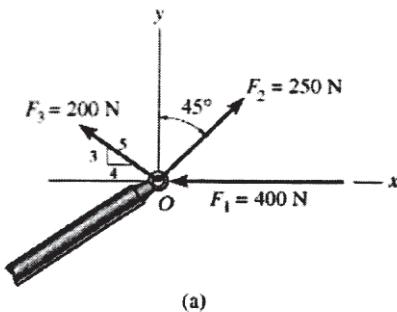
[5868] - 128

F.E.

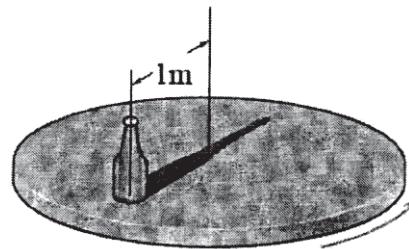
ENGINEERING MECHANICS**(2015 Pattern) (Semester - I & II) (101011)****Time : 2 Hours]****[Max. Marks : 50]****Instructions to the candidates :**

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data, if necessary.
- 4) Use of electronic pocket calculator is allowed in the examination.
- 5) Use of cell phone is prohibited in the examination hall.

- Q1)** a) Determine the resultant of all the three forces 200 N, 250 N and 400 N, acting at 'O' on the bracket as shown in **Fig. 1a**. [4]



(a)

Fig. 1a**Fig. 2b**

- b) The bottle rests at a distance of 1 m from the center of the horizontal platform as shown in **Fig. 2b**. If the coefficient of static friction between the bottle and the platform is $\mu_s = 0.3$ determine the maximum speed that the bottle can attain before slipping. Assume the angular motion of the platform is slowly increasing. [4]
- c) The acceleration of a particle as it moves along a straight line is given by $a = (2t - 1) \text{ m/s}^2$, where t is in seconds. If $s = 1 \text{ m}$ and $v = 2 \text{ m/s}$ when $t = 0$, determine the particle velocity and position when $t = 6 \text{ s}$. [4]
- d) A tennis ball dropped from a height 1800 mm and it rebounds back to a height of 1100 mm. Determine the coefficient of restitution. [4]

OR

- Q2)** a) Determine the position of centroid of the shaded area with respect to origin 'O' as shown in **Fig. 2a.** [4]

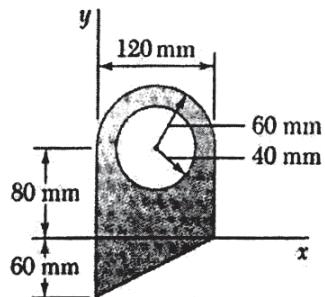


Fig. 2

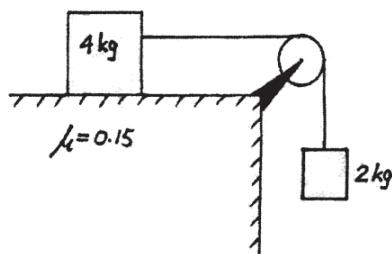


Fig. 2b

- b) The system as shown in **Fig. 2b**, 4 kg block resting on the horizontal floor with coefficient of friction as 0.15, connected with 2 kg block by a inextensible cable which is passing over a frictionless pulley, initially is at rest. Neglecting mass of the pulley, determine the acceleration of the 2 kg block. [4]
- c) A projectile fired from the edge of a 150 m high cliff with an initial velocity of 180 m/s at an angle of elevation of 30° with the horizontal. [4]
Neglecting air resistance find :
- The greatest elevation above the ground reached by the projectile;
 - Horizontal distance from the gun to the point, where the projectile strikes the ground.
- d) A ball has a mass of 20 kg is thrown upward with a speed of 25 m/s. Determine the time and distance travelled by the ball before stopping. Use impulse momentum principle. [4]

- Q3)** a) The I joist supports 20 kN and 40 kN on beam AB of span 7.5 m, as shown in **Fig. 3a.** Determine the support reactions at hinge B and roller D. [5]

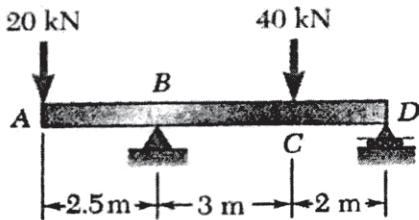


Fig. 3a

- b) A cylinder of 2.5 kN is resting in a trough as shown in **Fig. 3b**. Determine the normal reactions at A and B. [6]

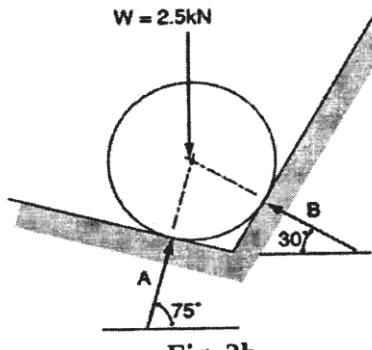


Fig. 3b

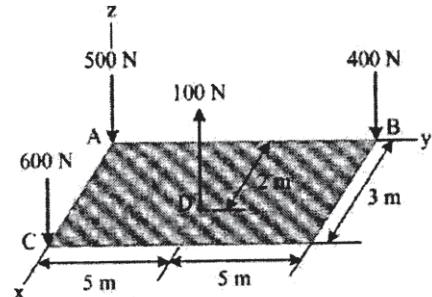


Fig. 3c

- c) The rectangular $3\text{m} \times 10\text{m}$, steel plate subjected to four forces, as shown in **Fig. 3c**. Determine the resultant force in magnitude and direction w.r.to 'O'. [6]

OR

- Q4)** a) Determine the horizontal and vertical components of force that pins A and B exert on the frame as shown in **Fig. 4a**. [6]
- b) Three rods meeting at point A as shown in **Fig. 4b**. Find magnitude of the tension developed in each rod AB, AC and AD. [6]

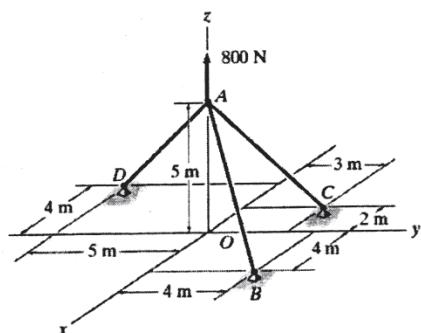


Fig. 4b

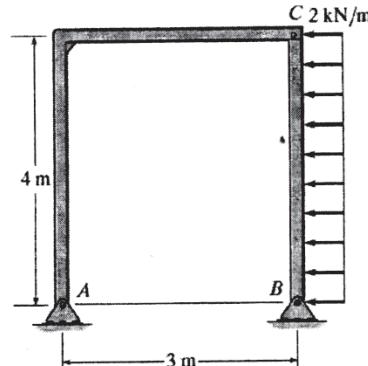


Fig. 4a

- c) The I joist supports 4 kN as shown in **Fig. 4c**. Determine the support reactions at hinge A and roller B, if the self weight of the joist is 2 kN/m. [5]

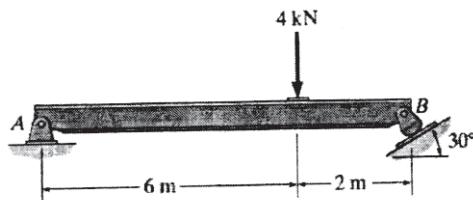


Fig. 4c

- Q5) a)** A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750N stands on a rung 1.5 meter from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor. [6]
- b)** Determine the forces in all the members of the truss loaded and supported as shown in the **Fig. 5b**. Tabulate the result with magnitude and nature of force in the members. [6]

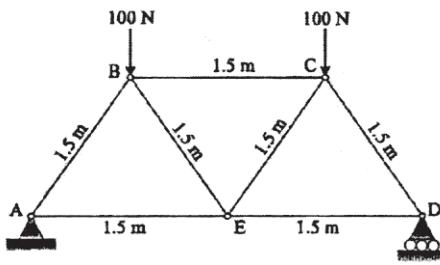


Fig. 5b

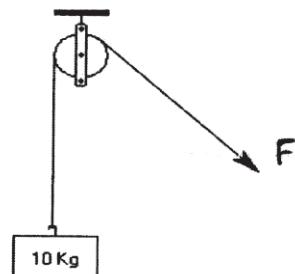


Fig. 5c

- c)** A block of 10kg hanging through a frictionless cable and kept at rest by applying a force of 'F' N on other side of the cable, which is passing through the pulley as shown in the **Fig. 5c**. Determine the range of force required 'F' required to keep the block in rest, if the lap angle between cable and pulley is 125° degrees. (Take $\mu = 0.15$). [5]

OR

- Q6) a)** Cable ABCD is loaded and supported as shown in the **Fig. 6a**. If $d_c = 0.75$ m, determine the component of reaction at A & maximum tension in the cable. [6]

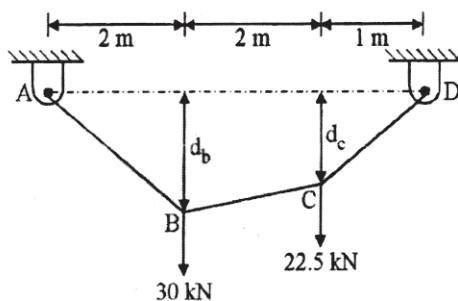


Fig. 6a

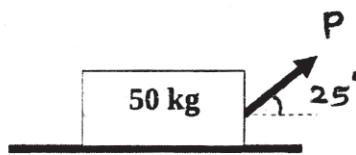


Fig. 6b

- b) A 50 kg block resting on rough horizontal floor with coefficient of friction between floor and block as 0.25, applied with force P inclined upward at an angle 25 degrees with horizontal. Determine the magnitude of the force required just to start the motion of the block. Refer **Fig. 6b.** [6]
- c) Determine the forces in the members BC, BE and AE of the truss loaded and supported as shown in the **Fig.5b**, using section method. Tabulate the result with magnitude and nature of force in the members. [5]

▽ ▽ ▽ ▽

Total No. of Questions : 8]

SEAT No. :

P6501

[5868] - 129

[Total No. of Pages : 2

F.E. (Common)

BASIC MECHANICAL ENGINEERING
(2015 Pattern) (Semester I & II) (102013)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Neat diagrams must be drawn whenever necessary.*
- 2) *Figures to right indicate full marks.*
- 3) *Assume suitable data, if necessary.*
- 4) *Use of non-programmable electronic calculator is permitted.*
- 5) *Attempt four questions of eight : Q.No. 1 or Q.No. 2, Q.No. 3 or Q.No.4, QNo.5 or Q.No.6 Q.No.7 or Q.No8.*

- Q1)** a) What is machine design? Explain various steps involved in design process. [6]
b) How bearings are classified? Explain, with neat sketch, Ball Bearing. [6]

OR

- Q2)** a) Explain working of disc brake with neat sketch. [6]
b) Compare belt drive, chain drive and gear drive. [6]

- Q3)** a) With neat sketch, explain electric arc welding. [7]
b) Explain Turning and Facing operation performed on lathe machine. [6]

OR

- Q4)** a) Explain tapping, Reaming, countersinking operations performed on drilling machine. [6]
b) With neat sketch, explain forging process with its advantages and applications. [7]

- Q5)** a) Explain following terms: [4]
i) Zeroth law of thermodynamics
ii) Closed system

P.T.O.

- b) Define and explain, atmospheric pressure, gauge pressure, absolute pressure and unit of pressure. [4]
- c) A heat pump is used to maintain the house at 24°C , the house is losing the heat at the rate of 1800 kJ/min to the surrounding. If the heat pump is driven by an electric motor of power rating 12kW , find: [5]
- The amount of heat absorbed from the surrounding
 - The COP of heat pump

Draw the sketch of system

OR

- Q6)** a) Explain “Kelvin Plank and Clausius” statement of secod law of thermodynamics. [4]
- b) Prove that : $(\text{COP})_{\text{heat pump}} = 1 + (\text{COP})_{\text{Refrigerator}}$ [4]
- c) A U-tube manometer connected to pipe carrying oil, shows reading of 40cm of mercury. Find the absolute pressure of oil in the pipe, if barometer reading is 10m of water. Assume: density of mercury is 13600kg/m^3 and $g=9.81\text{m/s}^2$. [5]

- Q7)** a) Draw layout of nuclear power plant and explain the energy extraction with its limitations. [6]
- b) Explain with neat sketch working of reciprocating pump. [6]

OR

- Q8)** a) Explain working of four stroke petrol engine with neat sketch. [6]
- b) Explain with neat sketch, single acting single stage reciprocating air compressor. [6]



Total No. of Questions : 9]

SEAT No. :

PA-4292

[Total No. of Pages : 4

[5924]-1

F.E.

ENGINEERING MATHEMATICS - II
(2019 Pattern) (Semester - II) (107008)

Time : 2½ Hours

[Max. Marks : 70

Instructions to the candidates :

- 1) *Question 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, Q.No.8 or Q.No.9.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

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

a) $\int_0^{\pi/2} \sin^5 x dx =$ [2]

- | | |
|---------------------|----------------------------------|
| i) $\frac{15}{8}$ | ii) 0 |
| iii) $\frac{8}{15}$ | iv) $\frac{8}{15} \frac{\pi}{2}$ |

b) To evaluate integration $\int_0^a \int_{\sqrt{a^2-y^2}}^{y+a} f(x, y) dx dy$ we should first evaluate the

inner integral with respect to [2]

- | | |
|---------|--------------|
| i) y | ii) x |
| iii) xy | iv) y then x |

P.T.O.

c) The general form of equation of sphere is [2]

$x^2 + y^2 + z^2 + 2ux + 2vy + 2wz + d = 0$ for which centre and radius are given by

- i) $c(u, v, w); r = \sqrt{u^2 + v^2 + w^2 - d}$
- ii) $c(-u, -v, -w); r = \sqrt{u^2 + v^2 + w^2 + d}$
- iii) $c(u, v, w); r = \sqrt{u^2 + v^2 + w^2 + d}$
- iv) $c(-u, -v, -w); r = \sqrt{u^2 + v^2 + w^2 - d}$

d) The curve $x = t^2, y = t - \frac{t^3}{3}$ is [2]

- i) symmetric about X-axis
- ii) symmetric about Y-axis
- iii) symmetric about both the axes
- iv) none of these

e) $\iiint dx dy dz$ represents [1]

- | | |
|-----------|------------------------|
| i) volume | ii) centre of gravity |
| iii) Area | iv) Moment of inertia. |

f) Total number of loops for the curve $r = a \sin 5\theta$ are [1]

- | | |
|--------|-------|
| i) 2 | ii) 3 |
| iii) 4 | iv) 5 |

Q2) a) If $I_n = \int_0^{\pi/4} \tan^n \theta d\theta$ then show that $I_n = \frac{1}{n-1} I_{n-2}$ [5]

b) Evaluate $\int_0^\infty \sqrt{x} e^{-x^3} dx$. [5]

c) Prove that $\int_0^\infty \frac{e^{-ax} \sin x}{x} dx = \cot^{-1} a$ [5]

OR

Q3) 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 $\int_0^1 x^3(1-\sqrt{x})^5 \, dx$. [5]

c) Prove that $\int_0^\infty e^{-x^2-2bx} \, dx = \frac{\sqrt{\pi}}{2} e^{b^2} [1 - \operatorname{erf}(b)]$ [5]

Q4) a) Trace the curve : $y^3 = x^2 (2a - y)$. [5]

b) Trace the curve : $r = a \cos 3\theta$. [5]

c) Find the length of the upper arc of one loop of Lemiscale $r^2 = a^2 \cos 2\theta$ [5]

OR

Q5) a) Trace the curve : $ay^2 = x^2(a - x)$. [5]

b) Trace the curve : $r = a(\sqrt{2} + \sin \theta)$. [5]

c) Trace the curve : $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [5]

Q6) a) Show that the plane $2x - 2y + z + 12 = 0$ touches the sphere [5]

$$x^2 + y^2 + z^2 - 2x - 4y + 2z - 3 = 0.$$

Also find the point of contact.

b) Find the equation of right circular cone having its vertex at the origin and passing through the circle : $x^2 + z^2 = 25$, $y = 4$. [5]

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

OR

- Q7)** a) Show that the spheres $x^2 + y^2 + z^2 = 25$ and $x^2 + y^2 + z^2 - 18x - 24y - 40z + 225 = 0$ touch externally and also find their point of contact. [5]
- b) Find the equation of right circular cone whose vertex is at $(0, 0, 10)$ and whose intersection with the XoY plane is a circle of radius 5. [5]
- c) Find the equation of right circular cylinder of radius 2 whose axis passes through $(1, 2, 3)$ and has direction ratios $2, -3, 6$. [5]

- Q8)** a) Change the order of integration and evaluate $\int_0^\infty \int_y^\infty \frac{e^{-x}}{x} dx dy$. [5]
- b) Find the area of one loop of the curve $r = a \cos 2\theta$. [5]
- c) Find the x -co-ordinate of the centre of gravity of the area bounded by $y^2 = x$ and $x + y = 2$. Given that $A = \frac{9}{2}$ is the area of the region bounded by the given curves. [5]

OR

- Q9)** a) Evaluate $\iint x^2 y^2 dx dy$ over positive quadrant of $x^2 + y^2 = a^2$, using polar transformations. [5]
- b) Prove that volume bounded by cylinders $y^2 = x$, $x^2 = y$ and planes $z = 0$, $x + y + z = 2$ is $\frac{11}{30}$. [5]
- c) Find the x -co-ordinate of the centre of gravity of one loop of $r = a \sin 2\theta$, (in first quadrant). Given that the area of loop is $A = \frac{\pi a^2}{8}$. [5]



[5924]-10

F.E. (All)

ENGINEERING MECHANICS**(2019 Pattern) (101011)***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 and Q.7 or Q.8.
- 2) Figures to the right side indicate full marks.
- 3) Assume suitable data if necessary.
- 4) Use of electronic pocket calculator is allowed in the examination.
- 5) Use of cell phone is prohibited in the examination hall.

- Q1) a)** Determine the magnitude and direction θ of force F, so that the particle is in equilibrium for force system as shown in Fig.1a. 8kN at 30 degrees, 4kN at 60degrees with 'x' axis. [6]

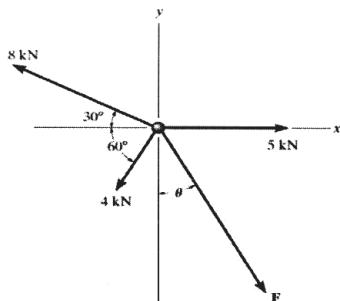


Fig. 1a

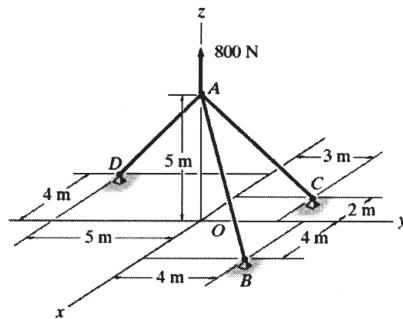
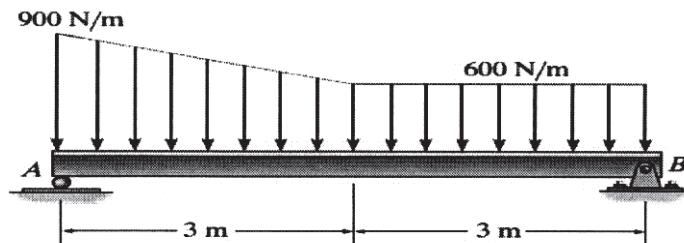


Fig. 1b

- b) Three rods meeting at point A as shown in Fig.1b. Find magnitude of the tension developed in each rod AB, AC and AD. [6]
- c) Determine the support reaction of beam loaded and supported as shown in Fig.1c. [6]



OR

P.T.O.

- Q2)** a) Cable ABC has a length of 5m. Determine the position x and the tension developed in ABC required for equilibrium of the 100-kg sack as shown in Fig.2a. Neglect the size of the pulley at B. [6]

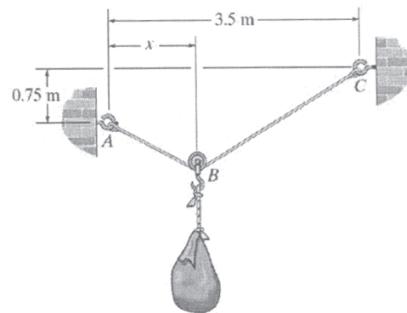


Fig. 2a

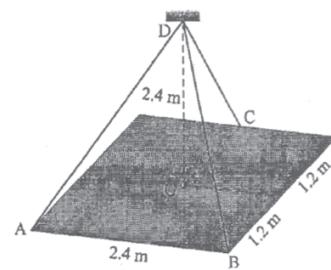


Fig. 2b

- b) The square $2.4\text{m} \times 2.4\text{m}$, steel plate has a mass of 1800kg with mass centre G (vertically below D) as shown in Fig.2b. Determine the tension in each cable AD, BD and CD, so that the plate remains in horizontal plane. [6]
- c) The I joist supports 4 kN as shown in Fig.2c. Determine the support reactions at hinge A and roller B. [6]

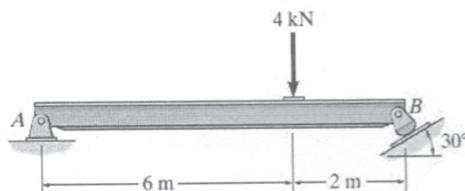


Fig. 2c

- Q3)** a) A snow load transfers the forces shown to the upper joints of a pratt roof truss. Neglect any horizontal reactions at the supports and determine the forces in all members. Refer Fig.3a. [6]

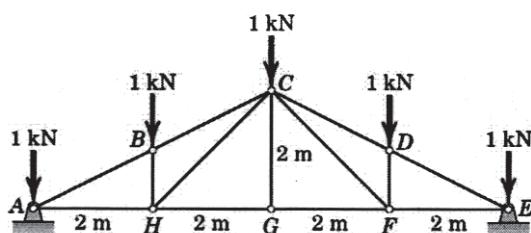


Fig. 3a

- b) The cable segment support the loading as shown in Fig.3b. Determine the support reaction and maximum tension in segment of cable. [5]
- c) Determine the horizontal and vertical components of force that pins A and B exert on the frame as shown in Fig. 3c. [6]

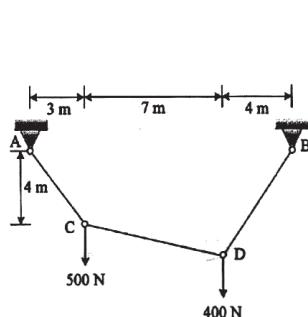


Fig. 3b

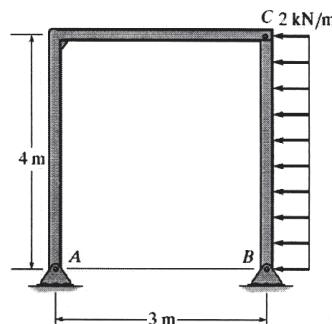


Fig. 3c

OR

- Q4)** a) Determine the forces in all members of the truss loaded and supported as shown in the Fig.4a. Tabulate the result with magnitude and nature of force in the members. [6]

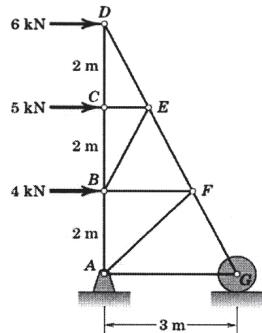


Fig. 4a

- b) Cable ABCDE supports three loads $P_1 = 800\text{N}$, $P_2 = 500\text{N}$, as shown in Fig.4b. Find vertical intercept 'y', at B and D. [5]

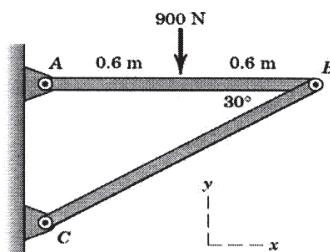


Fig. 4c

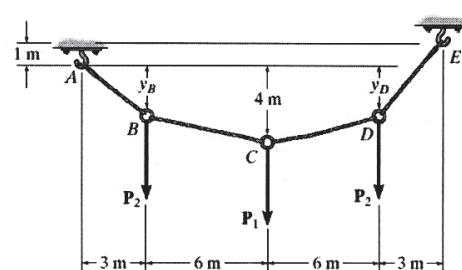


Fig. 4b

- c) Determine the force (magnitude and direction) which member BC exerts on member AB if the 900-N load is applied to the centre of member AB. Refer Fig. 4c. [6]

- Q5) a)** A sphere is fired downwards into a medium with an initial speed of 27 m/s. If it experiences a deceleration of $a = (-6t^2)$, where t is in seconds, determine the distance travelled before it stops. [6]
- b)** A projectile is launched with a speed of $V_0 = 25$ m/s at an angle of projection 30° with horizontal as shown in Fig. 5b. Determine the maximum distance travelled by projectile along horizontal and vertical direction. [6]

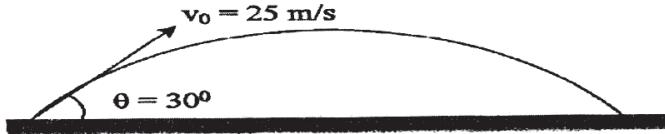


Fig. 5b

- c)** A car starts from rest and with constant acceleration achieves a velocity of 15m/s when it travels a distance of 200 m. Determine the acceleration of the car and the time required to attain the velocity. [6]

OR

- Q6) a)** Ball A is thrown vertically upward from the top of a 30-m-high-building with an initial velocity of 5 m/s. At the same instant another ball B is thrown upward from the ground with an initial velocity of 20 m/s. Determine the height from the ground and the time at which they pass. [6]
- b)** A motorist is traveling on a curved section of highway of radius 762 m at the speed of 96 kmph. The motorist suddenly applies the brakes, causing the automobile to slow down at a constant rate. Knowing that after 8s the speed has been reduced to 72 kmph, determine the acceleration of the automobile immediately after the brakes have been applied. [6]
- c)** A stone is dropped from the top of a tower 50 m high, At the same time another stone is thrown up from the foot of the tower with a velocity of 25 m/s. At what distance from the top & after how much time the two stones cross each other? [6]
- Q7) a)** A truck is traveling on a level road at a speed of 80 km/h when its brakes are applied to slow it down to 30 km/h. An antiskid breaking system limit the breaking force to a value at which the wheels of the truck are just about to slide. The coefficient of kinetic friction between the road and the wheels is 0.65, using impulse momentum principle determine the shortest time needed for the truck to slow down. [6]

- b) The bottle rests at a distance of 1m from the center of the horizontal platform as shown in Fig. 7a. If the coefficient of static friction between the bottle and the platform is $\mu_s = 0.3$ determine the maximum speed that the bottle can attain before slipping. Assume the angular motion of the platform is slowly increasing. [5]

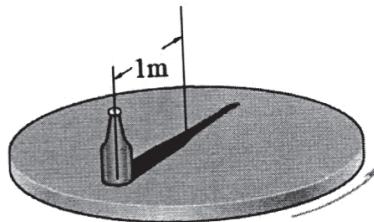


Fig. 7a

- c) A ball is dropped from a height $h_0 = 1$ m on a smooth floor. Knowing that the height of the first bounce is $h_1 = 81\text{cm}$, determine (a) coefficient of restitution, and (b) expected height h_2 after the second bounce. [6]

OR

- Q8)** a) Calculate the velocity V of the 50-kg crate, as shown in Fig. 8a, when it reaches the bottom of the chute at B, if it is given an initial velocity of 4 m/s down the chute at A. The coefficient of kinetic friction is 0.30. [6]

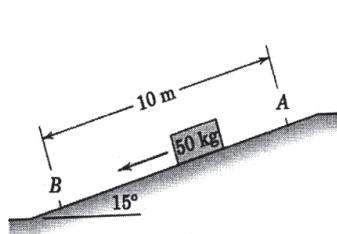


Fig. 8A

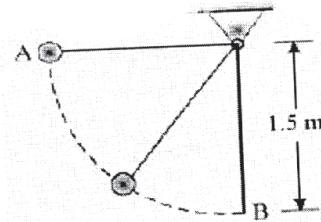


Fig. 8b

- b) The 2kg pendulum bob 1.5m, is released from rest when it is at A as shown in Fig.8b. Determine the speed of the bob, using work energy principle, when it passes through its lowest position B. [5]
- c) A ball of mass 1 kg moving with a velocity of 2 m/s impinges directly on a ball of mass 2 kg which is at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution. [6]

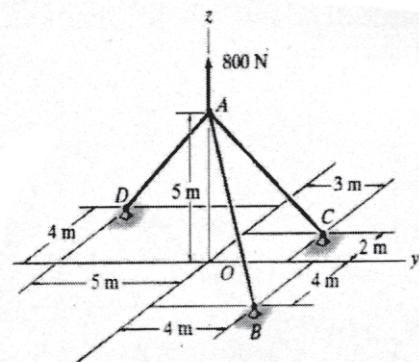
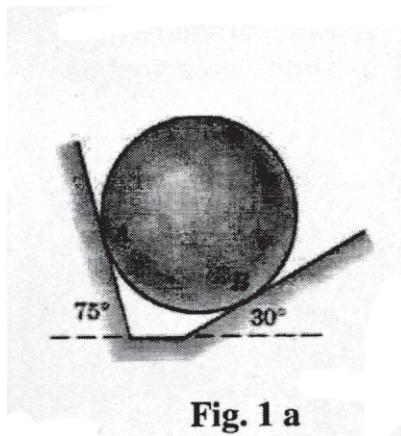


[5924]-10A
F.E. (Common)
ENGINEERING MECHANICS
(2019 Pattern) (End Sem) (101011)

*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.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 and clearly state.
- 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) Determine the tension developed in each cable AB, AC and AD due to pull 800 N applied at A, as shown in **Fig. 1 b.** [8]

**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) The building slab is subjected to four (F_1 , F_2 , 6kN, 12kN) parallel column loadings as shown in **Fig. 2b**. Determine the resultant force and specify its location (x , y) on the slab w.r.to origin. Take $F_1 = 8\text{kN}$ and $F_2 = 9\text{kN}$. [7]

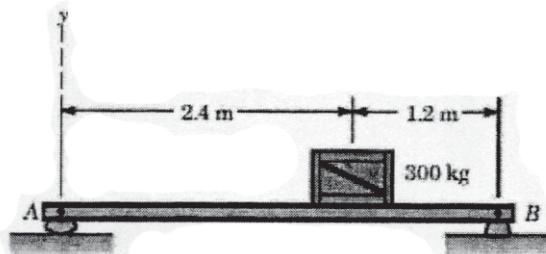


Fig. 2 a

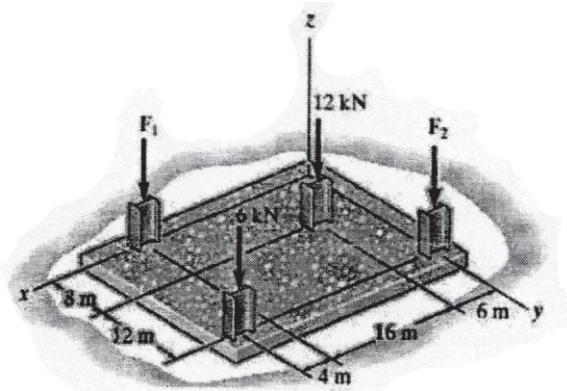


Fig. 2 b

- 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 tension in each segment of the cable loaded and supported as shown in **Fig. 3 b**. [7]

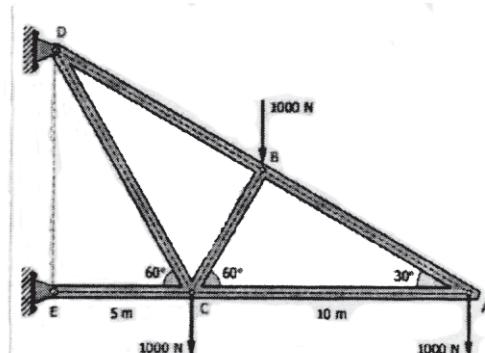


Fig. 3 a

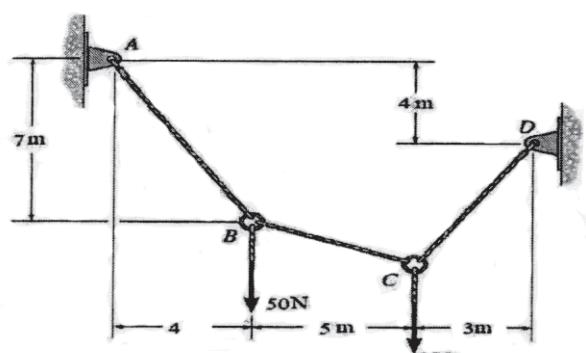


Fig. 3 b

- 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) Determine the tension in cables AC and AB needed to hold the 20-kg ball at D in equilibrium. Take $F = 300 \text{ N}$ and $d = 1 \text{ m}$, for the **Fig. 4 b.** [6]

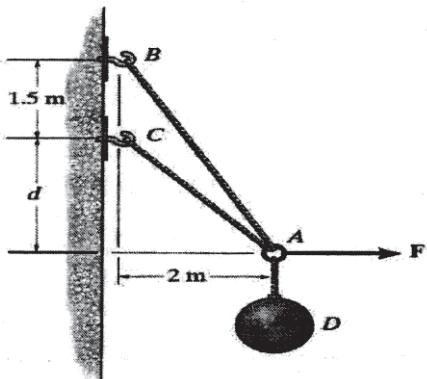


Fig. 4 b

- c) Explain " $m = (2j-3)$ "; " $m < (2j-3)$ " and " $m > (2j-3)$ " 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 $t = 0 \text{ sec}$, the velocity is 2 m/s and displacement is 7 m . Determine velocity and displacement of particle at $t = 3 \text{ seconds}$. [6]
- b) A stone thrown vertically upward with 25 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) It is observed that the time for the ball to strike the ground at B is 2.5 seconds , after throwing from A. Determine the speed v_A and θ_A angle at which the ball was thrown. Refer **Fig. 5c.** [6]

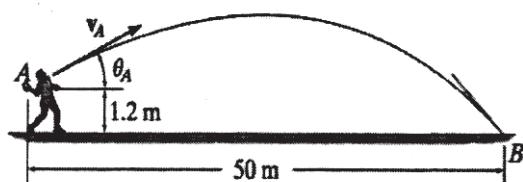


Fig. 5 c

OR

- Q6) a)** The car moves in a straight line such that for a short time its velocity is defined by $V = 3t^2 + 2t$ m/s where t is in seconds. Determine its position and acceleration when $t = 3$ s. When $t = 0$, $s = 0$. [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]

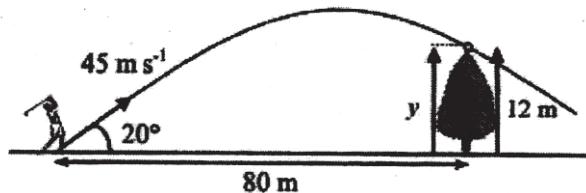


Fig. 6 b

- c)** A motorist is travelling on a curved section of highway of radius 762 m at a speed of 96 kmph. The motorist suddenly applies the brakes, causing the automobile to slow down at constant rate. Knowing that after 8 s the speed has been reduced to 72 kmph. Determine the acceleration of automobile when speed reduced to 72 kmph. [6]
- 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]

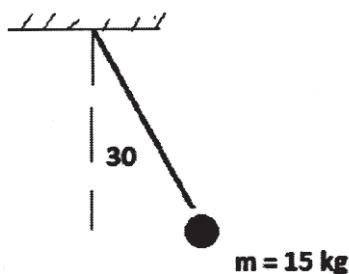


Fig. 7 a

- c) A ball of mass 1 kg moving with a velocity of 2 m/s impinges directly on a ball of mass 2 kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution. [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) If the coefficient of kinetic friction between the 100-kg crate and the inclined plane is, $\mu_k = 0.25$, determine the speed of the crate at the instant the compression of the spring is $x = 1.5 \text{ m}$. Initially the spring is upstretched and the crate is at rest, as shown in **Fig. 8b**. [6]
- c) Disk A has a mass of 2 kg and is sliding forward on the smooth surface with a velocity $v_{A1} = 5 \text{ m/s}$ when it strikes the 4-kg disk B, which is sliding towards A at $v_{B1} = 2 \text{ m/s}$ with direct central impact as shown in **Fig. 8c**. If the coefficient of restitution between the disks is $e = 0.4$. compute the velocities of A and B just after collision. [5]

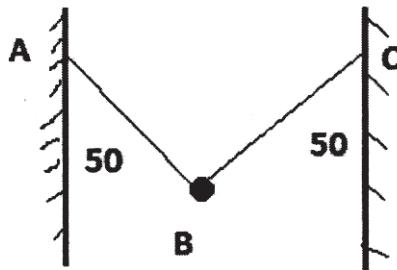


Fig. 8 a

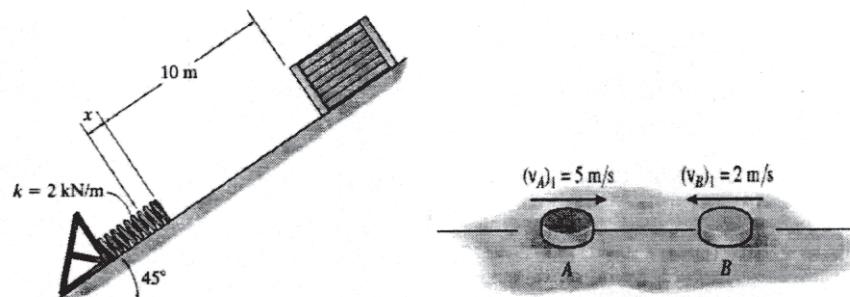


Fig. 8 b

Fig. 8 c



Total No. of Questions : 8]

SEAT No. :

PA-4293

[Total No. of Pages : 3

[5924]-2

F.E. (Theory)

ENGINEERING GRAPHICS

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

Time : 2½ Hours]

[Max. Marks : 50

Instructions to the candidates:

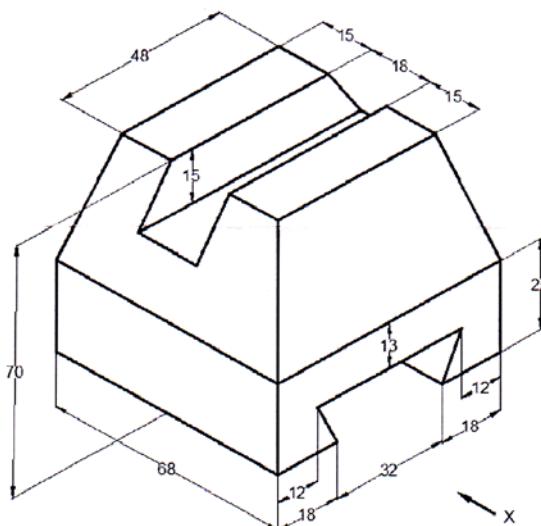
- 1) Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Assume suitable data, if necessary.
- 3) Retail all the construction lines.

Q1) The throw of a ball from a fielder on a cricket ground reaches the wicket-keeper's gloves, following a parabolic path. Assume the point of throw and the point of catch to be 1 meter above the ground. Maximum height achieved by the ball above the ground is 31 m. Draw the path of the ball if the radial distance between the fielder and the wicket-keeper is 75 m. Use suitable scale. [8]

OR

Q2) Draw a helix of one convolution around a cylinder when its diameter 60 mm, height 130 mm and pitch is 120 mm. [8]

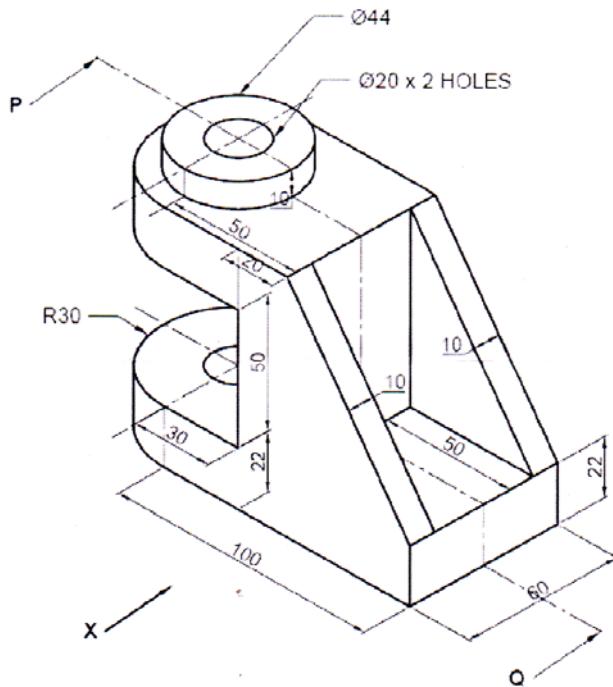
Q3) Figure shows a pictorial view of an object. By using first angle method of projection draw, Front View in the direction of X, Top View and LHSV. Give dimensions in all views. [16]



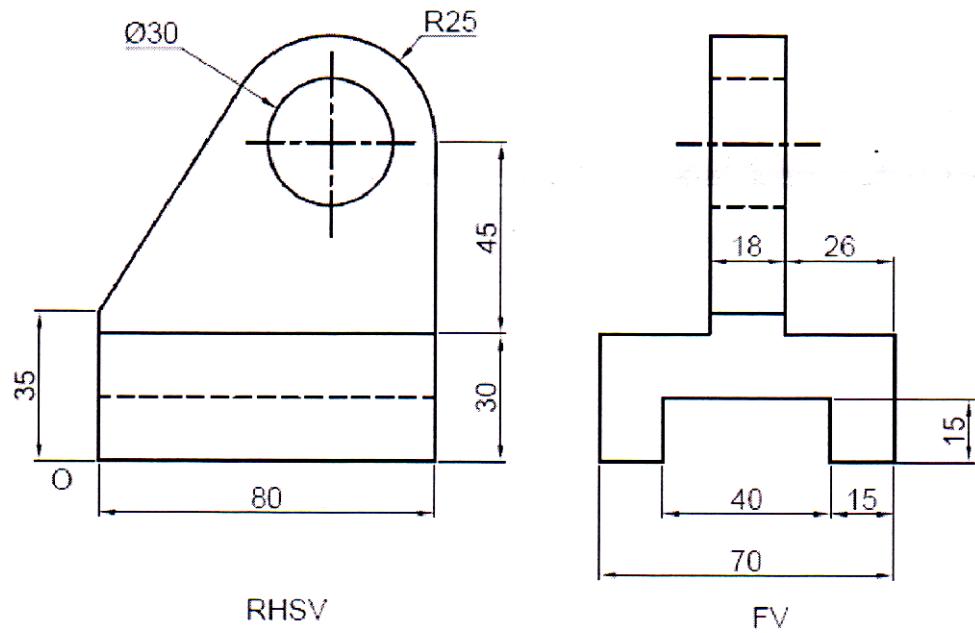
OR

P.T.O.

Q4) Figure shows a pictorial view of an object. By using first angle method of projection draw, Sectional Front View along section P-Q looking in the direction of X, Top View and RHSV. Give dimensions in all views. [16]

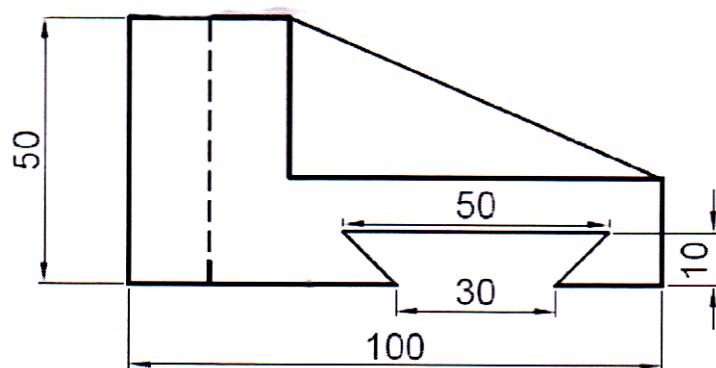
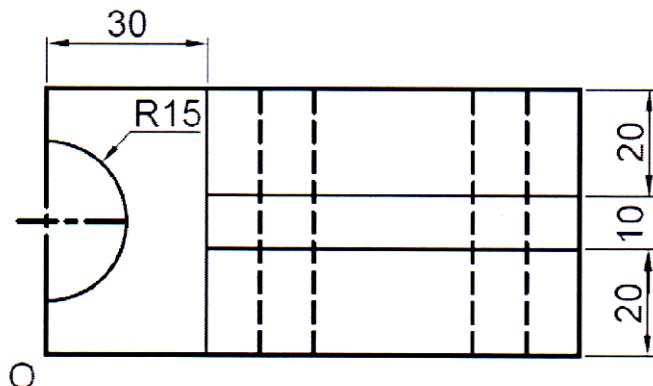


Q5) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. [16]



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 right circular cone having diameter of base 40 mm and axis length 60 mm is resting on its base in HP. It is cut by an AIP inclined at 45° to HP and bisecting the axis. Draw the development of the lateral surface of the cone. [10]

OR

Q8) A pentagonal prism of base side 30 mm and axis length 70 mm, resting in HP such way that one of the base sides is parallel to VP and near to observer. Draw the development of lateral surface when section plane is inclined at 45° and bisects the axis of solid. [10]



Total No. of Questions : 9]

SEAT No. :

PA-4294

[Total No. of Pages : 4

[5924]-3

F.E.

ENGINEERING CHEMISTRY
(2019 Pattern) (Semester - I) (107009)

Time : 2½ Hours

[Max. Marks : 70

Instructions to the candidates :

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

Q1) Multiple Choice Questions :

- a) Applications of quantum dots are [2]
i) Light emitting diode ii) Photo detectors
iii) Biological analysis iv) All of these
- b) CDS and DVDS can be made by using [1]
i) Polycarbonate ii) Polyphenylene vinylene
iii) Kevlar iv) Polyisoprene
- c) $NCV = GCV - \text{_____} \times H \times 587 \text{ Kcal/kg.}$ [1]
i) 0.9 ii) 9
iii) 0.09 iv) 90
- d) Kjeldhal's method is used for determination of [1]
i) % H ii) % N
iii) % S iv) % C

P.T.O.

- e) Electromagnetic radiations consist of _____ oscillating perpendicular to each other. [2]
- i) Electric and magnetic field ii) Electric and magnetic radiation
iii) Charged particle iv) All of these
- f) Infrared spectroscopy is also called as _____. [1]
- i) Rotational spectroscopy
ii) Electronic excitation spectroscopy
iii) Vibrational spectroscopy
iv) Nuclear excitation spectroscopy
- g) Which of the following film is protective? [1]
- i) Porous ii) Non porous
iii) Volatile iv) None of these
- h) Tinning is the example of [1]
- i) Anodic coating ii) Cathodic coating
iii) Neither anode nor cathode iv) Both anode and cathode

- Q2)** a) Define conducting polymers. What is the structural requirement for a polymer to show conductive property? Give doping reactions two properties and two applications of conducting polymer. [6]
- b) Explain the structure of graphene with the help of diagram and mention its two properties and two applications. [5]
- c) What are biodegradable polymers? Explain the three factors responsible for biodegradation. [4]

OR

- Q3)** a) Define Polymer composites. Discuss the classification on the basis of reinforcement with any two applications. [6]
- b) Discuss the different types of carbon nanotubes with respect to their structure. Give any two application of carbon nanotubes. [5]
- c) What are the nanomaterials? Classify any two on the basis of dimensions. Give any two applications. [4]

- Q4)** a) Explain in brief the process with diagram for distillation of crude petroleum. Give composition, boiling range and uses of two fractions obtained. [6]
- b) What is Power alcohol? Give its preparation with reactions and any two advantages. [5]
- c) Calculate the NCV of fuel containing 6% hydrogen with the following data of Bomb calorimeter experiment. [4]
- i) Mass of fuel = 0.850 gm
 - ii) Mass of water in calorimeter = 2200 gm
 - iii) Water equivalent of calorimeter set = 750 gm
 - iv) Rise in temperature = 2.82°C

OR

- Q5)** a) What is proximate analysis? Mention the principle involved in the analysis of each of these constituents. Give the significance of any one constituent. [6]
- b) Explain the production of hydrogen by steam reforming of methane and coke with reaction conditions. [5]
- c) 0.30 gm of coal sample on burning in combustion chamber in current of pure O₂ was found to increase weight of CaCl₂ U tube by 0.11 gm and KOH U tube by 0.62 gm. Find carbon hydrogen % in the coal sample. [4]

- Q6)** a) Draw the block diagram of single beam UV visible spectrophotometer. Explain its four components and give their function. [6]
- b) Give the principle of IR spectroscopy. Explain the fundamental modes of stretching vibrations. [5]
- c) Define the following terms : [4]
- i) Auxochrome
 - ii) Chromophore
 - iii) Bathochromic shift
 - iv) Hyperchromic shift

OR

Q7) a) Explain different types of electronic transitions that occurs in an organic molecule after absorbing UV radiations. [6]

b) What are the conditions of absorption of IR radiations by the molecule? Explain any two applications of IR spectroscopy. [5]

c) Calculate the fundamental modes of vibrations in the following molecules. [4]



Q8) a) Explain the mechanism of dry corrosion. Give the nature of oxide film and reaction in oxidation corrosion of Mg and Cr. [6]

b) What is the principle of Cathodic protection? Explain sacrificial anodic protection of metal. [5]

c) Explain any four factors affecting the rate of corrosion related to metal. [4]

OR

Q9) a) Define electroplating. Explain the process with diagram and reactions. Give any two applications of electroplating. [6]

b) Explain the mechanism of wet corrosion by Hydrogen evolution with diagram and reactions. [5]

c) What is Galvanising? Explain the process with neat labelled diagram to protect iron from corrosion. [4]



Total No. of Questions : 8]

SEAT No. :

PA-4295

[Total No. of Pages : 3

[5924]-4

F.E.

ENGINEERING PHYSICS

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 5) Assume suitable data, if necessary.

Physical Constants :

- 1) Mass of Electron (M_e) = 9.1×10^{-31} kg
- 2) Charge on Electron (e) = 1.6×10^{-19} C
- 3) Mass of Proton (M_p) = 1.673×10^{-27} kg
- 4) Mass of neutron (M_n) = 1.673×10^{-27} kg
- 5) Velocity of light (c) = 3×10^8 m/s
- 6) Plank's constant (h) = 6.63×10^{-34} J.s

- Q1)** a) What is the significance of Schrodinger's equation? Derive schrodinger's time independent equation. [6]
- b) Derive the expression for de Broglie wavelength for a particle when it is moving with kinetic energy 'E'. [4]
- c) With a schematic diagram, explain in brief the principle of scanning tunneling microscope. [4]
- d) If a proton is moving with velocity 2% of the velocity of light, calculate de Broglie wavelength. [4]

OR

- Q2)** a) For a particle trapped in one-dimensional rigid box (infinite potential well), derive the equation for its energy. Explain in brief why this energy is quantized. [6]

P.T.O.

- b) For an electron accelerated by potential difference V , derive the expression for its de Broglie wavelength. [4]
- c) What is de Broglie hypothesis of matter waves? Explain in brief why matter waves are neither electromagnetic nor mechanical waves. [4]
- d) An electron is trapped in an infinite potential well of width 1.75 \AA . Calculate energy difference between ground and first energy level. [4]

- Q3)**
- a) Explain Hall effect with suitable diagram. Derive the expression for Hall voltage and Hall coefficient. [6]
 - b) Draw a neat and labelled diagram showing I-V characteristics of a solar cell. Write the equations for fill factor and efficiency of solar cell. [4]
 - c) Define Fermi level in metals. Write Fermi-Dirac probability distribution function and explain the meaning of each term. [4]
 - d) Calculate number of donor atoms which must be added to an intrinsic semiconductor to obtain a resistivity of 12 ohm-cm (Mobility of electrons, $\mu_c = 500 \text{ cm}^2/\text{V.S.}$) [3]

OR

- Q4)**
- a) Explain classification of solids into conductors, semiconductors and insulators on the basis of band theory. [6]
 - b) Define Fermi level in semiconductor. Draw neat & labelled diagram showing position of Fermi level in intrinsic, N-type and P-type semiconductors. [4]
 - c) State the advantages (any two) and applications (any two) of solar cell. [4]
 - d) An N type semiconductor has a thickness 0.12 mm and a current of 1mA is flowing along its length. When a magnetic field of 1.5 T is applied along its thickness, calculate voltage developed across its width. [Hall coefficient, $R_H = 3.68 \times 10^{-4} \text{ m}^3/\text{C}$] [3]

- Q5)**
- a) On the basis of orbital and spin motion of electron and spin motion of nucleus, explain origin of magnetism. [6]
 - b) Define (i) magnetic field strength (ii) magnetic induction (iii) magnetic permeability. Write relation between them [4]

- c) What is super conductivity? Differentiate between type I & type II super conductors (any three). [4]
- d) The transition temperature T_c for lead is 7.26 K. The critical magnetic field at 0K i.e. $H_c(0)$ is 8×10^5 A/m. It is to be used as a super conductor subjected to a magnetic field $H_c(T)$ of 4×10^4 A/m. At what maximum temperature T, it can be operated without losing its superconductivity. [4]

OR

- Q6)** a) Explain Meissner effect in brief. What is the cause of Meissner effect? Show that super conductors exhibit perfect diamagnetism. [6]
- b) What is magnetic permeability (μ) & magnetic susceptibility (χ). Obtain relation between them. [4]
- c) Differentiate between diamagnetism and ferromagnetism (Any two points) [4]
- d) For Niobium, if critical temperature T_c is 11.3 K and critical magnetic field at 0K is. $H_c(0)$ is 2×10^5 A/m, Calculate critical magnetic field $H_c(T)$ at $T = 4.2\text{K}$. [4]
- Q7)** a) Explain electrical and mechanical properties of nanoparticles. [6]
- b) Write applications of nanotechnology in the field of electronics. Explain any one application in brief. [4]
- c) What are ultrasonic waves? An ultrasonic wave of velocity 6400 m/s is sent through the top of an aluminium block of thickness 4.5 cm. It is reflected back from the internal flaw. After what time echo would be obtained. [4]
- d) Explain in brief, the principle of radiography testing technique. [3]

OR

- Q8)** a) What is Non-Destructive Testing (NDT)? State objectives of NDT (any two). State advantages of NDT over DT (any two). [6]
- b) Write applications of nanotechnology in the field of automobiles. Explain any one application in brief. [4]
- c) What are ultrasonic waves? An ultrasonic wave is sent through a block of steel and its echo is received after 1.5 μs . if velocity of ultrasonic waves is 5890 m/s, determine location of the flaw. [4]
- d) Explain optical properties of nanoparticles. [3]



Total No. of Questions : 9]

SEAT No. :

PA-4296

[Total No. of Pages : 4

[5924]-5

F.E.

ENGINEERING MATHEMATICS - I

(2019 Pattern) (107001) (Semester - I) (End - Sem)

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, if necessary.
- 4) Figures to the right indicate full marks.

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

a) If $u = x^3 + y^3$ then $\frac{\partial^2 u}{\partial x \partial y}$ is equal to [2]

- | | |
|--------|--------|
| i) 3 | ii) -3 |
| iii) 2 | iv) 0 |

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

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

c) For $c_1 x_1 + c_2 x_2 = 0$ where, x_1, x_2 are non-zero vectors and c_1, c_2 are constants then x_1, x_2 are linearly independent if [2]

- | | |
|-----------------------------|---------------------------|
| i) $c_1 \neq 0, c_2 \neq 0$ | ii) $c_1 \neq 0, c_2 = 0$ |
| iii) $c_1 = 0, c_2 \neq 0$ | iv) $c_1 = 0, c_2 = 0$ |

P.T.O.

d) The quadratic form corresponding to the matrix $M = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -4 & 6 \\ 3 & 6 & 5 \end{bmatrix}$ is [2]

i) $Q(x) = x_1^2 - 4x_2^2 + 5x_3^2 + 4x_1x_2 + 6x_1x_3 + 12x_2x_3$

ii) $Q(x) = x_1^2 + 2x_2^2 + 3x_3^2$

iii) $Q(x) = x_1^2 - 4x_2^2 + 5x_3^2 + 2x_1x_2 + 3x_1x_3 + 6x_2x_3$

iv) $Q(x) = x_1^2 - 4x_2^2 + 5x_3^2$

e) If $u = x^2 + y^2 + 2x$, $\frac{\partial u}{\partial y}$ is equal to [1]

i) $2x + 2$

ii) $2y$

iii) $2x + 2y + 2$

iv) 2

f) If for a square matrix M of order 2, sum of diagonal elements = 4 and $|M|=3$ then. Characteristic equation of A is [1]

i) $\lambda^2 - 3\lambda + 4 = 0$

ii) $\lambda^2 - 4\lambda + 3 = 0$

iii) $\lambda^2 + 3\lambda + 4 = 0$

iv) $\lambda^2 + 4\lambda + 3 = 0$

Q2) a) If $u = 2x + 3y$, $v = 3x - 2y$ 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 $u = \operatorname{cosec}^{-1} \sqrt{\frac{x^{\frac{1}{2}} + y^{\frac{1}{2}}}{x^{\frac{1}{3}} + y^{\frac{1}{3}}}}$ then prove that
 $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{\tan 4}{144} [\tan^2 u + 13]$. [5]

c) If $x = u + v + w$, $y = uv + vw + uw$, $z = uvw$ and ϕ is function of x, y, z
then prove that $u \cdot \frac{\partial \phi}{\partial u} + v \frac{\partial \phi}{\partial v} + w \frac{\partial \phi}{\partial w} = x \cdot \frac{\partial \phi}{\partial x} + 2y \frac{\partial \phi}{\partial y} + 3z \frac{\partial \phi}{\partial z}$. [5]

OR

Q3) a) If $z = \tan(y + ax) - (y - ax)^{\frac{3}{2}}$ then find value of $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}$. [5]

b) If $u = \log(x^3 + y^3 - x^2y - xy^2)$ then find value of $x^2 \cdot \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \cdot \frac{\partial^2 u}{\partial y^2}$ [5]

c) If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ then find value of $x \cdot \frac{\partial u}{\partial x} + y \cdot \frac{\partial u}{\partial y} + z \cdot \frac{\partial u}{\partial z}$ [5]

Q4) a) If $x = v^2 + w^2$, $y = w^2 + u^2$, $z = u^2 + v^2$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ [5]

b) In calculating the volume of a right circular cylinder, using the formula :
 $V = \pi r^2 h$,
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) Find stationary points of :
 $f(x, y) = 3x^2 - y^2 + x^3$ and find f_{max} where if exists.
OR

Q5) a) If $x = u + v$, $y = v^2 + w^2$, $z = u^3 + w^3$ then find $\frac{\partial u}{\partial x}$, using jacobian. [5]

b) Examine for functional dependence :

$$u = \frac{x+y}{1-xy}, v = \tan^{-1} x + \tan^{-1} y \quad [5]$$

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]

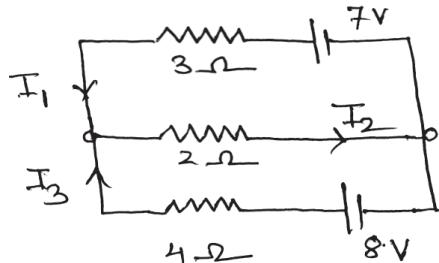
Q6) a) Solve the following system of linear equations. $4x + 2y + z + 3w = 0$,
 $6x + 3y + 4z + 7w = 5$, $2x + y + w = -1$. [5]

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

c) Find the values of a, b, c if A is orthogonal, where $A = \frac{1}{9} \begin{bmatrix} -8 & 4 & a \\ 1 & 4 & b \\ 4 & 7 & c \end{bmatrix}$. [5]

OR

- Q7)** a) Determine values of K for which the equations $x + y + z = 1$, $2x + y + 4z = k$, $4x + y + 10z = k^2$ are inconsistent. [5]
- b) Examine whether the vectors $x_1 = (3, 1, -4)$, $x_2 = (2, 2, -3)$, $x_3 = (0, -4, 1)$ 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 $A = \begin{bmatrix} 14 & -10 \\ 5 & -1 \end{bmatrix}$. [5]
- b) By using Cayley Hamilton theorem, find the inverse of the matrix $\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$, if it exists. [5]
- c) Reduce the matrix $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ to its diagonal form by finding modal matrix P. [5]

OR

- Q9)** a) Find the eigen values of $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$. Also find eigen vector corresponding to the largest eigen value of A. [5]

- b) Verify Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$. Hence find A^4 . [5]
- c) Find the transformation which reduces the quadratic form $x_1^2 + 2x_2^2 + 3x_3^2 + 2x_1x_2 - 2x_1x_3 + 2x_2x_3$ to the canonical form by using congruent transformations. Also write the canonical form. [5]



Total No. of Questions : 08]

SEAT No. :

PA-885

[Total No. of Pages : 4

[5924]-501

F.E. (Semester - I & II)

ENGINEERING MATHEMATICS - I

(2015 Pattern) (107001)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Use of electronic pocket calculator and steam tables is allowed.
- 4) Assume suitable data, if necessary.

Q1) a) Reduce the following matrix A into normal form and hence find it's rank. [4]

$$A = \begin{bmatrix} 2 & -3 & 4 & 4 \\ 1 & 1 & 1 & 2 \\ 3 & -2 & 3 & 6 \end{bmatrix}$$

b) Find Eigen values and Eigen vector corresponding to highest eigen value for the following matrix. [4]

$$A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$$

c) Two opposite vertices of a square are represented by complex numbers $9 + 12i$ and $-5 + 10i$. Find the complex numbers representing other two vertices of square. [4]

OR

P.T.O.

Q2) a) Examine the consistency of the system of following equations. if consistent solve it. [4]

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

b) If $\sin(\alpha + i\beta) = x + iy$ then prove that [4]

$$\text{i)} \quad \frac{x^2}{\cosh^2 \beta} + \frac{y^2}{\sinh^2 \beta} = 1 \quad \text{ii)} \quad \frac{x^2}{\sin^2 \alpha} - \frac{y^2}{\cos^2 \alpha} = 1$$

c) Prove that $\cos\left[i \log\left(\frac{a+ib}{a-ib}\right)\right] = \frac{a^2 - b^2}{a^2 + b^2}$ [4]

Q3) a) Solve any ONE. [4]

i) Test for convergence the series

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

ii) Test for convergence the series.

$$1 + \frac{3}{2!} + \frac{3^2}{3!} + \frac{3^3}{4!} + \dots$$

b) Expand e^{xcosx} in ascending powers of x up to the term containing x^3 . [4]

c) Find the n^{th} derivative of $y = \frac{2x+3}{(x-1)^2}$. [4]

OR

Q4) a) Solve any ONE. [4]

i) Evaluate $\lim_{x \rightarrow \frac{\pi}{2}} (\sec x - \tan x)$.

ii) Evaluate $\lim_{x \rightarrow 0} (1 + \tan x)^{\cot x}$

- b) Using Taylor's theorem, expand $2x^3 + 3x^2 - 8x + 7$ in ascending powers of $(x-2)$. [4]
- c) If $y = \sin \log(x^2 + 2x + 1)$, prove that $(x+1)^2 y_{n+2} + (2n+1)(x+1)y_{n+1} + (n^2+4)y_n = 0$. [4]

Q5) Solve any TWO.

- a) If $u = \tan(y+ax) + (y-ax)^{3/2}$ where a is a constant then show that $u_{xx} = a^2 u_{yy}$. [6]

b) If $u = \frac{\sqrt{x^7 + y^7}}{3\sqrt{x^4 + y^4}} + \cos\left(\frac{xy + y^2}{4xy}\right) + \log\left(\frac{x}{y}\right)$ find the value of

$$x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy} + xu_x + yu_y. \quad [7]$$

- c) If $z = f(x,y)$ and $x = u\cos\theta - v\sin\theta$, $y = u\sin\theta + v\cos\theta$ where θ is a constant then show that $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial u}\right)^2 + \left(\frac{\partial z}{\partial v}\right)^2$. [6]

OR

Q6) Solve any two.

- a) If $u = mx + ny$, $v = nx - my$ where m, n are constants then find the value of [6]

i) $(u_x)_y \cdot (x_u)_v$ ii) $(v_y)_x \cdot (y_v)_u$

- b) If $u = \tan^{-1}\left(\frac{\sqrt{x^3 + y^3}}{\sqrt{x} + \sqrt{y}}\right)$ then prove that [7]

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = -\sin 2u \cdot \sin^2 u.$$

- c) If $z = f(x,y)$ where $x = e^u \cos v$, $y = e^v \sin u$ show that $y \frac{\partial z}{\partial u} + x \frac{\partial z}{\partial v} = e^{2u} \frac{\partial z}{\partial y}$. [6]

Q7) a) If $u = \frac{yz}{x}, v = \frac{zx}{y}, w = \frac{xy}{z}$, find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$. [4]

b) Prove that the functions $u = y+z, v = x+2z^2, w = x-4yz-2y^2$ are functionally dependent. [4]

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

OR

Q8) a) If $u = xyz, v = x^2+y^2+z^2, w = x+y+z$ find $\frac{\partial x}{\partial u}$. [4]

b) Find the percentage error in the area of an ellipse if 1% error is made in measuring the major and minor axes. [4]

c) Given $x+y+z = a$, find the maximum value of $x^my^nz^p$. [5]



Total No. of Questions : 8]

SEAT No. :

PA-886

[Total No. of Pages : 2

[5924]-502

F.E.

ENGINEERING CHEMISTRY

(2015 Pattern) (Credit System) (Semester-I&II) (107009)

Time : 2 Hours]

[Max. Marks : 50

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) *Assume suitable data, if necessary.*

- Q1)** a) What are zeolites? Explain zeolite process of water softening with neat labelled diagram giving reactions involved in the removal of ions and regeneration of zeolite. Give any two limitations of the process. [6]
- b) Define: [3]
- i) Bathochromic shift
 - ii) Hypochromic shift
 - iii) Chromophore
- c) Explain conductometric titration curve for reaction between KCl and AgNO₃. [3]

OR

- Q2)** a) Explain potentiometric titration between Fe²⁺ and Ce⁴⁺. Draw titration curve calculating emf of the cell at various stages of titration. [6]
- b) Give disadvantages of traditional route and advantages of green route of indigo dye. [3]
- c) 50 mL Hard water sample consumed 15 mL of 0.01 M EDTA. Calculate total hardness of water in PPM of Caco₃ equivalent. [3]

- Q3)** a) Define glass transition temperature (Tg) of a polymer. Give significance of (Tg.). Discuss any four factors affecting Tg. [6]
- b) Define GCV & NCV. Justify relation between GCV and NCV. [3]
- c) A fuel has the following composition by mass. C=86% H=11.75% O=2.25%. Calculate the theoretical air supply per kg of fuel. [3]

OR

- Q4)** a) What is fractional distillation? Describe fractional distillation of crude petroleum with neat labelled diagram providing composition, boilling temperature range for gasoline & diesel. [6]

P.T.O.

- b) State purpose with example of following ingredients of compounding of plastic process [3]
- Filler
 - Lubricant
 - Plasticizer
- c) Explain solution polymerization technique of polymer synthesis with the help of neat labelled diagram. Give any two disadvantages of the solution polymerization technique. [3]

- Q5)** a) Explain structure of fullerene. Give any two properties and two applications of fullerene. [5]
- b) What are alanates & explain the mechanism of hydrogen release from sodium analate when sodium alanate is used to store hydrogen gas. [4]
- c) Give structure and any one method of silane preparation. Write an application of silanes. [4]

OR

- Q6)** a) Explain methods for industrial production of hydrogen by steam reforming of [5]
- methane (CH_4) and
 - Coke
- b) What are the different types of CNT based on structural features? Give any two applications of CNT. [4]
- c) Explain structure of diamond based on bonding. Give any four applications of diamond. [4]

- Q7)** a) Define Pilling-Bedworth ratio; give its significance. Also give oxidation reaction involved and type of film formed on surface in case of [5]
- Mg
 - Mo
 - Cr
- b) Explain how nature of metal affect rate of corrosion in general [4]
- c) Explain electroless plating with example and applications (any two). [4]

OR

- Q8)** a) Define corrosion state conditions favourable to lead wet corrosion mechanism of metal. Explain oxygen absorption mechanism of wet corrosion. [5]
- b) Compare cathodic and anodic protection measures [4]
- c) Explain cementation and cladding methods of applying metallic coatings on base metal [4]



Total No. of Questions : 8]

SEAT No. :

PA-887

[Total No. of Pages : 3

[5924]-503

F.E. (Engineering)

ENGINEERING PHYSICS

(2015 Pattern) (Semester - I & II) (107002)

Time : 2 Hours]

[Max. Marks : 50

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.

Q1) a) Explain the theory of formation of Newton's Rings. Prove that the diameter of dark rings is proportional to square root of natural number.

[6]

b) What is diffraction? Distinguish between Fresnel and Fraunhofer diffraction.

[3]

c) Calculate the length of an iron rod which can be used to produce ultrasonic waves of frequency 20KHz. Give : Young's Modulus = $1.16 \times 10^{11} \text{ N/m}^2$, $\rho = 7.23 \times 10^3 \text{ kg/m}^3$.

[3]

OR

Q2) a) What is diffraction grating? Derive condition of maxima and minima of diffraction pattern.

[6]

b) Explain with suitable diagram how the principle of interference is used in antireflection coating. Derive an expression for its thickness.

[3]

c) An ultrasonic source of 0.07MHz send down a pulse towards the sea bed, which returns after 0.65sec. The Velocity of sound in sea water is 1700m/s. Calculate the depth of the sea.

[3]

Q3) a) What are retardation plate? Give their types? Derive the expression for thickness of any one of them.

[6]

P.T.O.

- b) Give any three distinguishing features between spontaneous emission and stimulated emission. [3]
- c) Calculate the band gap energy (in eV) in silicon, given that it is transparent to radiation of wavelength greater than 11000 AU. (Given : $h = 6.63 \times 10^{-34}$ J-sec, $C = 3 \times 10^8$ m/s). [3]

OR

Q4) a) Explain Hall effect. Derive expression for Hall voltage and Hall coefficient. [6]

- b) What is optical resonator? What is its role in lasers? [3]
- c) Explain I-V characteristics of solar cell. [3]

Q5) a) State and explain Heisenberg's uncertainty principle. Show that it is applicable for energy and time. [6]

- b) Give Physical Significance of wave function (ψ). [4]
- c) Lowest energy of an electron trapped in an infinite potential well is 38eV. Calculate the width of the well. (Given : $e = 1.6 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J-sec, $m = 9.1 \times 10^{-31}$ kg). [3]

OR

Q6) a) Derive an expression for the energy of particle enclosed in an infinite potential well. [6]

- b) Derive an expression for the de Broglie wavelength in terms of energy. [4]
- c) A particle has mass 1.157×10^{-30} kg and kinetic energy 80eV. Find the de Broglie's wavelength. [3]

Q7) a) Explain chemical method for synthesis of nanoparticle by colloidal route. Give one example of synthesis of metal nanoparticles. [6]

- b) Explain the following terms of superconductivity. [4]
- Zero electrical resistance
 - Critical Magnetic field
- c) Explain any one properties of nanoparticles. [3]

OR

- Q8)** a) What is superconductivity? Explain Meissner effect and show that superconductors are perfectly diamagnetic. [6]
- b) Distinguish between type-I and type-II superconductor. [4]
- c) Give any six application of nanoparticles. [3]

□□□

Total No. of Questions : 8]

SEAT No. :

PA-888

[Total No. of Pages : 2

[5924]-504

F.E.

**BASIC ELECTRONICS ENGINEERING
(2015 Pattern) (Semester-I&II) (104012)**

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3. or Q4, Q5 or Q6, and Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.

- Q1)** a) Explain with neat circuit diagram bridge rectifier with it's input and output waveforms. [6]
- b) Draw output characteristics of BJT in CE configuration. Indicate and explain three regions of operations. [6]

OR

- Q2)** a) Draw the construction diagram and explain working of LED. [6]
- b) Draw and explain voltage multiplier circuit. [6]

- Q3)** a) What is Op-Amp. Draw and explain the functional block diagram of an Op-amp. [6]
- b) Design and implement half adder using logic gates with truth table and write the equation for SUM and carry. [6]

OR

- Q4)** a) For inverting amplifier using Op-Amp, if $R_f=100K\Omega$, $R_i=10K\Omega$, $V_{CC}=\pm 10V$ and $V_{in}=2Vdc$
- i) Calculate output voltage.
 - ii) Is the result in part (i) practically possible? Justify. [6]
- b) Draw and explain the block diagram of micro processor. [6]

P.T.O.

- Q5)** a) Draw construction of DIAC and explain working with VI characteristics. [7]
b) Compare active and passive transducers. [6]

OR

- Q6)** a) Draw and explain the block diagram of basic instrumentation system. [7]
b) Explain in detail temperature transducer. [6]

- Q7)** a) Explain block diagram of communication system in detail. [6]
b) Compare AM and FM. [7]

OR

- Q8)** a) Explain in detail IEEE frequency spectrum. [7]
b) Explain concept of cellular network. [6]



Total No. of Questions : 8]

SEAT No. :

PA-889

[Total No. of Pages : 3

[5924]-505

F.E. (All Branches)

BASIC ELECTRICAL ENGINEERING

(2015 Pattern) (Semester - I & II) (103004)

Time : 2 Hours]

[Max. Marks : 50

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) 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) What is insulation resistance? Derive the expression for insulation resistance of a single core cable. [6]
- b) Find the inductance of a 150 turns coil which is linked with a flux of 0.01 Wb while carrying a current of 10 A. If this current is uniformly reversed in 0.01 second, calculate the emf induced in the coil. [6]

OR

- Q2)** a) Obtain an expression for coefficient of coupling in case of two magnetically coupled coils of self inductances L_1 and L_2 respectively. [6]
- b) An electric motor runs at 600 rpm while producing torque of 210 Nm. The motor operates at efficiency of 88%. Find motor input power and current drawn when the motor is fed at 230V DC supply. [6]

- Q3)** a) Obtain expressions for instantaneous current, instantaneous power and average power of a purely resistive circuit connected across sinusoidal alternating voltage source. [6]
- b) Two capacitors A and B are connected in series across a 200 V DC supply. The potential difference across A is 120 V. This potential difference is increased to 140 V when a $3 \mu\text{F}$ capacitor is connected in parallel with B. Calculate the capacitances of A and B. [7]

OR

P.T.O.

Q4) a) Draw the connection diagram of direct loading test on a single phase transformer. Tabulate the observations to be made and write formulae for determining voltage regulation and efficiency. [6]

b) A sinusoidal current of maximum value 10 A flows through a pure resistance of 20Ω . Write an equation to represent instantaneous value of this current varying at 50 Hz. Find (i) rms value of current (ii) average value of current (iii) form factor and (iv) power consumed [7]

Q5) a) Write expressions for the following in case of a single phase AC circuit: (i) Active Power (ii) Reactive Power (iii) Apparent Power (iv) Complex power. Hence draw power triangles for R-L and R-C series circuits. [6]

b) Three inductive coils each having series combination of resistance of 15Ω and inductance of 0.03 H are connected in delta across a 3 phase, 400 V, 50 Hz supply. Calculate (i) inductive reactance and impedance per phase (ii) phase current, line current (iii) total power consumed. [6]

OR

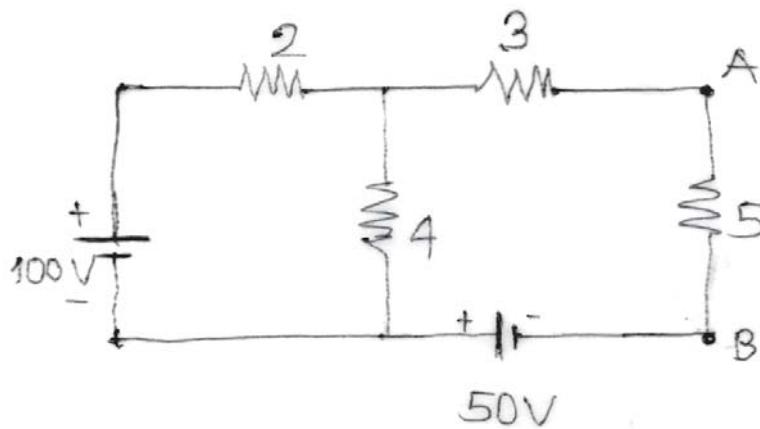
Q6) a) Draw circuit diagram and phasor diagram for star connected balanced load supplied by 3 Phase AC voltages. State the relations between (i) line current and phase current (ii) line voltage and phase voltage for this load. [6]

b) Two impedances $Z_1 = 6 + j8$ and $Z_2 = 4 + j3$ are connected in parallel across single phase 230 V, 50 Hz supply. Calculate (i) current drawn by each branch and (ii) total current. [6]

Q7) a) Define following terms in the context of DC circuits. [6]

- i) Active and passive elements
- ii) Linear and non-linear elements
- iii) Bilateral and unilateral elements

b) Find current through branch AB of the following circuit using Thevenin's Theorem. All resistance values mentioned are in Ohm. [7]

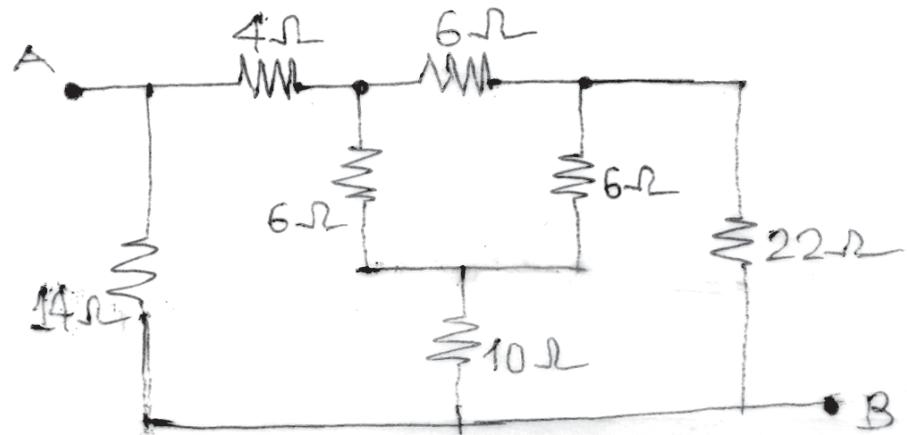


OR

Q8) a) State the following : [6]

- i) Kirchhoff's Laws
- ii) Superposition Theorem
- iii) Thevenin's Theorem

b) Determine effective resistance between A and B for the circuit shown in fig. below. [7]



Total No. of Questions : 8]

SEAT No. :

PA-890

[Total No. of Pages : 2

[5924]-506

F.E. (Common)

BASIC CIVIL AND ENVIRONMENTAL ENGINEERING
(2015 Pattern) (Semester - I & II) (101005)

Time : 2 Hours]

[Max. Marks : 50

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) *Figures to the right indicate full marks.*
- 3) *Use of electronics pocket calculator is allowed.*
- 4) *Neat diagrams must be drawn wherever necessary.*
- 5) *Assume suitable data if necessary.*

- Q1)** a) Explain in brief the general role of Civil Engineer in any construction work. [5]
b) State comparison between artificial sand and natural sand (any five points). [5]
c) State any four Practical Applications of Fluid Mechanics. [2]

OR

- Q2)** a) What is project management? Explain in brief the importance of Project management. [5]
b) Enlist basic materials used for construction. Explain in brief recycling of materials. [5]
c) Mention any four functions of foundation. [2]

- Q3)** a) The following readings were taken with a Dumpy level and 4 m leveling staff at a common interval of 20 m. The readings are, 1.540, 0.850, 1.720, 2.265, 1.730, 0.715, 1.415, 2.125 and 3.480. The level was shifted after Second and Fifth reading. The first reading was taken on PBM of R.L. 550.500 m. Calculate the Reduced Levels of Staff stations by Rise and fall Method. Apply Usual Arithmetic check. [5]

P.T.O.

- b) Discuss the importance of conserving the natural resources and preserving the Environment. [5]
c) What do you know about E-waste? [2]

OR

- Q4)** a) Enlist various modern instruments used in surveying. Explain any one in brief. [5]
b) Discuss any five steps to accomplish environmental sustainability in day todays activities. [5]
c) What is Scale? Why it is required in Engineering. [2]

- Q5)** a) “Privacy is the important principle of planning”. Comment on the statement. [5]
b) Write a short note on Green Building. [5]
c) What do you know about Orientation? [3]

OR

- Q6)** a) A plot owner has purchased a Rectangular plot, whose perimeter is 108 m and breadth is 20 m. He wants to construct G + 1 storied bungalow. As per Rules Permissible FSI is 1.50, Front Margin is 3 m and all other margins are 2.0 m, Calculate the possible construction on Ground Floor and First Floor. [5]
b) What is Roominess? How it is achieved during planning of Building? [5]
c) Differentiate between built up area and plinth area. [3]

- Q7)** a) Define Noise. State various sources of noise. Also state the ill effects of noise on human health. [5]
b) Enlist conventional sources of energy and explain the need of developing alternative to conventional sources of energy. [5]
c) State the ill effects of Green house gases on environment. [3]

OR

- Q8)** a) Define Air Pollution. State sources and effects of air pollution. [5]
b) Explain in brief the mechanism of production of Bio-Gas Energy. [5]
c) Write a short note on Water Pollution and its sources. [3]



Total No. of Questions : 8]

SEAT No. :

PA-891

[Total No. of Pages : 3

[5924]-507

F.E. Engineering

ENGINEERING GRAPHICS-I

(2015 Pattern) (Semester-I) (102006)

Time : 2 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) *Use only half imperial size drawing sheet as answer book.*
- 3) *Retain all construction lines.*
- 4) *Assume suitable data if necessary.*

Q1) The point ‘A’ of 65 mm long Line ‘AB’ is in HP and 15 mm in front of VP. The line is inclined to HP and VP at 40° and 35° respectively. Draw the projections of line AB and locate its traces. [12]

OR

Q2) An isosceles triangle, base 50 mm and altitude 80 mm, is resting in VP on its base. Its surface is inclined to VP so that the corner opposite to resting side is 50 mm in front of VP. Draw the projections if its resting side is inclined to HP at an angle of 45° . Find inclinations made by the plane with HP and VP. [12]

Q3) A triangular prism side of base 30mm and axis height 50mm is kept on HP on edge of its base in such a way that its axis makes 45° with HP. Draw the projections of prism when longer edge opposite to base edge on HP is inclined at 30° with the VP. [13]

OR

Q4) a) Draw an Archimedean spiral for one convolution given that Diameter is 120mm. [7]

b) Draw the development of lateral surface of hexagonal prism of base side 23mm and axis height 69mm. [6]

P.T.O.

Q5) Figure 1 shows a pictorial view of an object. By using first angle method of projections, draw; [13]

- a) Sectional front view, along symmetry of the object. [4]
- b) Right hand side view [4]
- c) Top view [4]
- d) Dimensions [1]

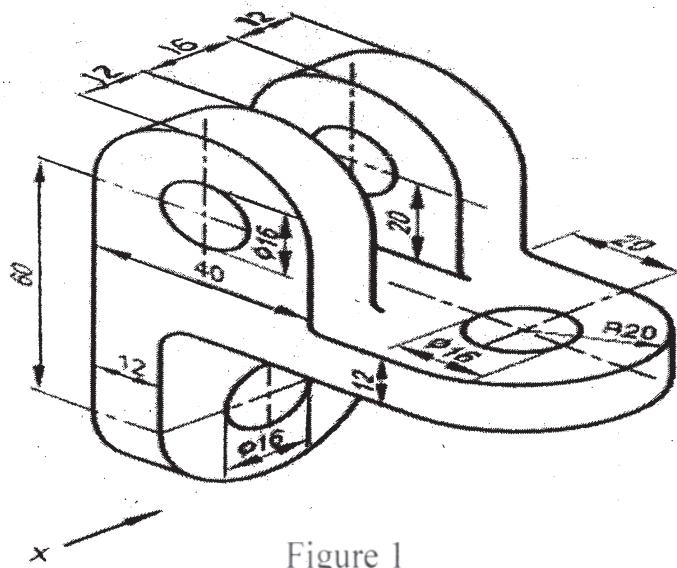


Figure 1

OR

Q6) Figure 2 shows a pictorial view of an object. By using first angle method of projections, draw; [13]

- a) front view in the direction X [4]
- b) Left hand side view [4]
- c) Top view [4]
- d) Overall Dimensions [1]

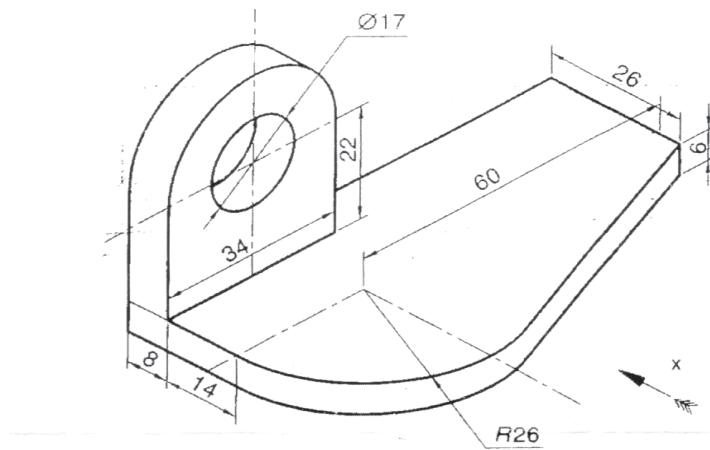


Figure 2

Q7) Figure 3 shows front view and end view of an object. Draw isometric view and show overall dimensions. [12]

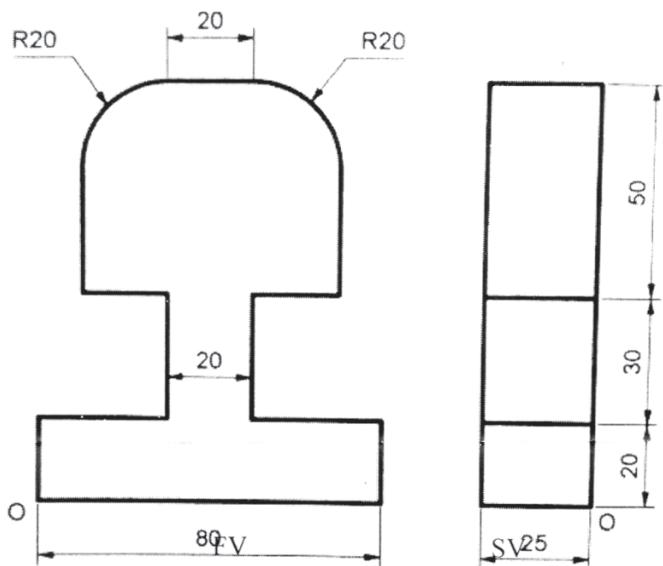


Figure 3

OR

Q8) Figure 4 shows front view and end view of a bracket. Draw isometric view and show overall dimensions. [12]

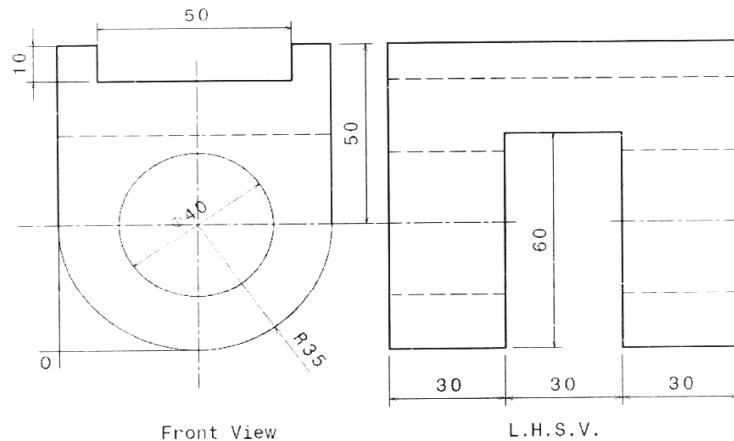


Figure 4



Total No. of Questions : 8]

SEAT No. :

PA-892

[Total No. of Pages : 4

[5924]-508

F.E. (Semester - I & II)

ENGINEERING MATHEMATICS - II

(2015 Pattern) (Credit System) (107008)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and 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.
- 5) Use of electronic pocket calculator is allowed.

Q1) a) Solve the following differential equations.

i) $\frac{dy}{dx} = e^{x+y} + x^2 e^y.$ [4]

ii) $(xy - 2y^2) dx - (x^2 - 3xy) dy = 0.$ [4]

b) A pipe 20 cm in diameter contains steam at 150°C and is protected by a covering 5 cm thick for which $k = 0.0025.$ If the temperature of outer surface of the covering is 40°C, find the temperature half way through the covering under steady conditions. [4]

OR

Q2) a) Solve $\frac{dy}{dx} + y \cot x = \sin 2x.$ [4]

b) Solve the following :

- i) If the temperature of the air is 30°C and the substance cools from 100°C to 70°C in 15 minutes. Find when the temperature will be 40°C. [4]

P.T.O.

- ii) A constant electromotive force ‘E’ volts is applied to a circuit containing a constant resistant ‘R’ ohms in a series and a constant inductance ‘L’ henries. If the initial current is zero, show that the current builds up to half its theoretical maximum in $\frac{L}{R} \log 2$ seconds. [4]

Q3) a) Find the Fourier Series for the function $f(x) = \pi^2 - x^2$ in the interval $-\pi < x < \pi$ and $f(x + 2\pi) = f(x)$. [5]

b) Prove that $\int_0^1 (x \log x)^4 dx = \frac{4!}{5^5}$ [3]

c) Solve any one : [4]

i) Trace the curve $x^2 y^2 = a^2 (y^2 - x^2)$.

ii) Trace the curve $r = a \sin 3\theta$.

OR

Q4) a) Establish the reduction formula connecting $U_n = \int_0^\pi x \cos^n x dx$, with U_{n-2} , where n is an even integer. [4]

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

c) Show that in the astroid $x = a \cos^3 t$, $y = a \sin^3 t$ $s^3 \propto x^2$, s being measured from cusp which lies on y -axis ($t = \pi/2$) to any point $t = \theta$. [4]

Q5) a) Find the equation of the sphere which has its centre at $A(2, 3, -1)$ and touches the line $\frac{x+1}{-5} = \frac{y-8}{3} = \frac{z-4}{4}$. [5]

- b) Find the equation of the right circular cone which passes through the point $(1, 1, 2)$ has its axis as the line $\frac{x}{2} = \frac{y}{-4} = \frac{z}{3}$ and vertex at origin. [4]
- c) Find the equation of the right circular cylinder whose axis is $x = 2y = -z$ and radius is 4. [4]

OR

- Q6)** a) Find the equation of the sphere which touches the sphere $x^2 + y^2 + z^2 - x + 3y + 2z - 3 = 0$ at the point $(1, 1, -1)$ and passes through the point $(0, 0, 3)$. [5]
- b) Find the equation of the right circular cone whose vertex is $(1, -1, 1)$, the axis is parallel to $x = \frac{-y}{2} = -z$ and one of its generator has direction cosines parallel to $2, 2, 1$. [4]
- c) Find the equation of the right circular cylinder whose guiding curve is $x^2 + y^2 + z^2 = 9, x - y + z = 3$. [4]

Q7) Attempt any two :

- a) By changing the order of integration, evaluate $\int_0^\infty \int_0^x x e^{-\left(\frac{x^2}{y}\right)} dy dx$. [6]
- b) Evaluate $\iiint xyz dx dy dz$ over the first octant of the sphere $x^2 + y^2 + z^2 = a^2$. [7]
- c) Show that the moment of inertia of a rectangle of sides ' a ' and ' b ' about its diagonal is $\frac{M}{6} \left(\frac{a^2 b^2}{a^2 + b^2} \right)$ where M is the mass of rectangle. [6]

OR

Q8) Attempt any two :

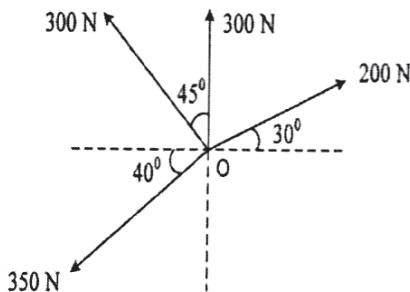
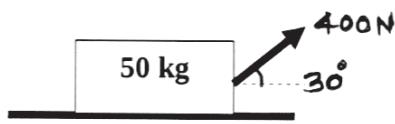
- a) Find the area of one loop of the curve $r = a \sin 2\theta$. Also find the total area. [6]
- b) Find the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$. [7]
- c) Find centre of gravity of the loop of the curve $9x^2 = (2y - 1)(y - 2)^2$. [6]



F.E. (Common)**ENGINEERING MECHANICS****(2015 Pattern) (Semester -I & II) (101011)****Time : 2½ Hours]****[Max. Marks : 50****Instructions to the candidates:**

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data, if necessary.
- 4) Use of electronic pocket calculator is allowed in the examination.
- 5) Use of cell phone is prohibited in the examination hall.

- Q1) a)** Determine the magnitude and direction of resultant force for all the four forces 300 N, 300 N and 200 N and 250 N, acting at 'O' as shown in Fig. 1a. [4]

**Fig. 1 a****Fig. 1b**

- b) A 50 kg crate shown in Fig. 1b, rest on a horizontal plane for which coefficient of kinetic friction is 0.3. the crate is subjected to 400 N force, determine the velocity of the crate after 5 sec starting from rest. [4]
- c) A Particle moves along a straight line with an acceleration $a = (4t^2 - 2)$, where a is in m/s^2 and t is in sec. when $t=0$, the particle is at 2m to the left of the origin and when $t=2$ sec the particle is at 20m to the left of the origin. Determine the position of particle at $t=4$ sec. [4]
- d) A ball is dropped from an unknown initial height 'h', on a horizontal floor, which is rebounds to a height of 8m. If $e = 0.667$, calculate the initial height from which the ball was dropped. [4]

OR**P.T.O.**

- Q2) a)** Determine the position of centroid of the shaded area with respect to origin 'O', as shown in Fig.2a. [4]

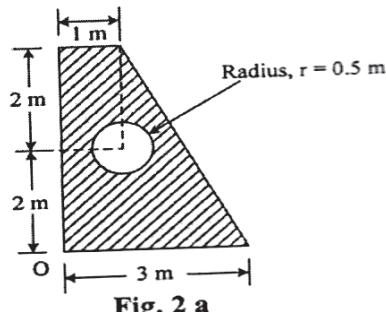


Fig. 2A

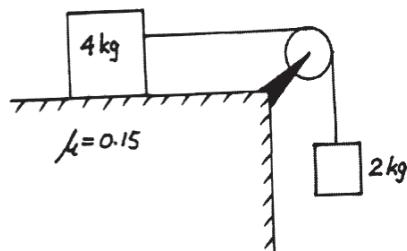


Fig. 2b

- b) The system as shown in Fig. 2b, 4 kg block resting on the horizontal floor with coefficient of friction as 0.15, connected with 2 kg block by a inextensible cable which is passing over a frictionless pulley, initially is at rest. Neglecting mass of the pulley, determine the acceleration of the 2 kg block. [4]
- c) A projectile fired from the edge of a 150 m high cliff with an initial velocity of 180 m/s at an angle of elevation of 30° with the horizontal. [4] Neglecting air resistance find:
- The greatest elevation above the ground reached by the projectile;
 - Horizontal distance from the gun to the point, where the projectile strikes the ground.
- d) A ball has a mass of 20 kg is thrown upward with a speed of 25 m/s. Determine the time and distance travelled by the ball when reaches to maximum height, Use impulse momentum principle. [4]

- Q3) a)** The I – Joist supports 20 kN and 40 KN on beam AB of span 7.5 m, as shown in Fig. 3a. Determine the support reactions at hinge B and roller D. [5]

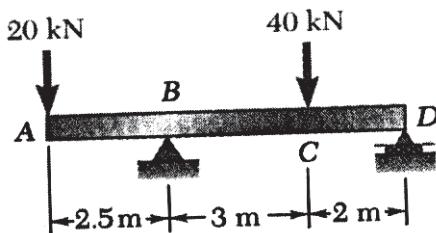


Fig. 3a

- b) A square foundation $5 \text{ m} \times 5 \text{ m}$, supports four loads as shown in Fig. 3b. Determine magnitude, direction and point of application of the resultant of four forces. [6]

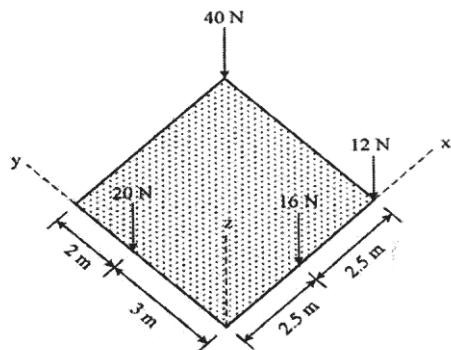


Fig. 3b

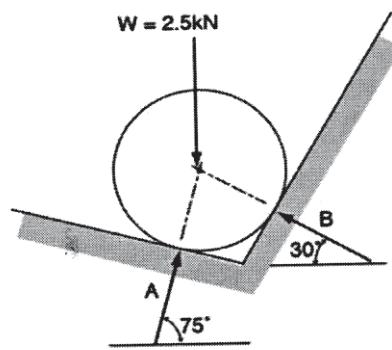
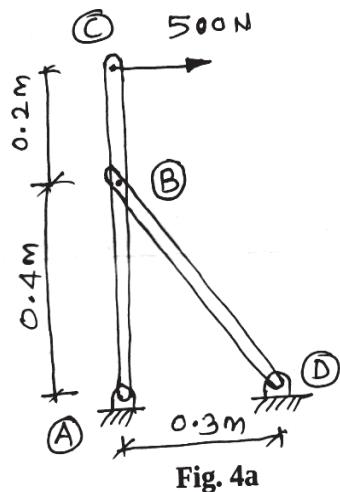


Fig. 3c

- c) A cylinder of 2.5kN is resting in a trough as shown in Fig. 3c. Determine the normal reactions at A and B. [6]

OR

- Q4)** a) Determine the horizontal and vertical components of force that pin 'B', for the frame as shown in Fig. 4a. [6]
- b) Three rods meeting at point A as shown in Fig. 4b, whose resultant force acting at 'A' is $R = -788 \text{ j}$. Find magnitude of the compression C₁, C₂ and C₃ developed in rod AB, AC, AD respectively. [See, $\Sigma i=0$ and $\Sigma k=0$]. [6]



[5924]-509

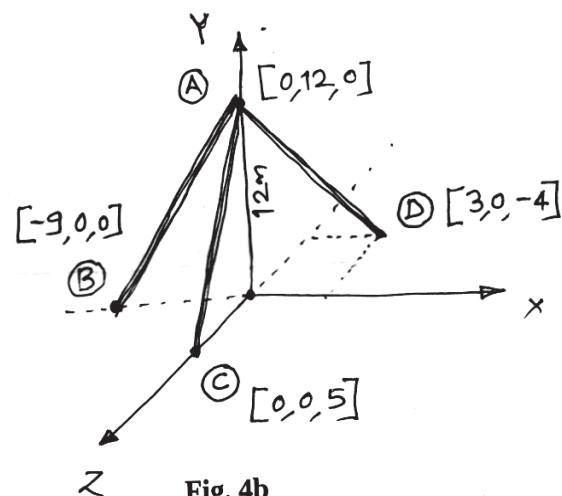


Fig. 4b

- c) The I joist supports 4 kN as shown in Fig. 4c. Determine the support reactions at hinge A and roller B, if the self weight of the joist is 2 kN/m. [5]

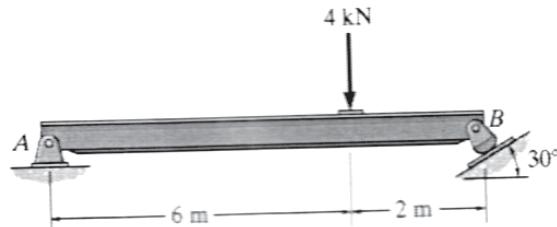


Fig. 4c

- Q5) a) Determine the forces in all the members of the truss loaded and supported as shown in the Fig. 5a. Tabulate the result with magnitude and nature of force in the members. [6]

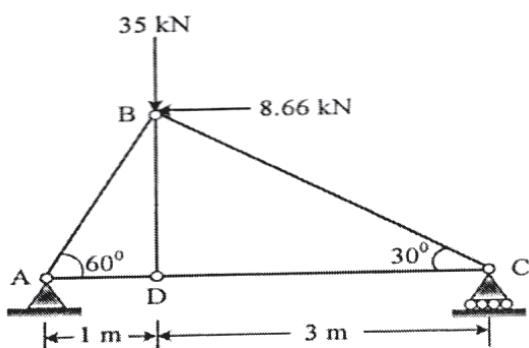


Fig. 5 a

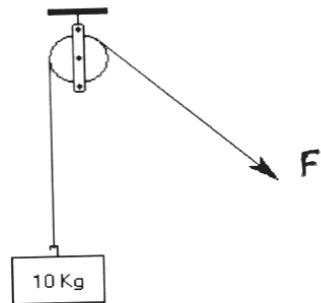


Fig. 5a

Fig. 5b

- b) A block of 10kg hanging through a frictionless cable and kept at rest by applying a force of 'F' N on other side of the cable, which is passing through the pulley as shown in the Fig. 5b. Determine the range of force required 'F' required to keep the block in rest, if the lap angle between cable and pulley is 125 degrees. (Take $\mu = 0.15$). [5]
- c) A 100 N ladder AB of length 6 m rest against a vertical wall and horizontal floor. Determine the slope of the ladder with vertical to maintain equilibrium if the coefficient of static friction at all contact surface is $\mu_s = 0.25$. [6]

OR

- Q6) a)** Cable ABCD is loaded and supported as shown in the Fig. 6a. If $d_c = 0.75$ m, determine the component of reaction at A & maximum tension in the cable. [6]

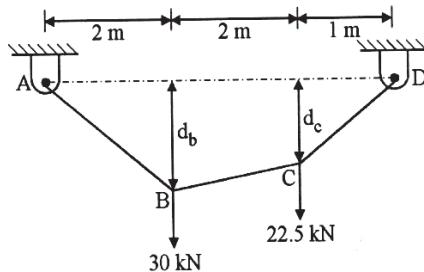


Fig. 6a

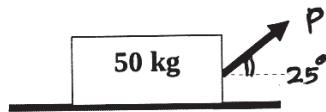


Fig. 6b

- b) A 50 kg block resting on rough horizontal floor with coefficient of friction between floor and block as 0.25, applied with force 'P' inclined upward at an angle 25 degrees with horizontal. Determine the magnitude of the force required just to start the motion of the block. Refer Fig.6b. [6]
- c) Determine the forces in the members AB, BD and DC of the truss loaded and supported as shown in the Fig. 5a using section method. Tabulate the result with magnitude and nature of force in the members. [5]



Total No. of Questions : 8]

SEAT No. :

PA-894

[Total No. of Pages : 2

[5924]-510

F.E. (Common)

BASIC MECHANICAL ENGINEERING
(2015 Pattern) (Semester - I & II) (102013)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt four questions out of eight : 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) *Assume suitable data, if necessary.*
- 4) *Use of non programmable electronic calculator is permitted.*
- 5) *Neat diagrams must be drawn wherever necessary.*

- Q1)** a) Draw neat diagrams of Parallel Key, Open Belt drive and simple gear train. [6]
- b) Define Machine and Mechanism. With neat sketch explain slider crank mechanism. [6]

OR

- Q2)** a) Define following mechanical properties : Strength, Hardness, Creep, Plasticity, Elasticity, Toughness. [6]
- b) Explain with neat sketch, rigid flange coupling. [6]

- Q3)** a) What is sand casting process? Draw neat sketch of sand casting setup and explain steps involved in sand casting. [7]
- b) Draw the sketches of cylindrical and centreless grinding process. State their applications. [6]

OR

- Q4)** a) Explain with neat sketch, any four sheet metal forming operations. [6]
- b) Draw block diagram of lathe machine and explain turning operation performed on it. [7]

P.T.O.

- Q5)** a) Explain working principle of barometer and thermocouple. [4]
 b) State first law of thermodynamics with its limitations. [4]
 c) A refrigerator with a COP of 1.8 removes heat from the refrigerated space at the rate of 90 KJ/min. determine : [5]
 i) The electrical power consumed by the refrigerator.
 ii) The rate of heat transfer to kitchen air.

Draw the sketch of system.

OR

- Q6)** a) Explain following terms : [4]
 i) Intensive properties and Extensive properties.
 ii) System, surrounding and boundary.
 b) Explain concept of heat engine and heat pump. [4]
 c) A U-tube manometer with one arm open to atmosphere is used to measure pressure in a steam pipe. The level of mercury in open arm is 10cm greater than that in the arm connected to pipe. Some of the steam in pipe is condensed in the manometer arm connected to the pipe. The height of this column is 3.5 cm. If the atmospheric pressure is 76 cm of HG, find the absolute pressure of steam. [5]

- Q7)** a) Draw layout of Solar power plant and state the advantages and limitations of it. [6]
 b) Explain construction and working of centrifugal pump. [6]

OR

- Q8)** a) Draw a neat sketch of window air-conditioning system showing the direction of hot and cool air flow and explain its working. [6]
 b) Explain working principle of impulse and reaction turbine with sketch. [6]



Total No. of Questions : 8]

SEAT No. :

PA-4297

[Total No. of Pages : 2

[5924]-6

F.E.

SYSTEMS IN MECHANICAL ENGINEERING
(2019 Pattern) (Semester-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 and Q.7 or Q.8.
- 2) Assume suitable data if necessary.
- 3) Figures to the right indicate full marks.

- Q1)** a) Explain different parts of internal combustion engine with neat sketch.**[10]**
b) Discuss the construction and working of hybrid Electric vehicle with neat sketch. **[8]**

OR

- Q2)** a) List Specifications of vehicle for LMV and Explain any four specifications. **[10]**
b) Explain working of Battery Electric Vehicle with neat diagram. **[8]**

- Q3)** a) Explain working of Disc Brake with neat line diagram. List any two applications. **[10]**
b) Explain telescopic suspension system with neat diagram. **[7]**

OR

- Q4)** a) State functions of following automobile components: transmission Systems, Gearbox, Propeller Shaft, Suspension System, Cooling System. **[10]**
b) Explain working of single plate clutch with neat diagram. **[7]**

- Q5)** a) What is Casting? Explain sand casting process with sketch. **[10]**
b) List type of Joining process and Compare Welding and soldering process. (three points). **[8]**

OR

P.T.O.

- Q6)** a) Define Machining operation and Explain turning and drilling operation principle with neat diagram. [10]
b) What is CNC machine? Explain working of CNC machine with block diagram. [8]

- Q7)** a) Define Refrigeration. Explain vapor Refrigerator with block diagram.[10]
b) Explain working of Solar Heater with neat diagram. [7]

OR

- Q8)** a) Explain concept of open belt pulley drive with neat diagram and List two applications. [10]
b) Explain working of printer with neat diagram. [7]



Total No. of Questions : 8]

SEAT No. :

PA-4298

[Total No. of Pages : 4

[5924]-7

F.E. (Electrical Engineering)
BASIC ELECTRICAL ENGINEERING
(2019 Pattern) (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 data wherever necessary.
- 5) Use of non-programmable calculator is allowed.

Q1) a) Calculate power factor angle and power factor in following cases : [4]

i) $Z = 10 + j10 \Omega$

ii) $Z = 30 - j20 \Omega$

b) If a single-phase AC supply is connected to RC circuit, answer the following. [6]

- i) Draw circuit diagram indicating all voltage drop and current.
- ii) Write equation for impedance and current.
- iii) Draw the phasor diagram.

c) A coil of 100mH is connected in series with 25Ω resistance across 230V, 50 Hz supply. Find [8]

- i) Inductive reactance and impedance
- ii) Current through circuit
- iii) Voltage drop across each element
- iv) Active power

OR

P.T.O.

- Q2)** a) A sinusoidal voltage $V = V_m \sin \omega t$ applied across pure resistance circuit. Derive expression active power consumed by the circuit. [4]
- b) A pure capacitance of $100\mu F$ is connected across single phase voltage given by $v = 100 \sin (314t)$ volts. Find [6]
- Frequency of supply in Hz
 - Capacitive reactance
 - Equation of current
- c) A resistance 20Ω , inductance of $50mH$ and capacitor of $75\mu F$ are connected in series across $230V$, variable frequency supply. [8]
- Calculate :
- The frequency at which resonance will occur
 - Current flowing through circuit
 - Power factor

- Q3)** a) State the advantages of 3– ph system over 1-ph system (any 3) : [3]
- b) What are the different losses in the transformer? In which party they take place and how to minimize them. [6]
- c) A three phase load having per phase impedance $(30 + j40)\Omega$ is connected in star across $400V$, $50Hz$, 3-phase AC supply. [8]

Determine :

- Line and phase voltage
- Line and phase current
- Power factor and power factor angle
- Active, reactive power

OR

- Q4)** a) State following statements are true or false with justification. [3]
- In transformer, as the load current increases, iron losses increase.
 - In transformer, as the load current increases, copper losses increase.
- b) Derive emf equation of a single-phase transformer. [6]
- c) Draw circuit diagram for delta load (RL types) connected across three phase balanced supply and derive relation between line and phase current and voltage. Also draw the phasor diagram. [8]

- Q5) a)** Define following terms : [4]
- Active and passive network
 - Linear and non-linear network
- b)** Find the current following through 2Ω resistance using KVL. (Refer Fig. 5(b)) [6]

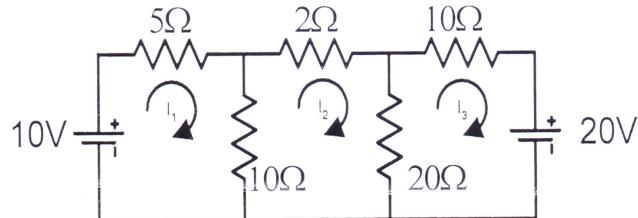


Figure 5b)

- c)** Determine equivalent resistance between XY Refer Fig. 5(c). [8]

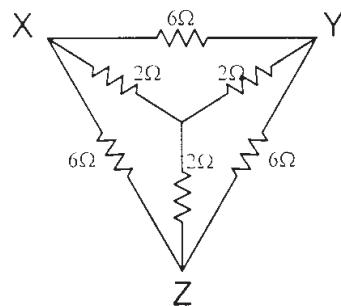


Figure Q5c)

OR

- Q6) a)** State and explain KCL and KVL. [4]
- b)**
- Three resistance each 60Ω are connected in delta, draw its equivalent star.
 - Three resistance each 60Ω are connected in star, draw its equivalent delta. [6]
- c)** Write the steps to find current I_L in given circuit using Thevenin's theorem. [8]

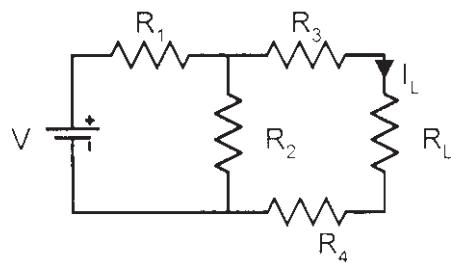


Fig Q6c)

Q7) a) State following statements are true or false with justification. [3]

i) A wire is having resistance of 10Ω . If the length of wire is doubled, then new resistance is 5Ω .

ii) A wire is having resistance of 10Ω . If the diameter of wire is doubled, then new resistance is 2.5Ω .

b) Explain construction, working of Lithium Ion Battery. [6]

c) Derive the formula for insulation resistance of a single core cable. State the factors affecting insulation resistance. [8]

OR

Q8) a) State the three conditions of fully charged lead acid battery. [3]

b) Explain construction, working and applications of Lead acid Battery. [6]

c) A wire is having resistance 10Ω , 20°C , Its RTC at 0°C is $0.004/\text{ }^\circ\text{C}$. Calculate :

i) RTC at 20°C

ii) Resistance of wire at 50°C

iii) The temperature at which resistance increases to 15Ω .



Total No. of Questions : 8]

SEAT No. :

PA-4299

[Total No. of Pages : 2

[5924]-8

F.E.

BASIC ELECTRONICS ENGINEERING
(2019 Pattern) (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 and Q.7 or Q.8.
- 2) Assume suitable data if necessary.
- 3) Figures to the right indicate full marks.

- Q1)** a) i) Convert $(27A.1C)_{16}$ to Octal. [6]
ii) Convert $(F89A.83)_{16}$ to Decimal.
iii) Perform $(110011 - 111001)$ using 2's complement method.
iv) Perform $(110011 \div 101)$.
b) State and prove De Morgan's theorem. [6]
c) Draw block diagram of microcontroller and explain its working. [6]

OR

- Q2)** a) Explain working of Half Adder with the help of truth table, logic expression of sum and carry and circuit diagram. [6]
b) Define Universal Logic Gates. Explain why they are known as Universal Logic Gates? [6]
c) Explain following Flip-Flops with the help of their truth table, logic diagram and state one application of each. [6]
i) T - Flip-Flop
ii) D - Flip-Flop

- Q3)** a) Explain working of Digital Multimeter with its block diagram. [6]
b) Explain working of Digital storage oscilloscope with its block diagram. [6]
c) Explain working principle of Auto Transformer. State its applications. [5]

OR

P.T.O.

- Q4)** a) Explain Function Generator with the help of its block diagram. [6]
b) Draw block diagram of power scope and explain its working. [6]
c) Explain operation of DC Voltmeter. Draw diagram of multi-range Voltmeter. [5]

- Q5)** a) Explain working of LVDT. Draw its construction diagram. State its applications. [6]
b) Explain working of RTD. Draw its construction diagram. State its applications. [6]
c) Explain working of Piezoelectric type Accelerometer. [5]

OR

- Q6)** a) Explain selection criterias of sensors. [6]
b) Explain working of LDR. State its applications. [6]
c) Explain operation of bio-sensor. State its application. [5]

- Q7)** a) Draw block diagram of electronic communication system and explain its working. [6]
b) Draw IEEE electromagnetic frequency spectrum. State use of each band. [6]
c) Draw and explain block diagram of GSM system. [6]

OR

- Q8)** a) Explain need of modulation. State different types of modulation techniques used in electronic communication. [6]
b) Draw block diagram of AM receiver and explain its working. [6]
c) Explain cellular concept of mobile communication system. [6]



Total No. of Questions : 9]

SEAT No. :

PA-4300

[Total No. of Pages : 3]

[5924]-9

F.E.

PROGRAMMING AND PROBLEM SOLVING

(2019 Pattern) (Semester-II) (110005)

Time : 2½ Hours]

[Max. Marks : 70]

Instructions to the candidates:

- 1) ***Question one is compulsory.***
 - 2) ***Solve Q2 or Q3, Q4 or Q5, Q6 or Q7 and Q8 or Q9.***
 - 3) ***Neat diagrams must be drawn wherever necessary.***
 - 4) ***Assume suitable data wherever necessary.***

Q1)

[10]

PTO:

- g) You can use Python for
 - i) Application programming ii) Web programming
 - iii) Artificial Intelligence iv) All of these
- h) Which is the default access mode in the open () function for files in Python?
 - i) w ii) r
 - iii) a iv) w+
- i) What does open() function return?
 - i) function ii) variable
 - iii) file object iv) None of these
- j) Which of the following is the correct way of closing a file?
 - i) close(file) ii) close("file")
 - iii) file.closed() iv) file.close()

- Q2)** a) Define a function. Explain function definition and function call with an example. [6]
- b) What do you mean by local and global variables? Explain it with example. [5]
- c) Write a program to swap two numbers using a function. [4]

OR

- Q3)** a) Explain the following types of function arguments with examples: [6]
 - i) Required arguments
 - ii) Keyword arguments
- b) What is a lambda function? Explain it with a suitable example. [5]
- c) What are the good Python programming practices? [4]

- Q4)** a) Explain any three string operations with suitable example. [6]
- b) Explain slicing operation on string with suitable example. [5]
- c) Write a program to count the number of characters and words in the given string. s= “Programming and Problem Solving” [4]

OR

Q5) a) Explain following string methods with example. [6]

- i) count()
- ii) find()
- iii) swapcase()

b) What is a string? With the help of an example explain string comparison operators. [5]

c) Explain ord() and chr() functions with suitable examples. [4]

Q6) a) Explain any three programming paradigms. [6]

b) Define a class in Python. Explain __init__() method with suitable example. [5]

c) Explain the concept of Inheritance and Polymorphism. [4]

OR

Q7) a) Explain the features of Object Oriented Programming. [6]

b) Explain class variables and object variables with suitable example. [5]

c) Explain class method with suitable example. [4]

Q8) a) What is a file? Differentiate between text and binary file. [6]

b) What is a dictionary? Explain how to create and access dictionary elements. [5]

c) Explain relative and absolute path of a file. [4]

OR

Q9) a) Explain any three methods for reading and writing files. [6]

b) Explain different directory methods with suitable examples. [5]

c) Write a program to copy the contents of one file to another file. [4]



Total No. of Questions : 9]

SEAT No. :

P-3926

[Total No. of Pages : 5

[6001]-4001

F.E.

ENGINEERING MATHEMATICS - I
(2019 Pattern) (Semester - I) (107001)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question 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, Q. No. 8 or Q. No. 9.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

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

a) If $u = \frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{x^2 + y^2}$ then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ is equal to [2]

- | | |
|--------|----------|
| i) 2u | ii) -2u |
| iii) 0 | iv) None |

b) If $u = x^y$ then $\frac{\partial u}{\partial y}$ is equal to [1]

- | | |
|-------------------|----------------|
| i) 0 | ii) yx^{y-1} |
| iii) $x^y \log x$ | iv) x^{y-1} |

c) If $x = uv$, $y = \frac{u}{v}$ then the value of $\frac{\partial(u,v)}{\partial(x,y)}$ is [2]

- | | |
|---------------------|---------------------|
| i) $\frac{-2u}{v}$ | ii) uv |
| iii) $\frac{v}{2u}$ | iv) $\frac{-v}{2u}$ |

P.T.O.

- d) A is orthogonal matrix then A^{-1} equal to [1]
- i) A
 - ii) A^T
 - iii) A^2
 - iv) 1
- e) For what value of K the homogeneous system $x + 2y - z = 0$, $3x + 8y - 3z = 0$; $2x + 4y + (k-3)z = 0$ has infinitely many solution. [2]
- i) $K = 0$
 - ii) $K = 1$
 - iii) $K = 2$
 - iv) $K = 3$
- f) Using Cayley Hamilton theorem A^{-1} for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ is calculated from [2]
- i) $\frac{1}{5}(-A - 4I)$
 - ii) $\frac{1}{5}(A - 4I)$
 - iii) $\frac{1}{5}(A + 4I)$
 - iv) $\frac{1}{5}(4I - A)$

- Q2)** a) If $u = \ln(x^2 + y^2)$, show that $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$. [5]
- b) If $e^{2u} = y^2 - x^2$, $\cosec v = \frac{y}{x}$ then find the value of [5]
- $$\left(x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} \right) \cdot \left(x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} \right)$$
- c) If $u = f(x - y, y - z, z - x)$ then find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. [5]

OR

- Q3)** a) If $u = ax + by$, $v = bx - ay$ find the value of $\left(\frac{\partial u}{\partial x} \right)_y \cdot \left(\frac{\partial x}{\partial u} \right)_v$. [5]
- b) If $T = \sin \left(\frac{xy}{x^2 + y^2} \right) + \sqrt{x^2 + y^2}$, find the value of $x \frac{\partial T}{\partial x} + y \frac{\partial T}{\partial y}$. [5]
- c) If $u = f(r, s)$ where $r = x^2 + y^2$, $s = x^2 - y^2$ then show that $y \frac{\partial u}{\partial x} + x \frac{\partial u}{\partial y} = 4xy \frac{\partial u}{\partial r}$. [5]

Q4) a) If $x = u + v$, $y = v^2 + w^2$, $z = u^3 + w^3$ then find $\frac{\partial u}{\partial x}$. [5]

b) In calculating resistance R of a circuit by using the formula :

$$R = \frac{V}{I}$$

errors of 3% and 1% are made in measuring Voltage V and current I respectively. Find the % error in the calculated resistance. [5]

c) Discuss the maxima and minima of : [5]

$$f(x, y) = x^2 + y^2 + xy + x - 4y + 5$$

OR

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

b) Examine for functional dependence : [5]

$$u = y + z, v = x + 2z^2, w = x - 4yz - 2y^2$$

c) A space probe in the shape of the ellipsoid $4x^2 + y^2 + 4z^2 = 16$ enters the earth's atmosphere and it's surface begins to heat. After one hour, the temperature at the point (x, y, z) on the surface of the probe is

$$T(x, y, z) = 8x^2 + 4yz - 16z + 600.$$

Find the hottest point on the surface of the probe, by using Lagrange's method. [5]

Q6) a) Examine for consistency and if consistent then solve it [5]

$$2x + 3y + 5z = 1 ; 3x + y - z = 2 ; x + 4y - 6z = 1$$

b) Examine whether the vectors [5]

$$X_1 = (1, 1, -1, 1); X_2 = (1, -1, 2, -1); X_3 = (3, 1, 0, 1)$$

are linearly independent or dependent. If dependent find relation between them.

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 [5]

Find a, b, c.

OR

- Q7)** a) Investigate for what values of k, the equations [5]

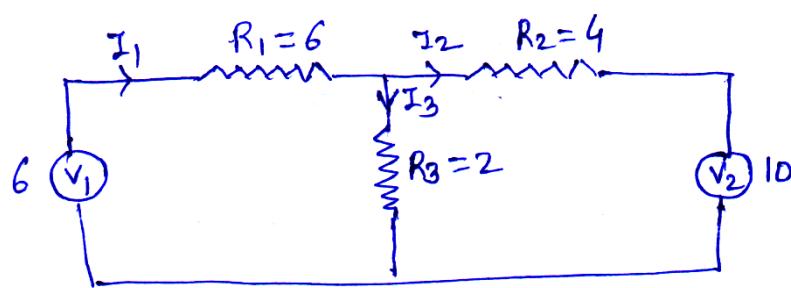
$x + y + z = 1; 2x + y + 4z = k; 4x + y + 10z = k^2$ have infinite number of solution? Hence find solution.

- b) Examine whether the vectors. [5]

$$X_1 = (2, 3, 4, -2); X_2 = (-1, -2, -2, 1); X_3 = (1, 1, 2, -1)$$

are linearly independent or dependent. If dependent find relation between them.

- c) Find the current $I_1; I_2; I_3$ in the circuit shown in the figure [5]



- Q8)** a) Find eigen values and eigen vectors of the following matrix [5]

$$A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$$

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

- c) Find the modal matrix p which transform the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ to the diagonal form. [5]

OR

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

b) Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ and use it to find A^{-1} .
[5]

c) Reduce the following quadratic form to the "sum of the squares form".
[5]

$$Q(x) = 2x^2 + 9y^2 + 6z^2 + 8xy + 8yz + 6xz$$



Total No. of Questions : 9]

SEAT No. :

P-3919

[Total No. of Pages : 4

[6001]-4002

F.E.

ENGINEERING PHYSICS

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *Question No. 1 is compulsory.*
- 2) *Q.No. 2 to Q.No. 9 carry equal marks.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*
- 5) *Use of electronic calculator is allowed.*

Physical Constants :

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

Q1) Write correct option of given questions with Answer. (1 mark each) : [10]

- i) According to Dr. Broglie's hypothesis, the wavelength $\lambda = \frac{h}{p}$ is applicable for
- a) Photons
 - b) Matter particles
 - c) Either matter particles or photons
 - d) Both matter particles and photons
- ii) According to Heisenberg's uncertainty principle -
- | | |
|--|--|
| a) $\Delta x \cdot \Delta p \geq \frac{h}{2n}$ | b) $\Delta x \cdot \Delta p \leq \frac{h}{2n}$ |
| c) $\Delta x \cdot \Delta p \geq \frac{h}{6n}$ | d) $\Delta x \cdot \Delta p \leq \frac{h}{4n}$ |

P.T.O.

- iii) In Schrodinger's time independent equation _____ of a particle is independent of time.
- a) Kinetic energy
 - b) Potential energy
 - c) Total energy
 - d) Wave function
- iv) Fermi level for a metal or conductor is highest energy level occupied by electrons at _____.
- a) 0°C
 - b) 0°F
 - c) 0°K
 - d) None of the above
- v) Hall effect is true for _____.
- a) Metals only
 - b) Semiconductors only
 - c) For N-type semiconductors only
 - d) Both metal and semiconductors
- vi) The magnetic materials exhibit the property of magnetisation because of _____.
- a) Orbital motion of electrons
 - b) Spin of electrons
 - c) Spin of nucleus
 - d) All of the above
- vii) A superconductor is a perfect _____ material.
- a) Insulator
 - b) Semiconductor
 - c) Dielectric
 - d) Diamagnetic
- viii) Tunneling of Cooper pairs through an insulating layer between two superconductors is called _____.
- a) Josephson effect
 - b) Onnes effect
 - c) Meissner effect
 - d) Kerr effect
- ix) With increase in size of nanoparticles its hardness _____.
- a) Increases
 - b) Decreases
 - c) Remains same
 - d) Difficult to predict
- x) In Non destructive testing (NDT) the physical and chemical properties of sample _____.
- a) Changes
 - b) Do not changes
 - c) Depends on temp
 - d) Does not depend on temp

- Q2)** a) Deduce Schrodinger's time independent wave equation. [6]
- b) State and explain Heisenberg's uncertainty principle using the except of small and large wave packet. [5]
- c) Calculate the energy difference between the ground state and first excited state of an electron in the rigid box of length 1A° . [4]

OR

- Q3)** a) State De Broglie's hypothesis. Derive an expression for De Broglie's wavelength of an electron accelerated by a potential difference of 'V'. [6]
- b) Define wave function. Write the conditions of well behaved wave function. [5]
- c) The uncertainty in the location of a particle is equal to its De Broglie wavelength. Show that the uncertainty in the velocity to a particle is equal to the particle velocity itself. [4]

- Q4)** a) With the help of bond theory of solids explain the classification of solids into conductors, semiconductors and insulators. [6]
- b) What are solar cells? Draw I-V characteristics of solar cells and define the terms i) Short circuit current and ii) Open circuit voltage. [5]
- c) The Hall coefficient of a specimen of a doped silicon is found to be $3.66 \times 10^{-4} \text{ m}^3/\text{c}$. The resistivity of the specimen is $1 \times 10^{-2} \Omega\text{m}$. Determine the mobility of the charge carriers. [4]

OR

- Q5)** a) Explain the Hall effect with a neat labelled diagram. Derive an expression for Hall voltage. [6]
- b) Define Fermi level in semiconductors. For a P-N junction diode draw energy band picture showing the position of Fermi level in i) Zero bias and ii) Forward bias. [5]
- c) Calculate the number of donors atoms which must be added to an intrinsic semiconductors to obtain the resistivity of $10^{-6} \Omega\text{cm}$. (Given mobility of electrons = $1000 \text{ cm}^2/\text{V sec.}$) [4]

- Q6)** a) Differentiate between diamagnetism, paramagnetism and ferromagnetism. (Any two points) [6]
- b) Define : [5]
- Magnetic permeability and
 - Magnetic susceptibility
- Obtain the relation between them.
- c) The critical magnetic field of niobium is 1×10^5 A/m at 8°K and 2×10^5 A/m at 0°K. Calculate the critical temperature of the element. [4]

OR

- Q7)** a) Explain **artificial** magnetic field in brief. Distinguish between Type-I & Type II superconductors. (Any 3 points). [6]
- b) Explain **Melssner** effect in brief. Show that superconductors are characterised by perfect diamagnetism. [5]
- c) Define the terms : [4]
- Magnetic field strength (H)
 - Magnetic induction (B)
 - Magnetisation (M)
 - Relation** permeability (μ_r)

OR

- Q8)** a) What is echosounding technique? Using this technique explain non destructive testing for the measurement of thickness of a metal sheet using ultrasonic waves. [6]
- b) What is Non Destructive Testing (NDT)? Distinguish between Non Destructive Testing and Destructive Testing. (Any two points) [5]
- c) Write any four applications of nanotechnology in the field of automobile. Explain any one in brief. [4]

OR

- Q9)** a) Explain optical and mechanical properties of nanoparticles. [6]
- b) What are nanoparticles? What is the effect of quantum confinement on the properties of nanoparticles? [5]
- c) An ultrasonic pulse is sent through a copper block. The echo pulse is received after 4 μ s. If velocity of ultrasonic in copper is 5000 m/s, calculate the thickness of copper block. If the reflection pulse recorded after 1.253 μ s from the top what is the location of flaws? [4]



Total No. of Questions : 9]

SEAT No. :

P-3920

[Total No. of Pages : 4

[6001]-4003

F.E.

ENGINEERING CHEMISTRY

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *Question No. 1 is compulsory.*
- 2) *Solve any one of Q.2 or Q3, Q4 or Q5, Q6 or Q7, Q8 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) Multiple Choice Questions :

- i) Electroluminiscent polymers are used in : [1]
a) Solar cell technology b) Digital display
c) LED d) All of above
- ii) Properties of polymer composite depends on : [1]
a) colour of particle b) monomer
c) size of particle d) none of the above
- iii) Which of following industries have prominent applications for quantum dots? [1]
a) Electronic b) Agriculture
c) Medical d) None
- iv) In _____ λ_{\max} shift to higher side. [1]
a) hyperchromic effect
b) hypochromic effect
c) bathochromic shift
d) blue shift

P.T.O.

- v) Following is the most important characteristic of a good fuel. [1]
- a) high heat value b) bright light
- c) high sound d) colourful smoke
- vi) Following is not a prominent application of UV spectroscopy. [1]
- a) Study of reaction kinetics
- b) Detection of functional group
- c) Quantitative analysis
- d) Qualitative analysis
- vii) The possible number of fundamental modes of vibrations in case of CO_2 molecule is [1]
- a) 2 b) 3
- c) 4 d) 5
- viii) In the process of tinning : [1]
- a) Zn is coated on Fe
- b) Sn is coated on Fe
- c) Sn is coated on Zn
- d) Fe is coated on Zn
- ix) Ideal piling Bed worth ratio for effective protection of metal against corrosion is [1]
- a) $\text{PBR} < 1$
- b) $\text{PBR} \geq 1$
- c) $\text{PBR} > 2$
- d) $\text{PBR} > 2.5$
- x) Sacrificial anode is [1]
- a) anodic protection method
- b) cathodic protection method
- c) an example of metal cladding
- d) an example of powder coating

- Q2)* a) What are conductive polymer? Give types of conducting polymers. Explain doping with reactions and give any two applications of conducting polymers. [6]
- b) Give classification and any four applications of SWCNT. [5]
- c) Give structure, any three properties and any three applications of polycarbonate. [4]

OR

- Q3)** a) Explain with diagram the structure of graphene. Give three properties and three applications of it. [6]
- b) What is biodegradable polymer? Give three factors affecting biodegradation process of a polymer. Give any two applications of biodegradable polymer. [5]
- c) What are quantum dots? Give any two types of quantum dots. Write any two applications of Q.D.S. [4]
- Q4)** a) Explain steam reforming of coke and methane with reaction conditions for industrial production of hydrogen. Give process of CO₂ removal. [6]
- b) Explain fractional distillation process with diagram for petroleum crude. Give composition, boiling temperature range and use of any one fraction. [5]
- c) Exactly 2.500 gram was weighed into silica crucible. After heating for one hour at 110°C the residue weighed 2.415 gram. The crucible next was covered with vented lid and strongly heated for exactly seven minutes at 950 ± 20°C. The residue weighed 1.528 gram. The crucible was then heated without the cover, until a constant weight was obtained. The last residue was found to weight 0.245 gram. Calculate % moisture, % volatile matter, % ash and % Fixed carbon. [4]

OR

- Q5)** a) Give construction with figure and working of Bomb calorimeter. Write corrected formula to find out Gross calorific value of a coal using Bomb calorimeter. [6]
- b) What is ‘Power Alcohol’? Give procedure for preparation of ethanol with reactions. Give any two advantages of Power alcohol. [5]
- c) Observations in the Boy’s Gas calorimeter experiments are given below; find GCV and NCV of fuel. [4]

Volume of gas burnt at STP = 0.08m³

Mass of cooling water used = 29.5 kg

Rise in temperature of circulating water = 9.1°C

Mass of steam condensed = 0.04 kg

- Q6)** a) Explain with diagram the possible electronic transitions those may occur in organic molecule on absorption of UV-radiations. Also state forbidden electronic transitions. [6]
- b) Explain conditions for IR radiation absorption by organic molecule. Describe any three applications of IR spectroscopy. [5]
- c) Give statement and mathematical expression of Lambert-Beer's Law. [4]

OR

- Q7)** a) With the help of diagram explain construction of IR spectrometer. Describe different components of IR spectrometer. [6]
- b) Give any five applications of UV-visible spectroscopy. [5]
- c) Explain bending vibrations observed in IR spectroscopy. [4]

- Q8)** a) Explain hydrogen evolution and oxygen absorption mechanisms of wet corrosion with diagram and reactions. [6]
- b) Explain any five factors responsible for corrosion of metals. [5]
- c) What is galvanisation? Explain process with diagram. [4]

OR

- Q9)** a) Explain types of oxide films with corrosion reactions for metals, Na, Al, Ag, Mo. [6]
- b) Explain process of electroplating with the help of neat labeled diagram. Give any four applications of electroplating. [5]
- c) Distinguish between anodic and cathodic coatings. [4]



Total No. of Questions : 8]

SEAT No. :

P3921

[Total No. of Pages : 3

[6001]-4004

F.E.

SYSTEMS IN MECHANICAL ENGINEERING (SME)

(2019 Credit Pattern) (Semester - I) (102003)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.
- 2) Neat Diagram must be drawn wherever necessary.
- 3) Figures to the right indicates full marks.

Q1) a) Classify automobiles based on various considerations. [7]

b) Define vehicle specification, Explain following engine specifications -[7]

- i) Torque
- ii) Power and
- iii) Stroke

c) Compare vehicle specifications for two-wheeler and three-wheeler vehicles. [4]

OR

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

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

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

Q3) a) Explain the working principle of ABS system in vehicle with neat sketch. State its importance over conventional braking system. [7]

b) Explain construction and working of disc brake system with neat sketch. [7]

c) Define Gear Ratio for gear box. Determine gear ratio, if a pinion 110 mm with 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.

[3]

OR

P.T.O.

Q4) a) State types of steering system? Explain Ackerman steering mechanism with neat sketch. [7]

b) Explain construction and working of single plate clutch with neat sketch. [7]

c) Why safety arrangements needed in vehicle? Explain the importance of seat belts and air bags in the vehicle. [3]

Q5) a) State the importance of sheet metal working in manufacturing. Explain Punching and Blanking with neat sketch. [7]

b) State significance of Metal Cutting process in industry. Explain following metal cutting processes: [7]

i) Turning

ii) Milling and

iii) Drilling operation with neat sketch.

c) Draw a block diagram of 3D printer with all its components. [4]

OR

Q6) a) Explain sand casting process with neat sketch. State its advantages and disadvantages. [7]

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

c) Write a short note on open and closed die forging. [4]

Q7) a) Using block diagrams, write a short note on [7]

i) Electric Geyser and

ii) Electric iron State specifications for Electric Geyser. [7]

- b) Explain with block diagram, working of a refrigerator, state its domestic and industrial applications. [7]
- c) An electric motor driven pump fills an over headed tank placed at a height of 20 m from the ground level. The mass of the water pumped per second is 5.56 kg. Input power of the motor is 2200 W. Calculate the efficiency of the motor. (Use $g = 9.81 \text{ m/s}^2$) [3]

OR

- Q8)* a) Using block diagram, explain the application of blower in kitchen chimney and vacuum cleaner. [7]
- b) State various applications of springs in domestic appliances. With neat sketch, explain any one mechanism making use of spring. [7]
- c) A refrigerator has working temperatures in the evaporator and condenser coils as - 30°C and 32°C . What is the maximum COP of the system? Draw its block diagram. [3]

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Total No. of Questions : 8]

SEAT No. :

P3663

[Total No. of Pages : 4

[6001]-4005

F.E. (All Branches)

**BASIC ELECTRICAL ENGINEERING
(2019 Credit Pattern) (Semester - I/II) (103004)**

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) *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-programable calculator is allowed.*

Q1) a) Define impedance. Draw the impedance triangle for R-L & R-C series circuit. [4]

b) Obtain the expression for current and power, when voltage $v = V_m \sin \omega t$ is applied across purely inductive circuit. [6]

c) The series circuit having resistance 10Ω , inductance 0.1 H and capacitance $150 \mu\text{F}$ is connected to 1-phase, 200 V , 50 Hz AC supply, Calculate - [8]

- i) Inductive reactance X_L
- ii) Capacitive reactance X_C
- iii) Net reactance X
- iv) Impedance Z
- v) Current drawn by the circuit
- vi) Power factor
- vii) Active power P
- viii) Reactive power Q .

OR

Q2) a) If 200 V , 50 Hz supply is applied across the resistance of 10Ω , find equation for voltage & current. [4]

P.T.O.

- b) Derive the expression for power, when voltage $v = V_m \sin \omega t$ is applied across R-L series circuit. [6]
- c) The series circuit having resistance 10Ω and capacitance $150 \mu F$ draws a current of $9.4 A$ from 1-phase, 50 Hz AC supply. Calculate -
- i) Capacitive reactance
 - ii) impedance
 - iii) power factor
 - iv) supply voltage
 - v) Active power and
 - vi) reactive power.
- [8]

Q3) a) Define

- i) Balanced load
 - ii) Unbalanced load and
 - iii) Phase sequence.
- [3]

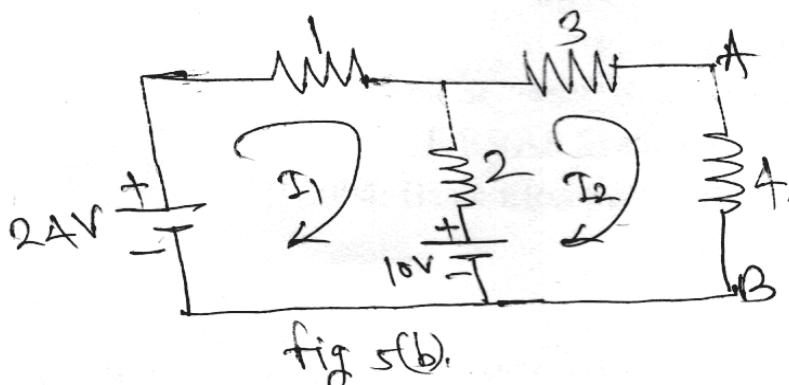
- b) Derive the EMF equation of single phase transformer. [6]
- c) Derive the relation between i) phase voltage and line voltage ii) phase current and line current in case of balanced STAR connected 3-ph inductive load. Assume phase sequence RYB. Draw the circuit diagram & necessary phasor diagram. [8]

OR

- Q4)* a) Define the voltage regulation and efficiency of transformer along with formula. [3]
- b) The maximum flux density in core of a $250/1000 V$, 50 Hz , 1-ph transformer is $1.2 T$. If EMF/turn is $10 V$, calculate i) Primary & secondary number of turns ii) area of cross section of core. [6]

- c) Three identical impedances each of $6+j8 \Omega$ are connected in star across 3-ph, 400 V, 50 Hz ac supply. Determine. [8]
- phase voltage
 - phase current and line current
 - power factor, 3-ph active, reactive and apparent power

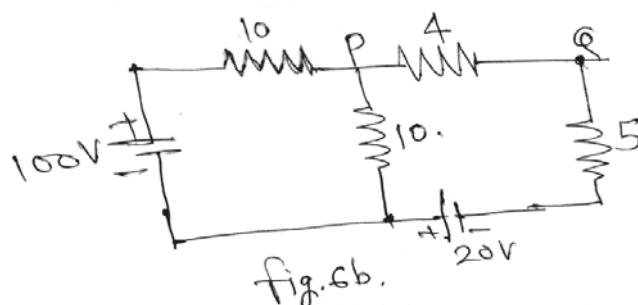
- Q5)* a) State and explain KCL & KVL [4]
 b) Calculate the current flowing through 4Ω (AB) for the circuit shown in fig 5b, using Kirchhoff's Laws. All resistances are in Ω [6]



- c) Derive the equations to convert Delta connected resistive circuit into equivalent Star circuit. [8]

OR

- Q6)* a) Explain the practical current source by means of [4]
- Symbol of representation
 - Value of internal resistance
 - Graphs between V and I
- b) Calculate the current flowing through 4Ω (PQ) for the circuit shown in fig 6b, using Superposition Theorem. All resistances are in Ω [6]



- c) Calculate the current flowing through 4Ω (PQ) for the circuit shown in fig 6b, using Thevenin's Theorem. [8]

- Q7)** a) Define resistance of the material & state factors on which it depends.[3]
 b) Explain construction and working principle of Lithium ion battery. [6]
 c) Derive an expression for insulation resistance of a single core cable with the necessary diagram. [8]

OR

- Q8)** a) State the material used for positive plate, negative plate & electrolyte for lead acid battery. [3]
 b) The current flowing at the instant of switching 240 V, 40 Watt lamp is 2 A. The TCR of tungsten filament is 0.0055 per degree Celsius at 20°C. Determine.
 i) temperature of filament of the lamp ii) working current [6]
 c) If α_1 and α_2 are the RTC of a conducting material at $t_1^0 C$ and $t_2^0 C$ respectively prove that $\alpha_2 = \frac{\alpha_1}{1 + \alpha_1(t_2 - t_1)}$ & hence, obtain $\alpha_t = \alpha_0 / (1 + \alpha_0 \cdot t)$ [8]

❖ ❖ ❖

Total No. of Questions : 8]

SEAT No. :

P3922

[Total No. of Pages : 2

[6001]-4006

F.E.

**BASIC ELECTRONICS ENGINEERING
(2019 Pattern) (Semester - II) (104010)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Attempt Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.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) i) Convert:

- 1) $(372.26)_8$ to Hexadecimal
- 2) $(5F1.6C)_{16}$ to Octal
- 3) $(9D.33)_{16}$ to Decimal

ii) Solve:

- 1) $(110011-111001)$ using 2s compliment method
- 2) (1101×110)
- 3) $(111011.11 + 100100.01)$

[6]

b) Define Universal Logic Gates. Why they known as Universal Logic Gates?

[6]

c) Draw block diagram of Microprocessor and explain function of each block.

[6]

OR

Q2) a) With the help of truth table, explain operation of AND, OR, EX-OR gates.

[6]

b) State and prove De-Morgan's Theorems.

[6]

c) Explain in detail the working of a full adder with the help of a truth table and give its sum and carry.

[6]

P.T.O.

- Q3)** a) Explain digital multimeter with block diagram. [6]
b) Explain Power Scope with block diagram. [5]
c) Explain how to convert Galvanometer to Analog Voltmeter and how to use it as multi-range Voltmeter? [6]

OR

- Q4)** a) Explain function Generator with block diagram. [6]
b) Explain Auto Transformer and list its applications. [5]
c) Explain how to convert Galvanometer to Analog Ammeter and how to use it as multi-range Ammeter? [6]

- Q5)** a) Explain selection criteria of transducers. [6]
b) Draw construction of LVDT and explain its operation. Write its advantages, disadvantages and applications. [6]
c) Explain working principle of strain gauge. Explain load cell. [5]

OR

- Q6)** a) Differentiate between active and passive sensors. [6]
b) Explain RTD with its construction, working, advantages, disadvantages and applications. [6]
c) Explain operation of Biosensor with one application. [5]

- Q7)** a) With the help of block diagram, explain basic communication system. [6]
b) Explain IEEE electromagnetic frequency spectrum and state allotment of frequency bands for different applications. [6]
c) Draw diagram explain GSM architecture. [6]

OR

- Q8)** a) Explain different types of cables used in electronic communication. [6]
b) Draw block diagram of FM Transmitter and explain. [6]
c) Explain cellular communication system. [6]

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[6001]-4007
F.E. (Common)
ENGINEERING MECHANICS
(2019 Pattern) (Semester - I/II) (Credit System) (101011)

*Time : 2½ Hours]**[Max. Marks : 70]***Instructions to the candidates:**

- 1) Attempt Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary and clearly state.
- 5) Use of cell phone is prohibited in the examination hall.
- 6) Use of electronic pocket calculator is allowed.

- Q1) a)** Determine the force ‘P’ need to pull over the 50 kg smooth roller over the step of 50 mm as shown in Fig. 1 a. Calculate the contact reactions at B if radius of roller is 300 mm. Take $\theta=30^\circ$. **[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]**

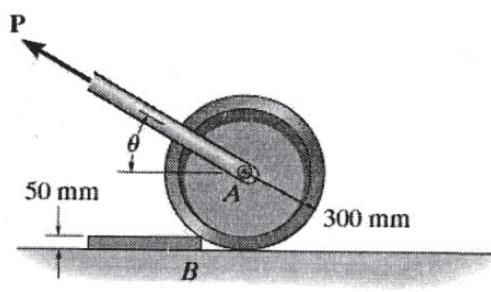


Fig. 1 a

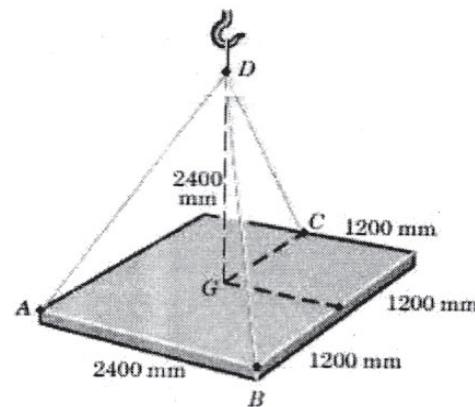


Fig. 1 b

- c) Explain Simple, Roller, Hinge and Fixed support with number of reactions developed at each support with sketch. [4]

OR

- Q2)** a) Determine the support reactions at fixed end A for a beam loaded with 6 kN/m UVL and 3 kN/m UDL as shown in Fig. 2 a. Neglect the weight of 3 m span beam. [6]
- b) A uniform steel plate of 20 cm \times 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. [6]

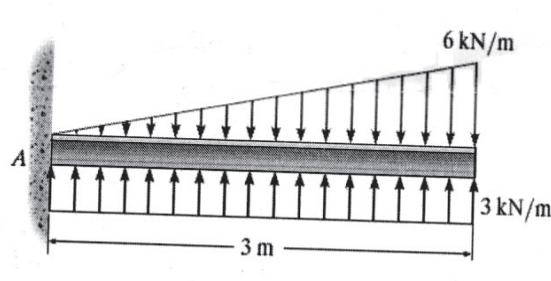


Fig. 2 a

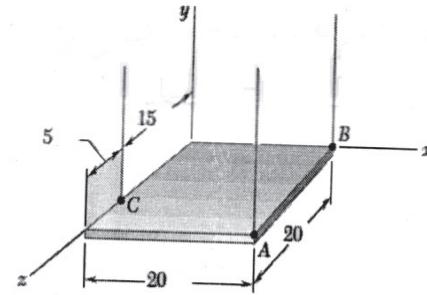


Fig. 2 b

- c) Explain how uniformly distributed load (UDL) and uniformly varying load (UVL) is converted in to a point load with sketch. [6]

- Q3)** a) Determine the force in all members of the truss loaded with 3 kN and 4 kN forces at D and B respectively with supports hinge at A and Roller at B, as shown in Fig. 3 a. Take $\theta = 30^\circ$. [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]

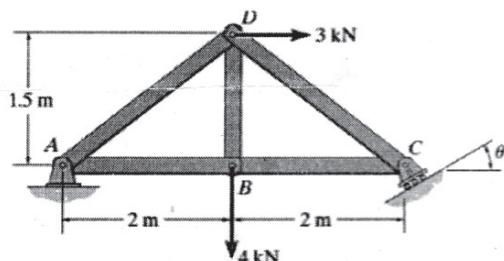


Fig. 3 a

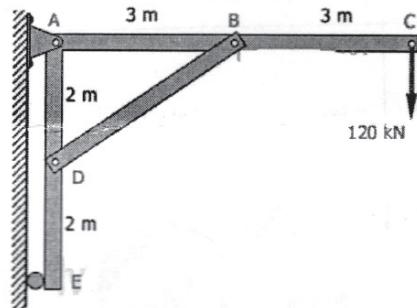


Fig. 3 b

- c) Define zero force members in truss and what are the conditions to identify them, with a sketch? [4]

OR

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

- b) Knowing that lamp attached at D is, $m_F = 20 \text{ kg}$, determine the tension in each segment of the cable loaded and supported as shown in Fig. 4b.[5]

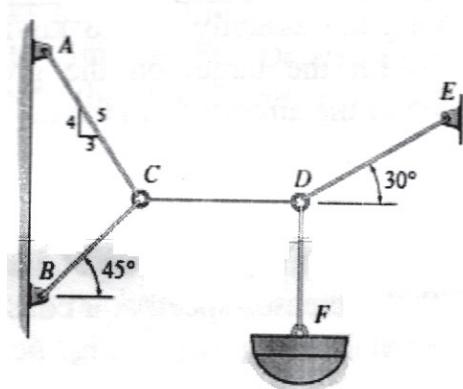


Fig. 4 b

- c) Explain $2.j - 3 <m; 2.j - 3 = m; 2.j - 3 > m$ with sketch. [6]

- Q5)** a) The motion of a particle is given by : $a = t^3 - 3t^2 + 5$ where ‘a’ is the acceleration in m/s^2 and ‘t’ is the time in seconds. The velocity of the particle, at $t = 1$ second is 6.25 m/sec and the displacement is 8.8 m . Calculate the displacement and velocity at $t = 2$ seconds. [6]
- b) A ball thrown vertically upward with a velocity of 10 m/s from a window located 20 m above the ground. Knowing that the acceleration of the ball is constant and equal to 9.81 m/s^2 downward, determine [6]
- the highest elevation reached by the ball and the corresponding value of t ;
 - velocity with which it hit the ground.
- 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]

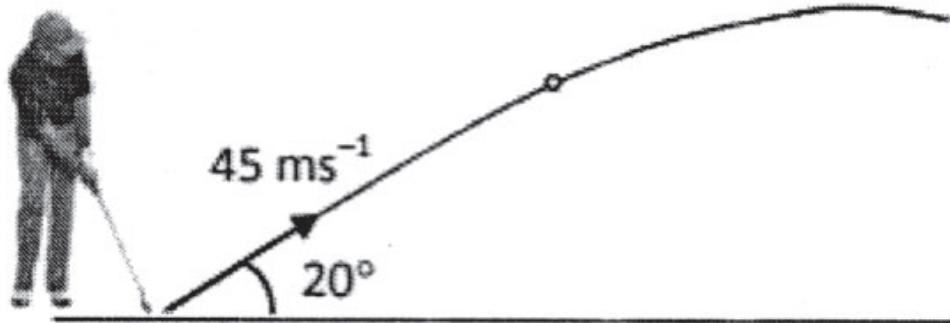


Fig. 5c

OR

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

- b) An aircraft, moving horizontally at 108 km/hr at an altitude of 1000 m wants to hit the target on the ground. Estimate the horizontal distance of the aircraft from the target, when it released the bomb. Calculate also the direction and velocity with which the bomb hits the target. Neglect air friction. [6]

- c) A motorist starts from rest at point A on a circular ramp of 150 m radius when $t = 0 \text{ s}$, 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]

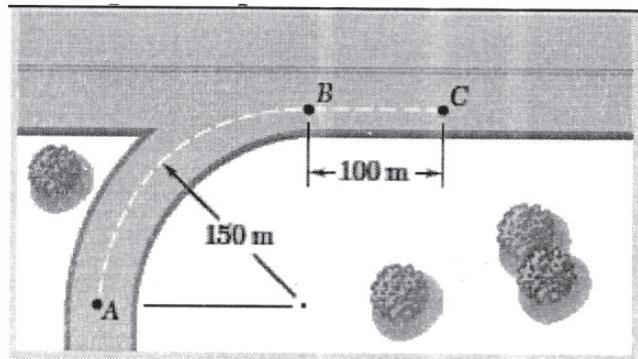


Fig. 6 c

- Q7) a)** If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$, determine the distance the crate travels when its velocity reaches to 8 m/s. Assume crate starts from rest, and $P = 200$ N, for crate shown in Fig. 7a. Use work-Energy principle. [6]

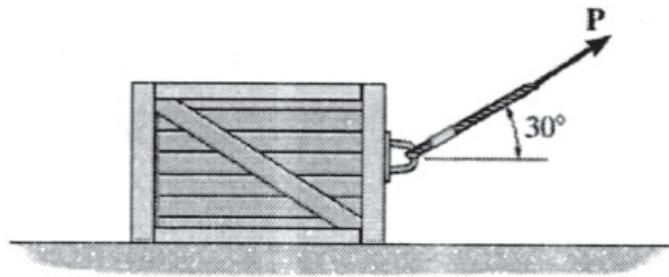


Fig. 7 a

- 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]
- c)** A ball of mass 1 kg 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 renounce height after falling from 3m again. [5]

OR

- Q8) a)** The conveyor belt is designed to transport packages of various weights. Each 10-kg package has a coefficient of kinetic friction $\mu_k = 0.15$. If the speed of the conveyor is 5 m/s, and then it suddenly stops, determine the distance the package will slide on the belt before coming to rest. [6]

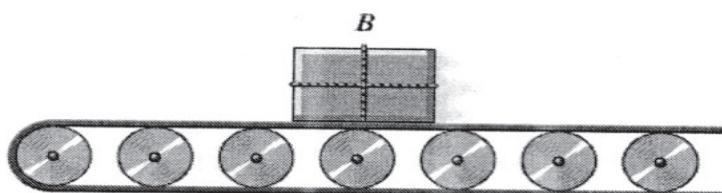


Fig. 8 a

- 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 $k = 3\text{kN/m}$. Assuming the impact to be perfectly plastic, determine the compression of the spring after impact.

[6]

- c) Ball 'A' of 5 kg moving with 10m/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. Also determine coefficient of restitution 'e'.

[5]

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Total No. of Questions : 8]

SEAT No. :

P-3664

[Total No. of Pages : 3

[6001]-4008

F.E. (Semester - II)

PROGRAMMING AND PROBLEM SOLVING

(2019 Pattern) (110005)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *Question one is compulsory.*
- 2) *Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and Q.7 or Q.8.*
- 3) *Neat diagrams must be wherever necessary.*
- 4) *Assume suitable data wherever necessary.*

Q1) a) Explain in-built and user defined functions with syntax and suitable example. [6]

b) Explain the following terms with suitable examples. [6]

- i) local variable
- ii) global variable

c) Write a program to check whether a number is prime or not using function. [5]

OR

Q2) a) Explain the following types of function arguments with examples: [6]

- i) positional arguments
- ii) variable length arguments

b) Explain different ways of importing an in-built module in python with suitable example. [6]

c) Write a program to find cube of a number using lambda function. [5]

Q3) a) Justify strings are immutable with example. [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? [5]
S = “Programming and Problem Solving”
- i) print(S[:11])
 - ii) print(S[::-1])
 - iii) print("And" not in S)
 - iv) print(S[4])
 - v) print (S[0:10])

OR

- Q4)** a) Explain string format operator with suitable example. [6]
- b) Explain following string methods with example. [6]
- i) title()
 - ii) startswith()
 - iii) zfill()
- c) Write a program to display a string and count characters in the string using a loop. [5]

- Q5)** a) Explain the following Programming Paradigms in detail. [6]
- i) Monolithic Programming
 - ii) Structured Programming
 - iii) Object Oriented Programming
- b) Explain the following concepts with example. [6]
- i) public members
 - ii) private members
- c) Write a python program to create a class Student with the attributes Name, roll no and age and display data of 4 students. [6]

OR

- Q6)** a) Explain any three object oriented features in brief. [6]
- b) Explain class method and class variable with suitable example. [6]
- c) Write a program to calculate area of triangle using a class. [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) write()
 ii) writelines()
 iii) close()
c) Explain file access modes in brief. [6]

OR

- Q8)** a) Explain different directory methods with example. [6]
b) Differentiate between text and binary files. [6]
c) Explain the following dictionary methods. [6]
 i) update()
 ii) keys()
 iii) pop()



Total No. of Questions : 9]

SEAT No. :

P3924

[6001]-4009

[Total No. of Pages : 4

F.E.

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q. No.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 electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

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

a) $\int_0^{\frac{\pi}{2}} \sin^4 t dt =$ [2]

i) $\frac{3\pi}{16}$ ii) $\frac{3}{8}$

iii) $\frac{3}{16}$ iv) $\frac{3\pi}{8}$

b) The equation of the tangent to the curve $y(1+x^2)=x$ at origin, if exist is [2]

- i) X=0 ii) Y=0
iii) $x=1, x=-1$ iv) $y=x$

c) The value of double integration $\iint_0^1 \frac{1}{1+x^2} \cdot \frac{1}{1+y^2} dx dy =$ [2]

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

iii) $\frac{\pi}{4}$ iv) $\frac{\pi^2}{8}$

P.T.O.

d) Centre (C) of sphere $x^2 + y^2 + z^2 - 2z = 4$ is [2]

- i) $C \equiv (0, 0, 0)$
- ii) $C \equiv (0, 0, 1)$
- iii) $C \equiv (0, 1, 0)$
- iv) $C \equiv (1, 0, 0)$

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

- i) Pole
- ii) $\theta = 0$
- iii) $\theta = \frac{\pi}{2}$
- iv) $\theta = \frac{\pi}{4}$

f) $\iiint_V dxdydz$ represents [1]

- i) Area
- ii) Mass
- iii) Mean Value
- iv) Volume

Q2) a) If $I_n = \int_0^{\frac{\pi}{4}} \sec^n \theta d\theta$, then prove that $I_n = \frac{(\sqrt{2})^{n-2}}{n-1} + \frac{n-2}{n-1} I_{n-2}$ [5]

b) Evaluate $\int_2^5 (x-2)^3 (5-x)^2 dx$ [5]

c) Using DUIS, prove that $\int_0^\infty \frac{e^{-x} - e^{-ax}}{x \sec x} dx = \frac{1}{2} \log\left(\frac{a^2 + 1}{2}\right), a > 0$ [5]

OR

Q3) a) Evaluate

i) $\int_0^{2\pi} \sin^2 \frac{\theta}{2} \cos^{10} \frac{\theta}{2} d\theta$ [3]

ii) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos^4 t dt$ [2]

b) Evaluate: $\int_0^1 (x \log x)^4 dx$ [5]

c) Prove that: $\frac{1}{x} \frac{d}{da} \operatorname{erf}_c(ax) = -\frac{1}{a} \frac{d}{dx} \operatorname{erf}(ax)$ [5]

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

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

c) Find the are length of Astroid $x^{2/3} + y^{2/3} = a^{2/3}$ [5]

OR

Q5) a) Trace the curve $x^3 + y^3 = 3axy$. [5]

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

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

Q6) a) Show that the plane $x - 2y - 2z = 7$ touches the sphere $x^2 + y^2 + z^2 - 10y - 10z - 31 = 0$. Also find the point of contact. [5]

b) Find the equation of right circular cone whose vertex is at origin, whose axis is the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ and which has a semi-vertical angle of 60° . [5]

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

OR

Q7) a) Show that the two spheres: $x^2 + y^2 + z^2 = 25$ and $x^2 + y^2 + z^2 - 18x - 24y - 40z + 225 = 0$ touches externally. Also find the point of contact. [5]

b) Find the equation of right circular cone whose vertex is at $(0,0,10)$, axis is the Z-axis and the semi-vertical angle is $\cos^{-1}\left(\frac{2}{\sqrt{5}}\right)$ [5]

c) Find the equation of right circular cylinder of radius $\sqrt{6}$, whose axis passes through the origin and has direction cosines $\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$. [5]

- Q8)** a) Evaluate $\iint_R xy \, dx \, dy$, where R is $x^2 = y, y^2 = -x$. [5]
- b) Find area of cardioide $r = a(1 - \cos\theta)$ using double integration. [5]
- c) Find the moment of inertia of one loop of the lemniscate $r^2 = a^2 \cos 2\theta$ about initial line. Given that density $\rho = \frac{2m}{a^2}$, m is a mass of the area. [5]

OR

- Q9)** a) Change order of integration $\int_0^5 \int_{2-x}^{2+x} f(x, y) \, dx \, dy$. [5]
- b) Find the volume bounded by the cone $x^2 + y^2 = z^2$ and paraboloid $x^2 + y^2 = z$. [5]
- c) Find the x - co-ordinate of centre of gravity of one loop of $r = a \cos 2\theta$, which is in the first quadrant, given that area of loop is $A = \frac{\pi a^2}{8}$. [5]



Total No. of Questions : 8]

SEAT No. :

P3925

[6001]-4010

[Total No. of Pages : 3

F.E.

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

Time : 2½ Hours]

[Max. Marks : 50]

Instructions to the candidates:

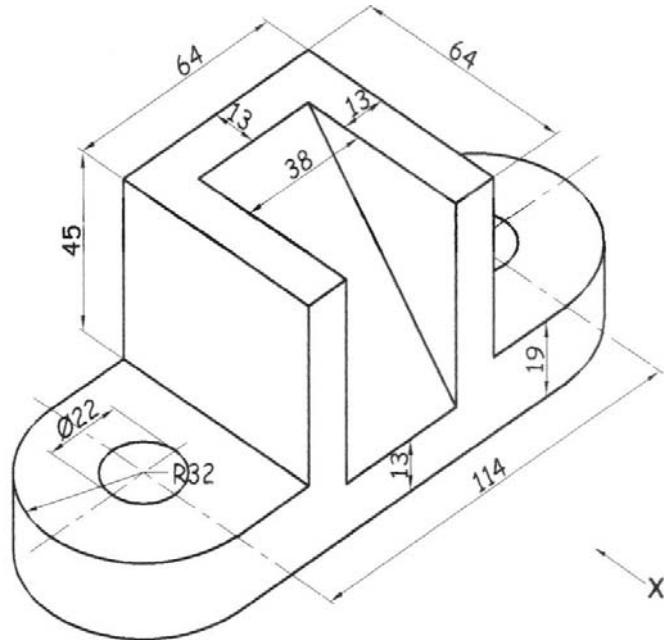
- 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Assume suitable data, if necessary.
- 3) Retain all the construction lines.

Q1) Draw an ellipse by rectangular method if the major axis and minor axis are 160 mm and 100 mm respectively. [8]

OR

Q2) Draw a cycloid of a rolling circle of diameter 40 mm. Assume the point 'P' is away from the base. [8]

Q3) Figures 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 Left-Hand Side View. Give dimensions in all views. [16]

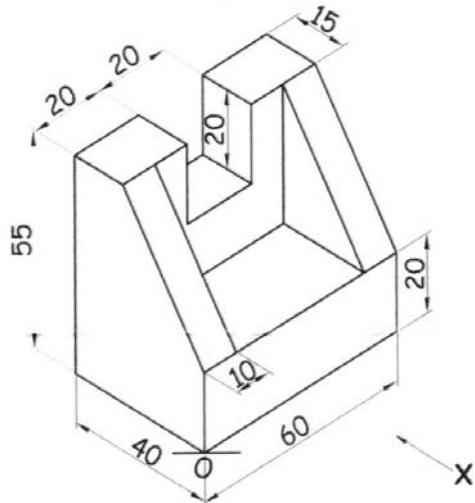


OR

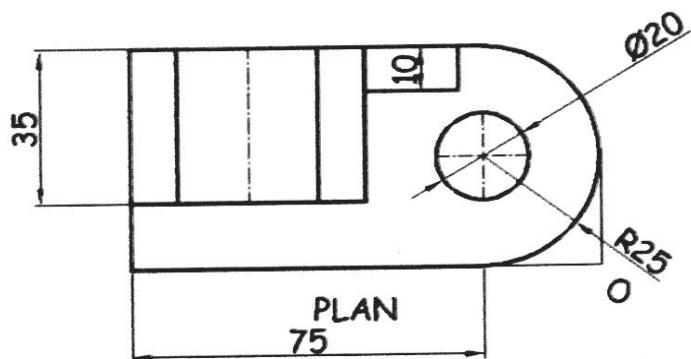
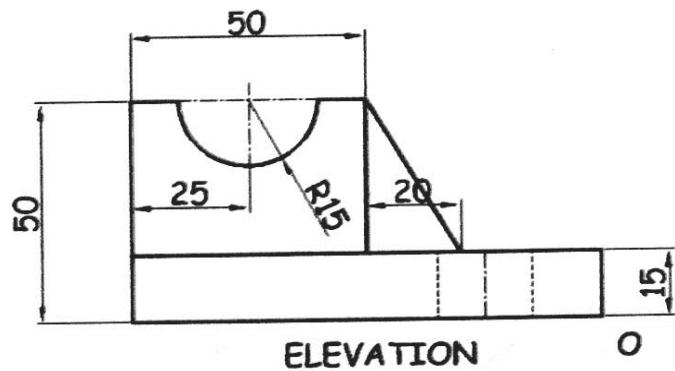
P.T.O.

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

- Front View in the X direction
- Top View
- Sectional Left-Hand Side View along symmetry of the object.

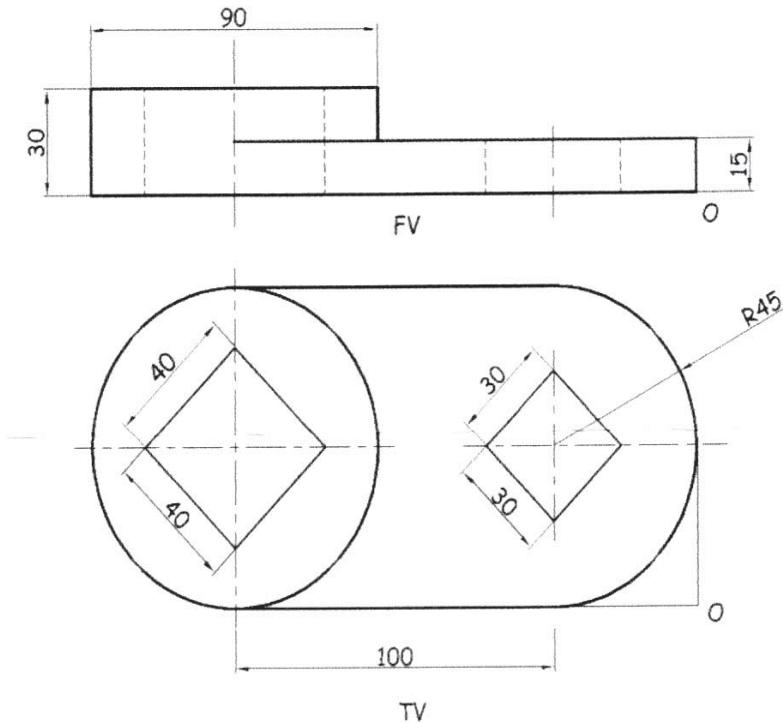


Q5) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. [16]



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 hexagonal pyramid of base 30 mm and axis and axis height 75 mm is resting on H.P. with side of the base parallel to V.P. It is cut by a section plane, perpendicular to V.P. and inclined at 45° to H.P. and bisecting axis of the pyramid. Draw the development of lateral surfaces of the pyramid. [10]

OR

Q8) A pentagonal prism side of base 30 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 near to the observer. A cutting plane bisects its axis at 45° . Draw the development of lateral surfaces the pentagonal prism. [10]



Total No. of Questions : 8]

SEAT No. :

P4230

[6001]-5001

[Total No. of Pages : 4

F.E.

ENGINEERING MATHEMATICS - I

(2015 Pattern) (Credit System) (Semester - I & II) (107001)

Time : 2 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 and Q.7 or Q.8.
- 2) Figures to the right indicate full marks.
- 3) Use of electronic pocket calculator allowed.
- 4) Assume suitable data, if necessary.

Q1) a) Examine consistency of following system. [4]

$$x+y+z = 1$$

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

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

b) Find eigenvalues and eigenvector corresponding to largest eigenvalue of [4]

$$A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$$

c) If $\sin(\alpha + i\beta) = x + iy$ then prove that [4]

$$\text{i)} \quad \frac{x^2}{\cosh^2 \beta} + \frac{y^2}{\sinh^2 \beta} = 1$$

$$\text{ii)} \quad \frac{x^2}{\sin^2 \alpha} - \frac{y^2}{\cos^2 \alpha} = 1$$

OR

P.T.O.

- Q2)** a) Find roots of $x^5+1 = 0$. [4]
 b) Find principal value of i^{-2i} [4]
 c) Show that [4]

$$A = \frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix} \text{ is orthogonal}$$

- Q3)** a) Solve any one: [4]

- i) Test the convergence of the series: $\sum \frac{2^n}{n^3 + 1}$
 ii) Test the convergence of the series: $1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} \dots \dots \dots$

- b) Prove that :

$$x \operatorname{cosec} x = 1 + \frac{x^2}{6} + \frac{7}{360} x^4 + \dots \dots \dots [4]$$

- c) Find n^{th} derivative of

$$y = \sin^{-1} \left(\frac{2x}{1+x^2} \right) [4]$$

OR

- Q4)** a) Solve any one : [4]

i) $\lim_{x \rightarrow 0} \frac{x - \log(1+x)}{x^2}$

ii) $\lim_{x \rightarrow 0} (\cos x)^{\cot x}$

- b) Using Taylor's theorem expand $x^3 - 2x^2 + 3x + 1$ in powers of $x-1$. [4]
 c) Find y_n for $y = x^2 e^{ax}$ by using Leibnitz's theorem. [4]

Q5) Solve any two :

a) If $u = 2x + 3y, v = 3x - 2y$

[6]

Prove that

$$\text{i)} \quad \left(\frac{\partial y}{\partial v} \right)_x \left(\frac{\partial v}{\partial y} \right)_u = \frac{13}{4}$$

$$\text{ii)} \quad \left(\frac{\partial u}{\partial x} \right)_y \left(\frac{\partial x}{\partial u} \right)_v = \frac{4}{13}$$

b) If $u = \frac{x^3 + y^3}{x + y}$ then by Euler's theorem and deductions prove

[7]

$$\text{i)} \quad x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = zu$$

$$\text{ii)} \quad x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = 2u$$

c) If $u = f(r, s)$ and $r = x^2 + y^2$ and $s = x^2 - y^2$ then prove that

[6]

$$y \frac{\partial u}{\partial x} + x \frac{\partial u}{\partial y} = 4xy \frac{\partial u}{\partial r}$$

OR

Q6) Solve any two :

[6]

a) If $z = e^{y+ax} + (y - ax)^z$, find the value of $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}$

b) If $u = \sin^{-1}(x^2 + y^2)^{\frac{1}{5}}$ then prove that

[7]

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{2}{5} \tan u \left[\frac{2}{5} \sec^2 u - 1 \right]$$

c) If $z = f(x, y)$ where $x = u + v, y = uv$ then prove that

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

[6]

Q7) a) If $x = r \cos\theta$, $y = r \sin\theta$,

then show that $J J' = 1$. [4]

b) Examine whether the following functions are functionally dependent. If so, find the relation between them.

$$u = \sin^{-1}x + \sin^{-1}y, \quad v = x\sqrt{1-y^2} + y\sqrt{1-x^2}. \quad [4]$$

c) Discuss the maxima and minima of the function $x^2 + y^2 + 6x + 12$. [5]

OR

Q8) a) If $u = x + y$ and $v = x^2 + y^2$, [4]

$$\text{find } \frac{\partial u}{\partial x}.$$

b) Find the percentage error in the area of an ellipse when errors of 2% and 3% are made in measuring its major and minor axes respectively. [4]

c) Divide 120 into three parts so that the sum of their products taken two at a time shall be maximum. [5]



Total No. of Questions : 8]

SEAT No. :

P-4231

[Total No. of Pages : 2

[6001]-5002
F.E. (Semester - I/II)
ENGINEERING CHEMISTRY
(2015 Pattern) (107009) (Credit System)

Time : 2 Hours]

[Max. Marks : 50]

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) *Assume suitable data, if necessary.*

- Q1)*** a) Describe Demineralisation method with figure, process, ion exchange and regeneration reaction for softening of hard water. [6]
b) What is a reference electrode? Draw a neat labeled diagram of glass electrode and give its representation. [3]
c) Define the terms :
 i) Resistance ii) Cell constant
 iii) Equivalent conductance

OR

- Q2)*** a) Explain principle, instrumentation and applications of UV visible spectrophotometer. [6]
b) Explain any three principles of green chemistry. [3]
c) An exhausted zeolite softener was regenerated by passing 150lit. of NaCl solution having strength 150gm/lit. of NaCl how many lit of hard water sample having hardness 400ppm can be softened by using softner. [3]

- Q3)*** a) Give preparation reaction properties and applications of following. [6]
 i) Styrene - butadiene rubber,
 ii) HDPE
b) What is power alcohol? Give preparation reaction and advantages of power alcohol. [3]

P.T.O.

- c) Calculate carbon and hydrogen in coal sample from the following data: 0.25gm of coal sample on burning in combustion chamber in current of pure O₂, was found to increase weight of CaCl₂ U tube by 0.12gm and KOH U tube by 0.57 gm. [3]

OR

- Q4)** a) Draw neat labeled diagram and give the construction working of Bomb calorimeter to determine GCV of a fuel. State formula with corrections to calculate GCV. [6]
- b) Explain bulk polymerization technique Draw the figure and state its disadvantages. [3]
- c) Distinguish between thermo-softening and thermosetting polymer with examples. [3]

- Q5)** a) Explain industrial production of hydrogen by steam reforming of methane and coke. [5]
- b) Give structure, one method of preparation of silane. [4]
- c) Explain the structure and properties of graphite. [4]

OR

- Q6)** a) What are carbon nanotubes? Give types with respect to their structure and its applications. [5]
- b) Discuss the properties of hydrogen which make it difficult for storage. [4]
- c) Explain the structure of diamond Give its properties and applications. [4]

- Q7)** a) Discuss any five factors affecting corrosion. [5]
- b) What is cathodic protection? Explain any one method in detail. [4]
- c) Define electroplating. Explain the process with a neat labeled diagram and its applications. [4]

OR

- Q8)** a) Define Wet corrosion. Explain corrosion by hydrogen evolution mechanism. [5]
- b) What is anodic and cathodic coating? Which one is more protective? Give reason. [4]
- c) What is Galvanization? Explain the process with neat labeled diagram to protect iron from corrosion. [4]



Total No. of Questions : 8]

SEAT No. :

P4232

[6001]-5003

[Total No. of Pages : 2

F.E.

ENGINEERING PHYSICS

(2015 Credit Pattern) (Semester - I & II) (107002)

Time : 2 Hours]

[Max. Marks : 50]

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) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of non-programmable electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

Constants:

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

- Q1)** a) For a thin film of uniform thickness, derive the conditions for constructive and destructive interference for the light rays that are reflected from the top surface of the film. [6]
- b) Explain in brief Magnetostriction Effect. [3]
- c) In a Newtons rings experiment, the diameter of certain right ring is 0.65 cm and that of 10th bright ring beyond it is 0.95 cm. If $\lambda = 6000 \text{ \AA}$ calculate the radius of curvature of a convex lens in contact with the glass plate. [3]

OR

- Q2)** a) Explain in brief Piezoelectric effect. Explain construction and working of piezoelectric oscillator for the production of ultrasonic waves. [6]
- b) What is diffraction of light? Explain the difference between Fraunhofer and Fresnel diffraction (any two points). [3]
- c) Calculate the depth of the sea if the time interval between the emitted signal and the echo received is 2sec in sonar studies. Assume the velocity of sound in sea water as 1490m/s. [3]

P.T.O.

- Q3)** a) Explain construction and working of Ruby laser. Why it is pulsed laser? [6]
 b) Draw the energy band diagram for p-n junction diode in [3]
 i) zero bias condition ii) forward bias condition
 c) For a light of wavelength 6350 AU, find the thickness for a Half Wave Plate and Quarter Wave Plate. (Given: $\mu_o = 1.658$ and $\mu_e = 1.486$). [3]

OR

- Q4)** a) What is Hall effect? Derive an expression for Hall Voltage and Hall Coefficient. State applications of Hall effect. [6]
 b) Explain double refraction in brief with suitable diagram? State points of differences between positive and negative crystal (any two). [3]
 c) Calculate the conductivity of pure Si at room temperature when the concentration of carriers is 1.6×10^{10} per cm^3 . (Given $\mu_e = 1500 \text{ cm}^2/\text{V.sec}$ and $\mu_h = 500 \text{ cm}^2/\text{V.sec}$). [3]

- Q5)** a) Starting from de-Broglie equation, derive Schrodinger's time independent wave equation. [6]
 b) What is phase velocity? Show that the phase velocity of a matter wave is C^2/v . [4]
 c) An electron is trapped in a rigid box of 2.5 AU wide. Find the 3rd energy level of electron in eV. [3]

OR

- Q6)** a) State and explain Heisenberg's Uncertainty Principle. Illustrate it by the experiment of electron diffraction at a single slit. [6]
 b) Explain physical significance of ψ and $|\psi|^2$. State and explain the mathematical conditions that wave function ψ need to obey. [4]
 c) Find the de-Broglie wavelength of electron of energy 10 keV. [3]

- Q7)** a) What is superconductivity? Distinguish between Type I & Type II superconductors (any four points). [6]
- b) Explain any one physical method for synthesis of nanoparticles. [4]
- c) List the three applications of nano-particles. Explain any one of them in brief. [3]

OR

- Q8)** a) Explain Optical and Electrical properties of nano-particles. [6]
- b) What is Meissner effect? Explain in brief why superconductors exhibit Meissner effect. [4]
- c) List the three applications of superconductors. Explain any one of them in brief. [3]



Total No. of Questions : 8]

SEAT No. :

P-4233

[Total No. of Pages : 2

[6001]-5004

F.E.

**BASIC ELECTRONICS ENGINEERING
(2015 Pattern) (Semester - I & II) (104012)**

Time : 2 Hours]

[Max. Marks : 50]

Instructions to the candidates :

- 1) Answer Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.
- 2) Figures to the right indicate full marks.

Q1) a) Explain half wave rectifier circuit with it's waveforms. [6]

b) Draw and explain BJT as a switch along with its region of operations. [6]

OR

Q2) a) Explain Zener diode as voltage regulator. [6]

b) Draw and explain drain and transfer characteristics of n-channel enhancement MOSFET. [6]

Q3) a) With a neat circuit diagram explain Inverting summing amplifier with its equation. [6]

b) Compare Microprocessor and micro-controller. [6]

OR

Q4) a) Draw and explain diagram of IC555 as an Astable multivibrator along with its waveform. [6]

b) Implement Basic Logic gates using any one of universal gates. [6]

P.T.O.

Q5) a) Draw the symbol and explain operation of TRIAC along with its VI characteristics. [7]

b) Compare RTD, Thermister and Thermocouple. [6]

OR

Q6) a) Draw and explain Linear Variable Differential Transducer (LVDT) along with its transfer characteristics. [7]

b) Draw and explain digital thermometer. [6]

Q7) a) What is the need of Modulation? Explain modulation index for AM and FM techniques. [7]

b) Compare various cables used in communication system. [6]

OR

Q8) a) A carrier of 20V peak and frequency 1 MHz is amplitude modulated (AM) by a sine wave of 10V peak and frequency 1 kHz. Determine the modulation index for the modulated wave and draw the frequency spectrum for AM wave. [7]

b) Draw and explain GSM architecture. [6]



Total No. of Questions : 8]

SEAT No. :

P-4234

[Total No. of Pages : 3

[6001]-5005
F.E. (All Branches)
BASIC ELECTRICAL ENGINEERING
(2015 Pattern) (103004) (Semester - I & II)

Time : 2 Hours]

[Max. Marks : 50

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) Neat Diagrams must be drawn wherever necessary.
- 3) Figure to right indicate full marks.
- 4) Use of Non-Programmable Scientific Calculators is allowed.
- 5) Assume Suitable Data if necessary.

- Q1)** a) Obtain the expression for insulation resistance of the single core cable.
Draw the necessary diagram. [6]
- b) Obtain the expression for coefficient of coupling between two magnetically coupled coils. [6]

OR

- Q2)** a) Compare Electrical & Magnetic circuit (similar points only). [6]
- b) If the temperature coefficient of resistance for copper wire is 0.00426 per degree Celsius at 0 °C. Find the temperature coefficient of resistance at [6]
- i) 20 °C and
 - ii) 50 °C &
 - iii) 70 °C

- Q3)** a) Obtain the emf equation of 1-phase transformer. [6]
- b) Obtain the expression for RMS value of alternating current in terms of its peak value. [7]

OR

P.T.O.

Q4) a) Convert rectangular to polar OR polar to rectangular form [6]

- i) $Z = 3 - j4$
- ii) $Z = 5 + j10$
- iii) $Z = 5 < -36.87^\circ$

b) The alternating voltage expression is given by $v = 282.84 \sin(100\pi t)$ Volt. Determine :

- i) maximum value of voltage
- ii) RMS value of voltage
- iii) average value of voltage
- iv) frequency
- v) periodic time
- vi) power consumed when it connected to resistance of 10Ω . [7]

Q5) a) Obtain the expression for power, when voltage $v = V_m \sin \omega t$ is applied across R-L series circuit. Draw the circuit diagram and phasor diagram. [6]

b) State the relation between

- i) phase voltage and line voltage
- ii) phase current and line current incase of balanced star connected 3-ph inductive load. By the use of above relations, derive the expressions for 3-ph active power and 3-ph reactive power. [6]

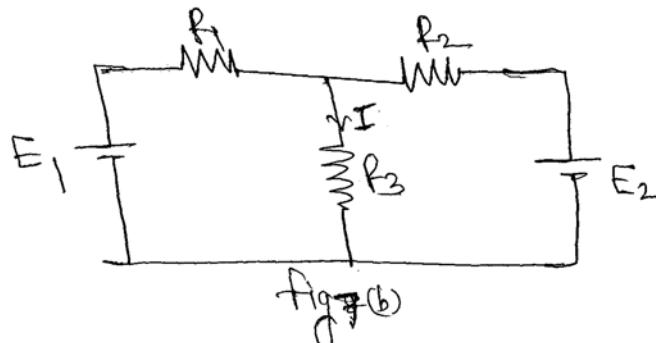
OR

Q6) a) Define admittance, conductance & susceptance. State their units. [6]

b) The R-L series circuit having resistance 10Ω and inductance 0.1 H is connected to 1-phase, 200 V , 50 Hz AC supply. Calculate -

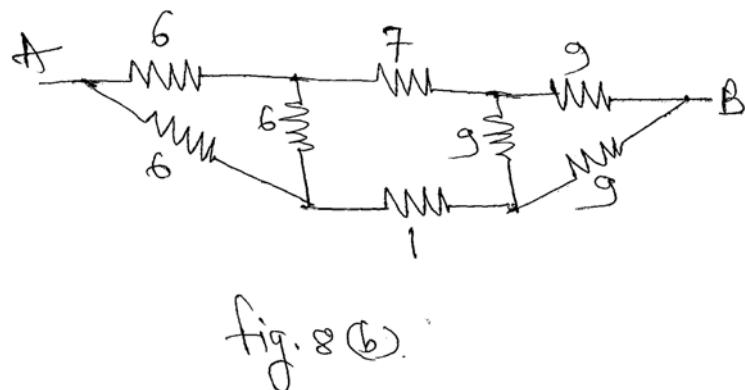
- i) inductive reactance X_L
- ii) impedance
- iii) current drawn by the circuit
- iv) power factor
- v) Active power and
- vi) reactive power. [6]

- Q7)** a) Derive the equations to convert Delta connected resistive circuit into equivalent star circuit. [6]
- b) Write down the steps to find current through resistance R_3 using Superposition theorem for the circuit shown in fig. 7.b. [7]



OR

- Q8)** a) State and explain Kirchhoff's laws. [6]
- b) Find the equivalent resistance between A & B for the network shown below. Fig 8 (b). All resistance are in Ω . [7]



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Total No. of Questions : 8]

SEAT No. :

P-4235

[Total No. of Pages : 3

[6001]-5006

F.E.

BASIC CIVIL & ENVIRONMENTAL ENGINEERING
(2015 Pattern) (Semester - I&II) (101005)

Time : 2 Hours]

[Max. Marks : 50

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) Neat diagrams must be drawn whenever necessary.
- 3) Figures to the right indicate full marks.

- Q1)** a) Explain in brief the role of civil engineering in construction of Hydropower station. [4]
b) What is Prestress concrete? State any two application of PSC. [4]
c) State any four applications of Fluid Mechanics. [4]

OR

- Q2)** a) Define Settlement and state its types. Also mention various causes of settlement. [4]
b) How will you correlate the importance of Environmental Engineering, and development activities? Explain. [4]
c) What is combined footing? Under which situation it is constructed. [4]

- Q3)** a) The following consecutive readings were taken with a dumpy level and 4 m leveling staff. [6]

0.750, 1.435, 1.800, 0.400, 1.705, 1.525, 0.865, 1.300

The level was shifted after third and sixth reading. The first reading was taken on A.B.M. of R.L. 100.000 m. Calculate the reduced levels of remaining staff stations. Apply usual arithmetic check.

- b) State the main objectives of environmental impact assessment. [4]
- c) What are the adverse effects of over-exploitation of mineral resources on the environment? [3]

P.T.O.

OR

- Q4)** a) Explain the tabular form and procedure for computing R.L. of stations using collimation plane method. What do you mean by 'rise' and 'fall' of stations? [5]
- b) Explain in detail the adverse environmental impacts of solid wastes. [4]
- c) What is meant by sustainable development? State its importance in the present context. [4]

- Q5)** a) What is Roominess? How it is achieved during planning of building. [4]
- b) Briefly explain the concept of Green building. [5]
- c) How will you achieve the filling of more space under restricted conditions of planning? [4]

OR

- Q6)** a) On a plot of 25 m X 30 m, a building of G + I is proposed with a built up area of 400 sq.m on the-ground and first floor. Permissible FSI is 0.9. All margins will be 2 m as per bye-laws. [5]

Find :

- i) Plinth area of building
 - ii) State with reason weather the plan will be sanctioned or not, based on allowable built up area as well as ground coverage.
- b) Explain in brief the Sanitation as a principle of building planning. [4]
- c) Define set back distance. Why it is necessary? [4]

- Q7)** a) When water is said to be polluted? What are the various causes of Water Pollution? [4]
- b) Write a short note on Air pollution. [4]
- c) Enlist any four non-conventional energy sources and explain any one in brief. [4]

OR

- Q8)** a) Write a short note on Geothermal Energy. [4]
- b) Explain in brief the mechanism of production of Biogas energy. [4]
- c) As a responsible member of Civil Society, How will you contribute yourself to reduce the Air pollution. [4]



Total No. of Questions : 8]

SEAT No. :

P4236

[Total No. of Pages : 4

[6001]-5007

F.E.

ENGINEERING GRAPHICS - I

(2015 Pattern) (Semester - I & II) (Credit System) (Theory) (102006)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6 and Q.No.7 or Q.No.8.
- 2) Assume suitable data, if necessary.
- 3) Retail all the construction lines.

Q1) Question Statements

A line AB, 65 mm long has its end A 20 mm above H.P. and 25 mm in front of V.P. The end B is 40 mm above H.P. and 65 mm in front of V.P. Draw the projections of AB and shows its inclination with H.P. [12]

OR

Q2) A square lamina of 50 mm side rests on one of the corners on the HP. The diagonal through that corner makes 30° to the VP. The two sides containing this corner make equal inclinations with the HP. The surface of the lamina makes 45° to the HP. Draw the TV and FV of the lamina. [12]

Q3) A tetrahedron of 80 mm long edges is held on one of its edge on HP such that the triangular face containing that edge is perpendicular to HP. Draw its projections of the tetrahedron when the edge which is on HP is inclined at 45° to VP. [13]

OR

Q4) a) Construct an Archimedean spiral for one revolution if the greatest radius vector is 70 mm and smallest radius vector is 10 mm. [7]
b) Draw the development of lateral surface of a hexagonal prism of base side 30 mm and axis height is 70 mm. [6]

P.T.O.

Q5) Figure 1 shows a pictorial view of an object. By using first angle method of projections, draw: [13]

- a) Front view
- b) Top view
- c) Right hand side view

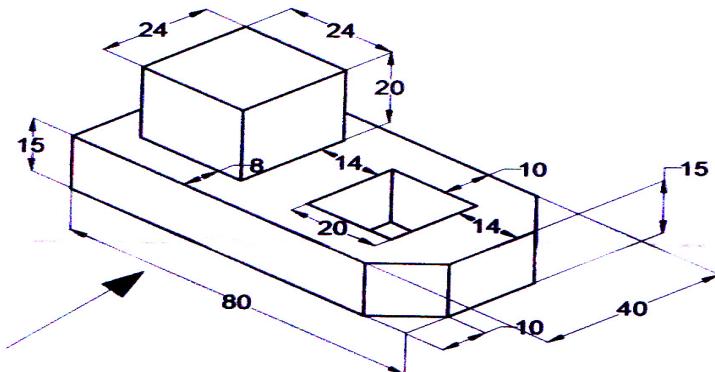


Figure - 1

OR

Q6) Figure 2 shows a pictorial view of an object. By using first angle method of projections, draw: [13]

- a) Front view
- b) Top view
- c) Left hand side view

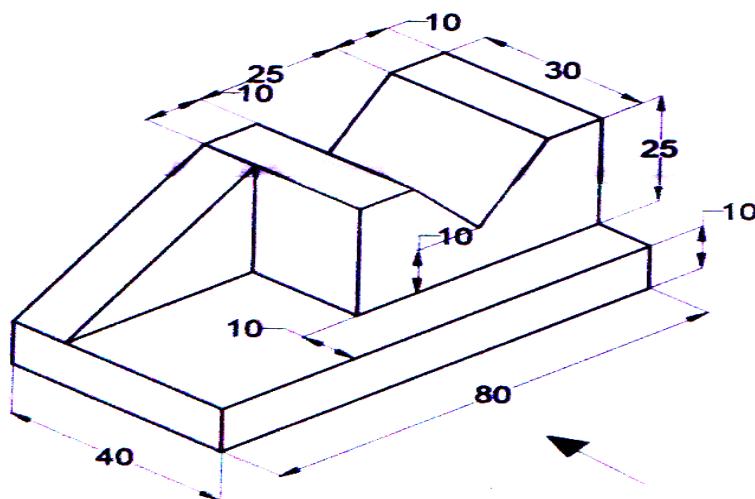


Figure - 2

Q7) The figure 3 shows Elevation (F.V) and Plan (T. V) of an object. Draw Isometric View and give basic dimensions in a view. [12]

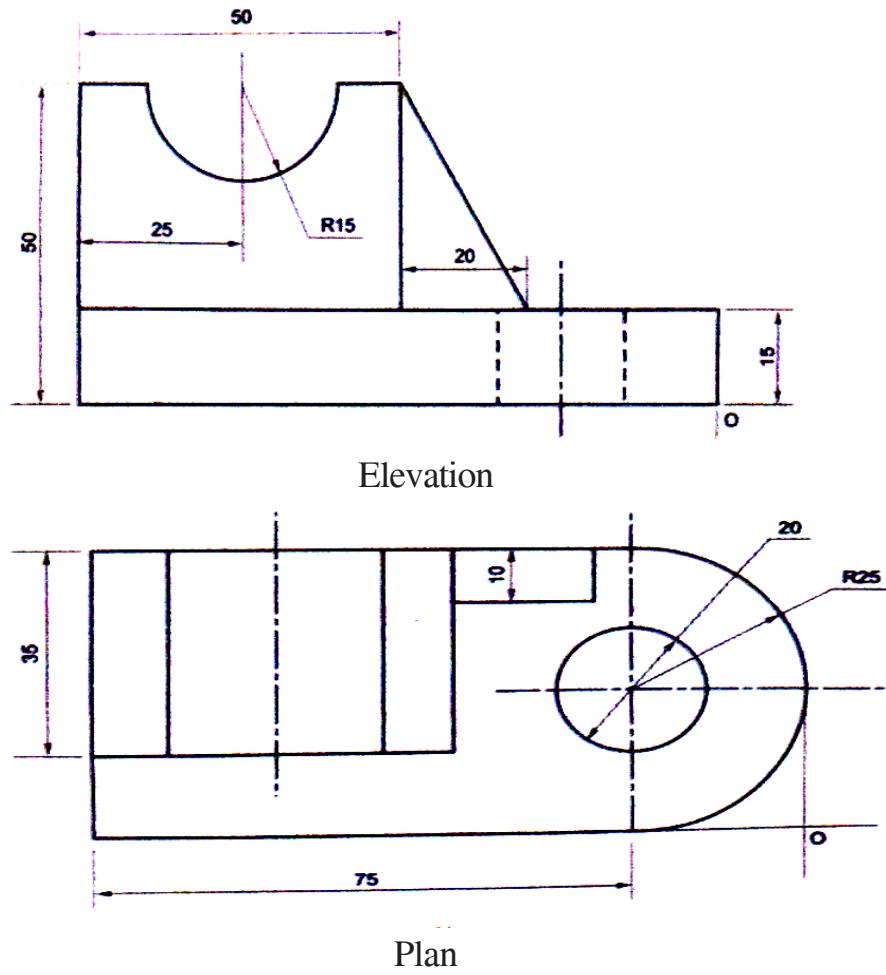
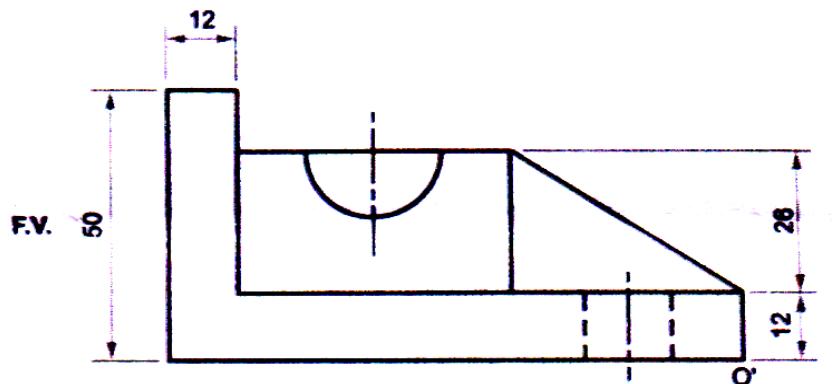


Figure - 3

OR

Q8) The figure 4 shows Front View and Top View of an object. Draw Isometric View and give basic dimensions in a view. [12]



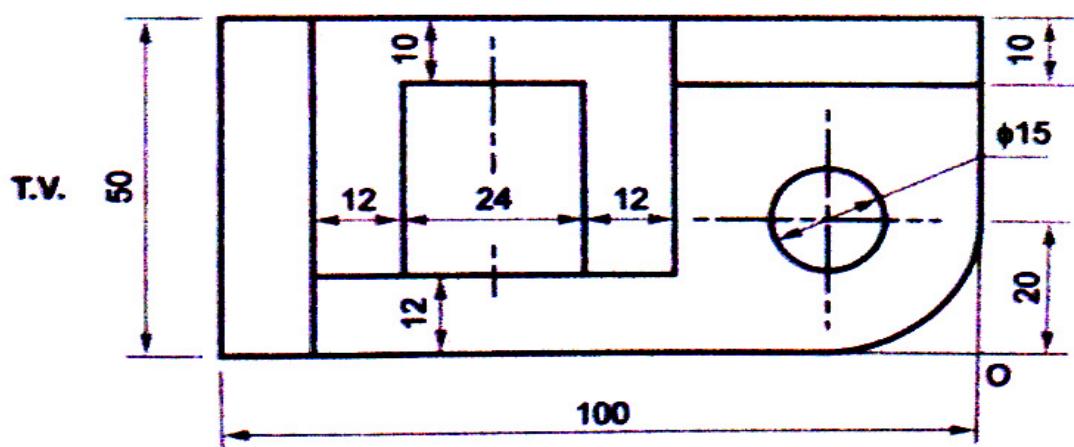


Figure - 4

କ୍ଷେତ୍ର ମାପ

Total No. of Questions : 8]

SEAT No. :

P-4333

[Total No. of Pages : 3

[6001]-5008

F.E.

ENGINEERING MATHEMATICS - II
(2015 Pattern) (Semester - I/II) (107008)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Attempt Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.
- 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) a) Solve the following differential equations.

i) $\frac{dy}{dx} = \frac{x - 2y + 5}{2x + y - 1}$ [4]

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

b) The distance x descended by a parachuter satisfies the differential equation

$$\frac{dv}{dt} = g \left(t - \frac{v^2}{k^2} \right) \text{ where } v \text{ is velocity, } k, g \text{ constants, If } v = 0 \text{ and } x = 0 \text{ at}$$

time $t = 0$, show that $x = \frac{k^2}{g} \log \cosh \left(\frac{gt}{k} \right)$. [4]

OR

Q2) a) Solve : $(x^2 + 1)\frac{dy}{dx} + 4xy = \frac{1}{(x^2 + 1)^2}$. [4]

b) i) A body originally at 100°C cools down to 60°C in one minute, the temperature of the air being 20°C . What will be the temperature of the body after two minutes from the original? [4]

P.T.O.

- ii) The charge ‘Q’ on the plate of a condenser of capacity ‘C’ charged through a resistance ‘R’ by a steady voltage ‘V’ satisfies the differential

$$\text{equation } R \frac{dQ}{dt} + \frac{Q}{C} = V \text{ If } Q = 0 \text{ at } t = 0, \text{ show that } Q = CV[1 - e^{-t/RC}]$$

[4]

- Q3)** a) Find Fourier series representation for $f(x) = x^2, -\pi \leq x \leq \pi$ and $f(x + 2\pi) = f(x)$. [5]

b) Prove that $\int_0^\infty e^{-h^2 x^2} dx = \frac{\sqrt{\pi}}{2h}$. [3]

- c) Trace the curve (any one) [4]

i) $y^2(2a - x) = x^3$

ii) $r = a \sin 2\theta$

OR

- Q4)** a) Evaluate $\int_0^{2a} x \sqrt{2ax - x^2} dx$. [4]

- b) Prove that [4]

$$\int_0^1 \frac{x^a - 1}{\log x} dx = \log(a+1); a > 0$$

- c) Find the perimeter of the cardioid $r = a(1 + \cos\theta)$. [4]

- Q5)** a) Prove 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 and find the coordinates of the point of contact. [5]

- b) Find the equation of right circular cone whose vertex is at $(0, 0, 0)$, semi-

vertical angle $\frac{\pi}{4}$ and axis along the line $\frac{x}{2} = \frac{y}{-1} = \frac{z}{2}$. [4]

- c) Find the equation of right circular cylinder of radius $\sqrt{6}$ whose axis is the

line $\frac{x}{1} = \frac{y}{-1} = \frac{z}{1}$. [4]

OR

- Q6)** a) Show that the plane $x - 2y - 2z - 7 = 0$ touches the sphere $x^2 + y^2 + z^2 - 10y - 10z - 31 = 0$. Also find the point of contact. [5]
- b) Find the equation of right circular cone whose vertex is at $(0, 0, 10)$ and whose intersection with the XoY plane is a circle of radius 5. [4]
- c) Find the equation of right circular cylinder of radius 2 whose axis passes through $(1, 2, 3)$ and has direction ratios 2, 1, 2. [4]

Q7) Attempt any two of the following.

- a) Evaluate $\iint_R y dx dy$, where R is the region bounded by $y = x^2$ and $y = x$. [4]
- b) Evaluate $\int_0^{\log 2} \int_0^x \int_0^{x+y} e^x e^y e^z dx dy dz$. [5]
- c) Find the centre of gravity (C.G.) of the area of cardioide $r = a(1+\cos\theta)$. [4]

OR

Q8) Attempt any two of the following.

- a) Find the area bounded by the parabola $y = x^2$ and the line $y = x$. [4]
- b) Find the volume of the region enclosed by the paraboloid $z = x^2 + y^2$ and the cone $z = \sqrt{x^2 + y^2}$. [5]
- c) Find the moment of inertia (M.I.) of the portion of the parabola $y^2 = 4ax$, bounded by x -axis and the latus rectum about x -axis if density at each point varies as the cube of the abscissa. [4]



Total No. of Questions : 6]

SEAT No. :

P-4334

[Total No. of Pages : 6

[6001]-5009

F.E. (Common)

ENGINEERING MECHANICS

(2015 Pattern) (101011) (Semester - I & II)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data, if necessary.
- 4) Use of electronic pocket calculator is allowed in the examination.
- 5) Use of cell phone is prohibited in the examination hall.

- Q1) A)** Determine moment of all the three forces, 250N (30° with vertical), 300N (60° with horizontal), and 500N, about Lit 'A', acting on L-shape rod as shown in Fig. 1A. [4]

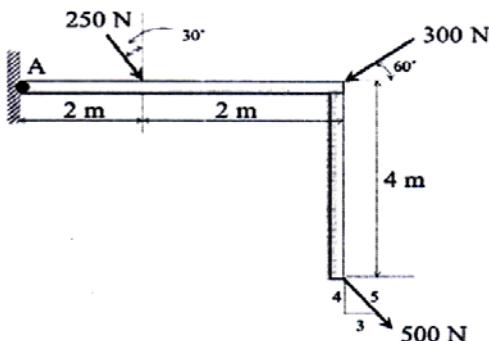


Fig. 1A

- B)** If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$, as shown in Fig. 1B. Determine the acceleration with which the crate moves. Also find its velocity when $t = 3\text{s}$. The crate starts from rest, and $P = 200 \text{ N}$. [4]

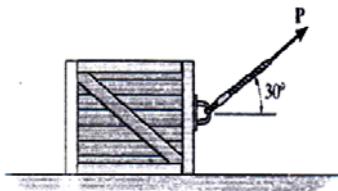


Fig. 1B

P.T.O.

- C) The car moves in a straight line such that for a short time its velocity is defined by, $V = (3t^2 + 2t)$ m/s, where t is in seconds. Determine its position and acceleration when $t = 3$ s. Note when $t = 0$, $s = 0$. [4]
- D) A tennis ball dropped from a height 800 mm rebounds back to a height of 250 mm. Determine the coefficient of restitution. [4]

OR

- Q2)** A) Determine the position of centroid of the shaded portion with respect to origin 'A' as shown in Fig. 2A. All dimensions are in mm. [4]

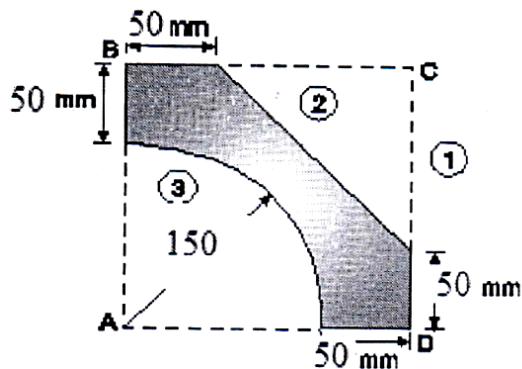


Fig. 2A

- B) The system as shown in Fig. 2B, 4 kg block resting on the horizontal floor with coefficient of friction as 0.15, connected with 2 kg block by inextensible cable, which is passing over a frictionless pulley. Neglecting mass of the pulley, determine the acceleration of the 2 kg block with which it moves after releasing from rest. [4]

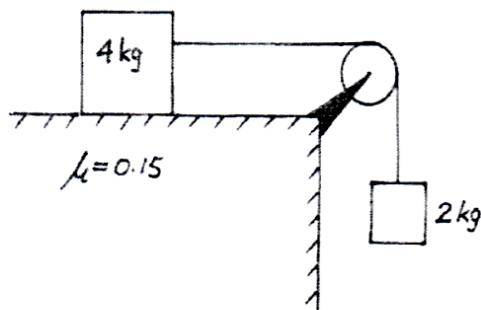


Fig. 2B

- C) The conveyor belt is designed to transport packages horizontally. Each 10-kg package has a coefficient of kinetic friction $\mu_k = 0.15$. If the speed of the conveyor is 5 m/s, and then it suddenly stops, determine the time taken by the package to come to rest. Use Impulse-momentum equation. [4]

- D) A package is projected up, on the 15° inclination as shown in Fig. 2D. from 'A' with an initial velocity of 8 m/s. Knowing that the coefficient of kinetic friction between the package and the incline is $\mu_k = 0.12$, determine the maximum distance 'd' that the package will move up the incline till 'B'. Use work-Energy principle. [4]

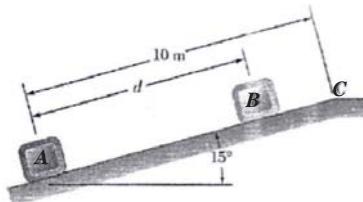


Fig. 2D

- Q3) A) The 'I' joist beam AB of span 6 m supported with hinge 'A' and Roller 'B', as shown in Fig. 3A. Determine the support reactions. [6]

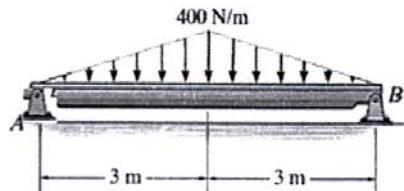


Fig. 3A

- B) Determine the forces in cables AC and AB needed to hold the 20-kg ball D in equilibrium, as shown in Fig. 3B. Take $F = 300 \text{ N}$ and $d = 1 \text{ m}$. [5]

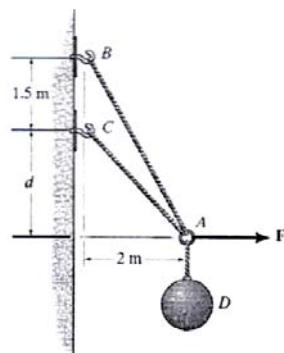


Fig. 3B

- C) The rectangular $3\text{m} \times 10\text{m}$, steel plate subjected to four forces, as shown in Fig. 3C. Determine the resultant force in magnitude and direction w.r.to A. [6]

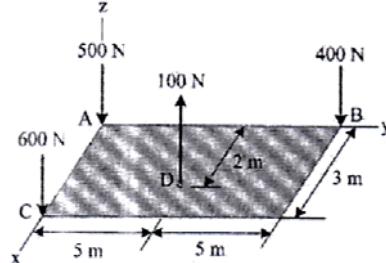


Fig. 3C

OR

- Q4) A)** Determine the support reactions for the beam AB of 8m span, loaded and supported as shown in Fig. 4A. [6]

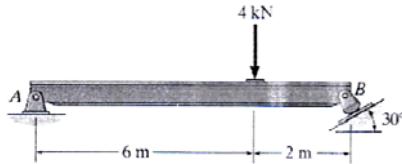


Fig. 4A

- B)** Three cables meeting at point A as shown in Fig. 4B. Find magnitude of the tension developed in each cable AB, AC and AD, supporting 50 N earthen pots. [OD = 1.5m; A from y = 1.5m; A from x = 2m]. [6]

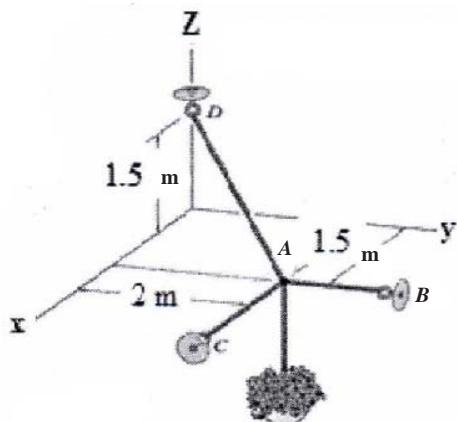


Fig. 4B

- C)** The I joist supports UVL (900 N/m) for 3 m length and UDL (600 N/m) for 3 m length, as shown in Fig. 4C. Determine the support reactions at hinge B and roller A. Neglect the self-weight of the joist. [5]

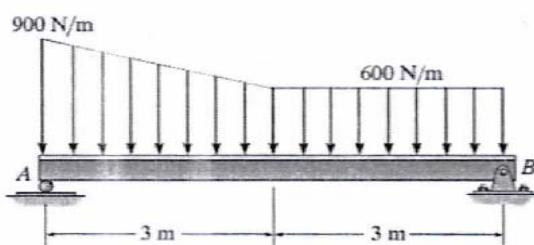


Fig. 4C

- Q5) A)** A ladder, 5 meters, long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. Calculate the coefficient of friction between the ladder and the floor, just to have equilibrium. [6]

- B) Determine the forces in all the members of the truss loaded and supported as shown in the Fig. 5B. Tabulate the result with magnitude and name of force in the members. [6]

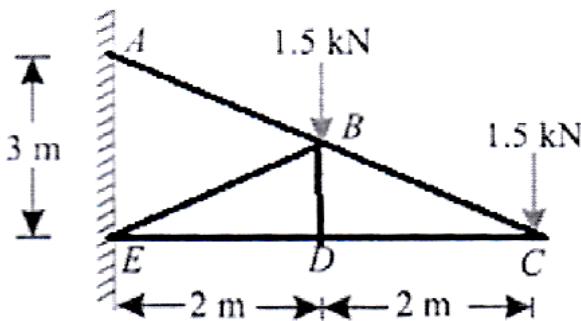


Fig. 5B

- C) A block of 10 kg hanging through a frictionless cable and kept at rest by applying a force of 'F' N on other side of the cable, which is passing through the pulley as shown in the Fig. 5C. Determine the range of force 'F' required to keep the block in rest, if the lap angle between cable and pulley is 145° . Take $\mu_s = 0.25$. [5]

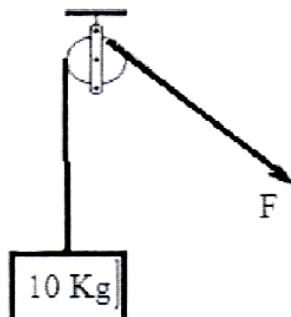


Fig. 5C

OR

- Q6)** A) Cable ABCD is loaded with 30 kN at 'B' and 22.5 kN at 'C' with supports as shown in the Fig. 6A. If $d = 0.75$ m, determine the component of reaction at A & maximum tension in the cable. [6]

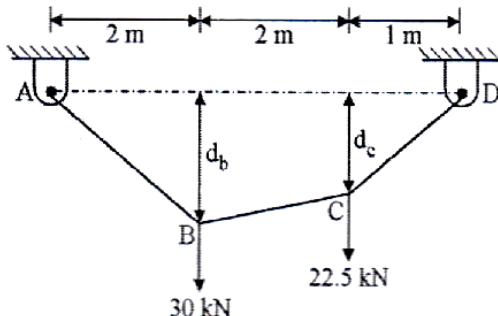


Fig. 6A

- B) A 50 kg block resting on rough horizontal floor with coefficient of friction between floor and block as 0.25, applied with force P inclined upward at an angle 30° with horizontal as shown in Fig. 6B. Determine the magnitude of the force required just to start the motion of the block. [6]

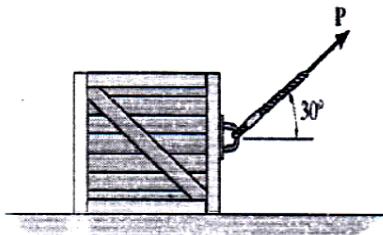


Fig. 6B

- C) Determine the forces in the members BC, DE and BD of the truss loaded and supported as shown in the Fig.5B, using section method. Tabulate the result with magnitude and nature of force in the members. [5]

❖❖❖

Total No. of Questions : 8]

SEAT No. :

P4237

[Total No. of Pages : 2

[6001]-5010

F.E. (Common)

BASIC MECHANICAL ENGINEERING

(2015 Pattern) (Credit System) (Semester - I & II) (End Sem) (102013)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.
- 2) Neat Diagram must be drawn whenever necessary.
- 3) Figures to the right indicates full marks.
- 4) Assume suitable data, if necessary.
- 5) Use of non-programmable electronic Calculator is allowed.

Q1) a) Draw neat labeled diagrams of : [6]

- i) Disc Brake
- ii) Ball bearing

b) Define following mechanical properties of material: [6]
Resilience, Brittleness, Hardness

OR

Q2) a) Draw labeled sketches with explanation of chain & Sprocket, V belt with Pulleys. [6]

b) Define machine. Draw and explain the working of slider crank mechanism. [6]

Q3) a) What is casting Process? Explain Sand Casting process with suitable sketch. [7]

b) Draw and explain, Radial drilling machine. [6]

OR

Q4) a) Explain with neat sketch, any four sheet metal shearing processes. [6]

b) Draw block diagram of lathe machine and explain the function of carriage, tailstock, lead screw. [7]

P.T.O.

- Q5)** a) With neat sketch compare the terms-atmospheric pressure, absolute pressure and gauge pressure. [4]
b) Explain measurement of pressure using U tube manometer. [4]
c) A cold storage is to be maintained at -5°C , while the surroundings are at 35°C . The heat leakage from surroundings into the system is estimated to be 29KW. The actual COP of the refrigeration plant is $1/3^{\text{rd}}$ of an ideal plant working between the same temperatures. Find the power required to drive the plant. [5]

OR

- Q6)** a) Explain with neat sketch, open system, closed system and isolated system. [4]
b) State Zeroth law and First law of thermodynamics. [4]
c) A U-tube manometer is used to measure pressure of oil having specific gravity of 0.85 in a pipe line. The oil-mercury interface is 1.8m above the centerline of the pipe. If the difference shown by manometer is 45cm, calculate the oil pressure in the pipeline. Draw the sketch of the system. Take the density of mercury as 13600Kg/m^3 . [5]
- Q7)** a) Draw block diagram of nuclear power plant and explain the energy transfer in it with its disadvantages. [6]
b) Differentiate between two stroke and four stroke engine. [6]

OR

- Q8)** a) Explain with neat sketch, working of centrifugal pump. [6]
b) With neat sketch explain working of household refrigerator. [6]

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Total No. of Questions : 9]

SEAT No. :

P9066

[Total No. of Pages : 4

[6178]-1

F.E.

ENGINEERING MATHEMATICS - I

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

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 electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

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

a) If $u = x^3 + y^3 - 3xy$ then $\frac{\partial^2 u}{\partial x \partial y}$ is equal to [1]

- | | |
|--------|--------|
| i) 3 | ii) -3 |
| iii) 2 | iv) 0 |

b) If $x = r \cos \theta$, $y = r \sin \theta$ then the value of $\frac{\partial(x, y)}{\partial(r, \theta)}$ is [1]

- | | |
|------------------|----------|
| i) $\frac{1}{r}$ | ii) r |
| iii) r^2 | iv) None |

c) The vectors $X_1 = (-1, 0, 3)$, $X_2 = (2, 4, 6)$ are [2]

- | | |
|--------------------------|--------------------------|
| i) linearly dependent | ii) linearly independent |
| iii) mutually orthogonal | iv) none of these |

d) The characteristic equation for the square matrix A is [2]

- | | |
|------------------------------|---------------------------|
| i) $ A - \lambda I = 0$ | ii) $ A + \lambda I = 0$ |
| iii) $ A^2 - \lambda I = 0$ | iv) None |

P.T.O.

e) If $u = \sin^{-1} \frac{\sqrt{x^2 + y^2}}{x+y}$ then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ is equal to [2]

- i) u
- ii) $2u$
- iii) 0
- iv) None

f) If $x = u(1-v)$, $y = uv$ then $\frac{\partial(x,y)}{\partial(u,v)}$ [2]

- i) u
- ii) $\frac{1}{u}$
- iii) uv
- iv) $u - uv$

Q2) a) If $u = x^2 \tan^{-1} \frac{y}{x} - y^2 \tan^{-1} \frac{x}{y}$ then show that $\frac{\partial^2 u}{\partial x \partial y} = \frac{x^2 - y^2}{x^2 + y^2}$. [5]

b) If $f(x,y) = \frac{1}{x^2} + \frac{\ln x - \ln y}{x^2 + y^2}$, using Euler's theorem find $xf_x + yf_y$. [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 $x = u \tan v$, $y = u \sec v$, prove that $\left(\frac{\partial u}{\partial x}\right)_y \cdot \left(\frac{\partial v}{\partial x}\right)_y = \left(\frac{\partial u}{\partial y}\right)_x \cdot \left(\frac{\partial v}{\partial y}\right)_x$. [5]

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

c) If $z = f(u,v)$ and $u = x \cos \theta - y \sin \theta$, $v = x \sin \theta + y \cos \theta$ where θ is a constant, show that $x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = u \frac{\partial z}{\partial u} + v \frac{\partial z}{\partial v}$. [5]

Q4) a) If $x = u \cos v$, $y = u \sin v$, prove that $JJ' = 1$. [5]

b) As certain whether the following functions are functionally dependent, if

so find the relation between then $u = \frac{x+y}{1-xy}$, $v = \tan^{-1} x + \tan^{-1} y$. [5]

c) Find the maximum and minimum values of $3x^2 - y^2 + x^3$. [5]

OR

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

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

c) Use Lagrange's method to find the minimum distance from origin to the plane $3x + 2y + z = 12$. [5]

Q6) a) Examine following system for consistency $x + y - 3z = 1$; $4x - 2y + 6z = 8$; $15x - 3y + 9z = 20$. [5]

b) Examine for linear dependancy or independance of following set of vectors. If dependent, find the relation between them $X_1 \equiv (3, 1, 1)$, $X_2 \equiv (2, 0, -1)$, $X_3 \equiv (1, 1, 2)$. [5]

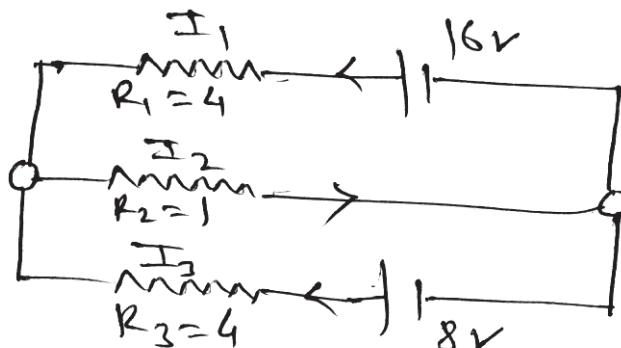
c) Show that $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \\ 0 & 1 & 0 \\ \frac{1}{\sqrt{2}} & 0 & \frac{-1}{\sqrt{2}} \end{bmatrix}$ is orthogonal matrix & hence find A^{-1} . [5]

OR

Q7) a) Determine values of k , for which following system have non-trivial solution.
 $5x + 2y - 3z = 0$; $3x + y + z = 0$; $2x + y + kz = 0$ [5]

b) Show that following set of vectors are linearly dependant $X_1 \equiv (2, 3, 4, -2)$, $X_2 \equiv (-1, -2, -2, 1)$, $X_3 \equiv (1, 1, 2, -1)$ [5]

c) Find the currents I_1 , I_2 , I_3 in the circuit, shown in the figure :- [5]



Q8) a) Find eigen values and corresponding eigen vectors of the following matrix

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

b) Verify Cayley Hamilton theorem for given matrix $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$. [5]

c) Find the modal matrix P which diagonalises the given matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. [5]

OR

Q9) a) Find eigen values and eigen vector corresponding to largest eigen value

of a following matrix $A = \begin{bmatrix} 15 & 0 & -15 \\ -3 & 6 & 9 \\ 5 & 0 & -5 \end{bmatrix}$. [5]

b) Verify Cayley Hamilton theorem and hence find A^{-1} for given matrix

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

c) Express the following quadratic form as “sum of the squares form” by consruent transformation. Write down the corresponding linear transformation $Q(x) = x_1^2 + 6x_2^2 + 18x_3^2 + 4x_1x_2 + 8x_1x_3 - 4x_1x_3$. [5]



Total No. of Questions : 09]

SEAT No. :

P-9067

[Total No. of Pages : 4

[6178] - 2

F.E.

ENGINEERING PHYSICS

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Q. 01 is compulsory, Answer Q2 or Q3, Q4 or Q5, Q6 or Q7, Q8 or Q9.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicates full marks.
- 4) Use of Electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

Physical Constants :-

- Plank's constant $h = 6.63 \times 10^{-34} \text{ J.S}$
- Mass of electron $m_e = 9.1 \times 10^{-31} \text{ Kg}$
- Charge on election $e = 1.6 \times 10^{-19} \text{ C}$

Q1) Write the correct option with answer for the following (1 mark each). [10]

- i) The de Broglie wavelength is _____ proportional to mass of the particle and _____ proportional to velocity of the particle
 - a) Directly, directly
 - b) Inversely, inversely,
 - c) Directly, inversely
 - d) Inversely, directly
- ii) If a wave function is finite, single valued, continuous and normalizable it is called as
 - a) Well behaved function
 - b) Probability function,
 - c) Fermi function
 - d) None of these
- iii) Heisenberg Uncertainty Principle is the product of _____ in position and momentum
 - a) Difference
 - b) Uncertainties
 - c) Addition
 - d) Subtraction

P.T.O.

- iv) In Hall effect, when a specimen carrying current I is placed in transverse magnetic field B then electric field developed in specimen is _____ to I and B
- a) parallel
 - b) intersect
 - c) perpendicular
 - d) none of above
- v) The resistivity has unit _____
- a) Ohm-m
 - b) Ohm
 - c) Ohm/m
 - d) Ohm/cm
- vi) Superconductivity is characterized by a state of _____
- a) Finite resistivity
 - b) Infinite resistivity
 - c) Zero resistivity
 - d) Zero conductivity
- vii) Superconductor is a perfect _____ material.
- a) Insulator
 - b) Semiconductor
 - c) Dielectric
 - d) Diamagnetic
- viii) _____ materials are weakly attracted when placed in the external magnetic field
- a) Paramagnetic material
 - b) Diamagnetic material
 - c) Ferromagnetic materials
 - d) Ferrimagnetic materials
- ix) A nanoparticle has dimensions in the range
- a) 10 to 100 micrometres
 - b) 1 to 100 nanometres,
 - c) 1 to 10 nanometres
 - d) Greater than 100 nm
- x) _____ testing is used to locate voids, cracks, flaws present inside the material
- a) Destructive testing
 - b) Both destructive and non-destructive testing
 - c) None in destructive and non-destructive testing
 - d) Non-destructive testing

- Q2)** a) Derive Schrodinger's time Independent wave equation. [6]
- b) State and explain Heisenberg's uncertainty principle. [5]
- c) Calculate the energy difference between the ground state and first excited state of an electron in the rigid box of length 1 \AA° . [4]

OR

- Q3)** a) Derive the equation for energy of the particle is enclosed in a one-dimensional rigid box (infinite potential well). [6]
 b) State de Broglie hypothesis. Derive the equation of de Broglie wavelength for an electron accelerated by a potential difference “V”. [5]
 c) An electron has a speed of 600 m/s with an accuracy of 0.005 %. Find the uncertainty in its position. [4]

- Q4)** a) Explain classification of solids on the basis of Band Theory. [6]
 b) Explain the working of PN junction diode in (a) forward bias (c) reverse bias on the basis of energy level diagram. [5]
 c) Calculate the mobility of charge carriers in doped silicon whose conductivity is 100 per $\Omega\text{-m}$ and the Hall coefficient is $3.6 \times 10^{-4} \text{ m}^3/\text{coulomb}$. [4]

OR

- Q5)** a) Explain Hall effect. Derive the equation of Hall coefficient. [6]
 b) Prove that in intrinsic semiconductor fermi level lies exactly at centre between valence band and conduction band. [5]
 c) Calculate the conductivity of pure silicon at room temperature when concentration of carriers is 1.6×10^{10} per cc [$\mu_e = 1500 \text{ cm}^2/\text{V-sec}$, $\mu_h = 500 \text{ cm}^2/\text{V-sec}$]. [4]

- Q6)** a) Differentiate between type I and type II superconductors. [6]
 b) Define the terms:
 i) Magnetic field strength (H)
 ii) Magnetization (M)
 iii) Magnetic Susceptibility (χ)
 iv) Magnetic Induction (B)
 v) Relative Permeability (μ)
 c) Explain DC and AC Josephson effect in brief. [4]

OR

- Q7)** a) Explain how the information is recorded and retrieved in magneto-optical recording devices. [6]
 b) State and Explain Meissner effect. Show that superconductors exhibit perfect diamagnetism. [5]
 c) Differentiate ferromagnetic materials and paramagnetic material. (Any two points) [4]

- Q8)** a) Explain Electrical and Mechanical properties of nanoparticles. [6]
b) Differentiate between Non-Destructive Testing techniques and destructive testing techniques. [5]
c) Explain the applications of Nano particles in Targeted Drug Dilivery. [4]

OR

- Q9)** a) What is Non Destructive Testing? Explain Ultrasonic Testing Technique for flaw detection. [6]
b) Explain nano technology is used in, Automobile and electronics field. [5]
c) An ultrasonic pulse of frequency 130 kHz is sent through a block of steel. The echo pulse is recorded after 1.695 microseconds. If the velocity of ultrasonic in steel is 5900 m/s, calculate the thickness of the steel block and the wavelength of the pulse. [4]



Total No. of Questions : 9]

SEAT No. :

P-9068

[Total No. of Pages : 4

[6178]-3

F.E.

ENGINEERING CHEMISTRY
(2019 Course) (Semester - I / II) (107009)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q. No. 1 is compulsory. 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.*
- 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 logarithmic tables slide rule, Mollier electronic pocket calculator and stem tables is allowed.*

Q1) Multiple Choice Questions :

- a) Which of the following is used for p-doping in conducting polymers? [1]
i) Lithium ii) Iodine
iii) Sodium iv) Calcium
- b) Electroluminescent polymers are used in _____. [1]
i) LED ii) Sutures
iii) Safety goggles iv) Rechargeable batteries
- c) Which among the following is an example of quantum dots? [1]
i) Se ii) K
iii) CdSe iv) AsF_5
- d) Unit of calorific value for solid fuel is _____. [1]
i) Kcal/m³ ii) cal/g
iii) Joules iv) J/m³
- e) The enzyme used for conversion of glucose to ethanol is _____. [1]
i) lactase ii) maltase
iii) invertase iv) zymase

P.T.O.

- f) Electromagnetic radiations with wavelength 10 to 400 nm are called as _____ radiations. [1]
- i) Visible ii) IR
iii) X-ray iv) UV
- g) According to Beer's law _____. [1]
- i) $A \propto x$ ii) $A \propto c$
iii) $A = -\log \frac{1}{T}$ iv) $A = -\log T$
- h) _____ is used as a source of light in UV-vis spectrophotometer. [1]
- i) Nernst filament ii) Globar
iii) Tungsten lamp iv) Mercury arc
- i) Galvanisation is coating of _____. [1]
- i) Fe on Zn ii) Sn on Zn
iii) Sn on Fe iv) Zn on Fe
- j) Pilling Bedworth ratio gives an idea regarding _____. [1]
- i) rate of combustion ii) quality of fuel
iii) amount of light absorbed iv) nature of oxide film formed

- Q2)** a) Discuss three important factors responsible for biodegradation of polymers. Draw the structure of PHBV and give its two applications. [6]
- b) Explain structure of graphene with diagram. Mention its four applications. [5]
- c) How are nanomaterials classified on basis of dimensions? Give example of each type. [4]

OR

- Q3)** a) Discuss the different types of carbon nanotubes w.r.t. their structure. Give any two applications of CNT. [6]
- b) Classify polymer composites on the basis of reinforcement. Give two properties and two applications of polymer composites. [5]
- c) Give the structure of polycarbonate. Mention its three properties and three applications. [4]

- Q4)** a) Discuss the construction and working of Bomb calorimeter with diagram for determination of GCV of fuel. State the formula (without corrections) to calculate GCV. [6]
- b) Give the preparation reaction of biodiesel. Give its four advantages and two disadvantages. [5]
- c) 1.2g of coal sample on complete combustion increased the weight of U-tube containing CaCl_2 by 0.7g and U-tube containing KOH by 2.5g. Calculate % C, % H in coal. [4]

OR

- Q5)** a) State the principle and explain the process of fractional distillation of petroleum with diagram. Give the composition, boiling range and application of any one fraction obtained. [6]
- b) Explain production of hydrogen by steam reforming of methane and coke with reaction conditions. [5]
- c) 1.0 g of coal sample was heated for 1 hr. at 105-110°C, weight of the residue obtained was 0.9 g. The crucible was then heated without lid till a constant weight of 0.15 g was obtained. In another experiment, 1.0g of the same coal sample was taken in a crucible with a vented lid and heated at 925°C for 7 minutes. The weight of the residue was 0.55 g. Calculate % moisture, % volatile matter, % ash and % fixed carbon. [4]

- Q6)** a) What are the conditions of absorption of IR radiations by molecules? Explain the fundamental modes of bending vibrations. [6]
- b) Discuss any five applications of UV-vis spectroscopy. [5]
- c) Define :
 i) Hypochromic shift ii) Chromophore
 iii) Red shift iv) Blue shift

OR

- Q7)** a) Explain the different types of electronic transitions with diagram which occur on absorption of UV-vis radiations by an organic molecule. State the forbidden transitions. [6]
- b) Draw block diagram of IR spectrophotometer. Explain and give function of its four components. [5]
- c) Calculate fundamental modes of vibrations for -
 i) NO ii) CH_4
 iii) NH_3 iv) CO_2

- Q8)** a) Give the reaction involved and mention the type of oxide film formed on the oxidation corrosion of Na, Mg, Cr, Mo. [6]
- b) What is electroplating? Explain the process with diagram and reactions involved. Give any two applications of electroplating. [5]
- c) Define cathodic and anodic coatings. Which are better and why? [4]

OR

- Q9)** a) Explain hydrogen evolution and oxygen absorption mechanisms of wet corrosion. [6]
- b) Discuss any five factors w.r.t. nature of metal affecting rate of corrosion. [5]
- c) Give the principle of cathodic protection. Explain any one method of cathodic protection. [4]



Total No. of Questions : 8]

SEAT No. :

P9069

[Total No. of Pages : 2

[6178]-4

F.E.

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

Time : 2½ Hours]

[Max. Marks : 70

Course Outcome :

CO 3 : List down the types of road vehicles and their specifications.

CO 4 : Illustrate various basic parts and transmission system of a road vehicle.

CO 5 : Discuss several manufacturing processes and identify the suitable process.

CO 6 : Explain various types of mechanism and its application.

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) List the specifications of vehicle and explain any four specifications of Light Motor Vehicle (LMV). [10]
b) Explain Electric Vehicle with neat diagram. [8]

OR

- Q2)** a) Explain with neat sketch the various components in SI engine. [10]
b) Classify Automobile and Compare specification of LMV and Heavy motor vehicle (HMV). [8]

- Q3)** a) Explain steering system with neat diagram. [10]
b) Explain with neat sketch the differential gearbox. [7]

OR

- Q4)** a) Explain antilock braking system in vehicle with neat diagram. [10]
b) Explain with neat sketch the working of Disc brake. [7]

P.T.O.

- Q5)** a) Explain with neat sketch the forging process. State its advantages and disadvantages. [10]
b) Explain with neat sketch drilling, chamfering, grooving, and taper turning operations. [8]

OR

- Q6)** a) Explain with neat sketch piercing, lancing, perforating, deep drawing, and embossing sheet metal operations. [10]
b) Explain with neat sketch sand casting. [8]

- Q7)** a) Explain with neat sketch the working of air conditioner. [10]
b) Explain with neat sketch the working of water purifier. [7]

OR

- Q8)** a) Explain with neat sketch solar water heater. State its advantages. [10]
b) Explain the working of electric geyser. [7]

❖ ❖ ❖

Total No. of Questions : 8]

SEAT No. :

P9070

[Total No. of Pages : 3

[6178]-5

F.E. (All Branches)

BASIC ELECTRICAL ENGINEERING

(2019 Pattern) (Credit System) (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.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.
- 5) Use of non-programmable electronic pocket calculator is permitted.

- Q1)** a) Derive the expression for resonant frequency in an RLC series circuit. [4]
b) A sinusoidal AC voltage given by $v = V_m \sin \omega t$ is applied across a pure inductor. Obtain the following for this circuit: [6]
 - i) Expression for the instantaneous current
 - ii) Phasor diagram. waveforms of instantaneous voltage and current
 - iii) Expression for the instantaneous powerc) A coil of resistance 24Ω has a reactance of 32Ω when connected across a single phase voltage given by $v = 566 \sin 314t$. Find: [8]
 - i) Frequency
 - ii) Rms value of current
 - iii) Power factor
 - iv) Equation of the resultant current

OR

- Q2)** a) State the power factor in case of following circuits: [4]
 - i) A purely resistive circuit
 - ii) A purely inductive circuit
 - iii) A purely capacitive circuit
 - iv) An RLC series circuit under resonanceb) Obtain the expression for power in an R-C series circuit when supplied with $v = V_m \sin \omega t$. [6]
c) A series R-L-C circuit consists of $R = 10 \Omega$, $L = 0.318 \text{ H}$ and $C = 63.6 \mu\text{F}$. This circuit is supplied by source of emf given by $e(t) = 100 \sin 314t$. Find: [8]
 - i) Expression for $i(t)$
 - ii) Phase angle between voltage and current
 - iii) Power factor of circuit
 - iv) Active power consumed

P.T.O.

- Q3)** a) Define the following in the context of three phase AC systems: [3]
- Symmetrical AC supply
 - Phase Sequence
 - Balanced Load
- b) Derive the emf equation of a single phase transformer. Hence obtain the transformation ratio. [6]
- c) Three impedances each of $(3 - j4) \Omega$ are connected in delta across a 3-phase, 230 V supply. Calculate: [8]
- Phase and line currents
 - Power factor of the load
 - Power delivered to the load

OR

- Q4)** a) Compare an autotransformer with a conventional two-winding transformer by mentioning any three differences. [3]
- b) Prove that the three phase delta connected balanced load consumes thrice the power consumed by that of the star connected load. [6]
- c) The primary winding of a single phase transformer is connected to a 230 V, 50 Hz supply. The secondary winding has 1500 turns. If the maximum value of the core flux is 0.00215 Wb, determine [8]
- secondary induced emf
 - number of turns in the primary
 - cross sectional area of the core if the maximum value of flux density is 0.1 T
 - whether it is a step up or a step down transformer?

- Q5)** a) State and briefly explain Kirchhoff's Laws for DC circuits. [4]
- b) Obtain the relations for converting delta connected resistances into equivalent star connection. [6]
- c) Find the current through 1Ω resistance of the circuit shown in Fig. 1 below using Thevenin's Theorem. [8]

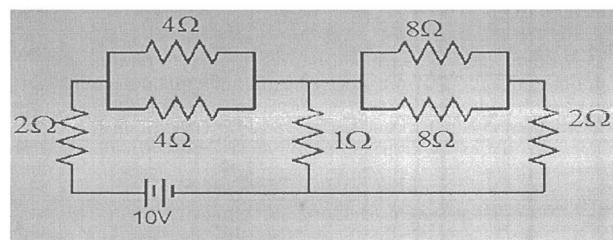


Fig.1

OR

- Q6)** a) Define the following terms: [4]
- Active Network and Passive Network
 - Lumped Network and Distributed Network
- b) Find the current through branch AB of the circuit shown in Fig.2 below by applying Kirchhoff's Laws. [6]

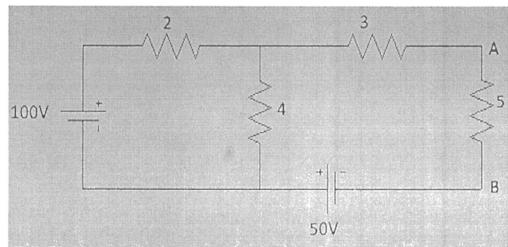


Fig.2

- c) State Superposition Theorem. Find the current through branch AB of the circuit shown in Fig.2 above by applying Superposition Theorem. [8]

- Q7)** a) Define the temperature coefficient of resistance of a material and state its unit. [3]
- b) Explain the construction and working of a Lead Acid Battery with the help of suitable diagram and chemical equations. [6]
- c) An electric kettle is required to heat 5 liters of water from 15°C to 96°C in 30 minutes. Find the input power of the kettle assuming the efficiency of 80 %. If the kettle operates on 230 V mains, find the resistance of the heating element. Assume the specific heat capacity of water to be 4200.J/kg. K and 1 liter of water as equivalent to a mass of 1kg. [8]

OR

- Q8)** a) Write your choice of either a lead acid battery or a lithium ion battery for the following applications: [3]
- Mobile phone
 - Electric bike
 - Conventional petroleum vehicle
- b) An electric motor runs at 500 rpm while producing torque of 20 Nm. The motor operates at efficiency of 85%. Find motor input power and current drawn when the motor is fed from 230V DC supply. [6]
- c) Define insulation resistance and derive the expression for insulation resistance of a single core cable. [8]



Total No. of Questions : 8]

SEAT No. :

P-9071

[Total No. Of Pages : 2

[6178]-6

F.E.

**BASIC ELECTRONICS ENGINEERING
(2019 Pattern) (Semester - I/II) (104010)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or 4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Figure to right indicate full mark.

- Q1) a) Draw and Explain full adder using two half adders with a Truth Table and give its sum and carry equation. [6]
- b) Give the expression and truth table of the Basic Gates. [6]
- c) State and prove De Morgan's laws. [6]

OR

- Q2) a) Convert the following.

i) $(5F1.6C)_{16}$ to octal ii) Convert the $(9D.33)_{16}$ to Decimal. [6]

- b) Draw and explain block diagram of Microprocessor. [6]
- c) Classify Gates and write the IC numbers with Truth Table. [6]

- Q3) a) Explain Function Generator with block diagram. [6]
- b) Explain the working principle of Autotransformer. Give its three applications. [5]
- c) Draw and explain the block diagram of digital Multi meter. [6]

OR

P.T.O.

- Q4) a) Explain how to convert Galvanometer to Analog Ammeter and how to use multi range Ammeter. [6]
b) Draw and explain the block diagram of AC/DC power supply. [5]
c) Compare CRO and DSO. [6]

- Q5) a) Draw the construction of LVDT and explain its operation. Write its advantages, disadvantages and applications. [6]
b) Explain working, principle and one application of biosensors. [6]
c) Explain the working principle of strain gauge.Explain load cell. [5]

OR

- Q6) a) Differentiate active and passive sensors. [6]
b) What is mean by thermocouple? Explain the principle, construction and working of thermocouple. Also state its advantages, disadvantages and applications. [6]
c) State and explain the selection criteria of Sensors. [5]
- Q7) a) Explain IEEE electromagnetic frequency spectrum and state allotment of frequency bands for different applications. [6]
b) Compare types of cables used in Electronic Communication System.[6]
c) Draw and explain the elements of communication system. [6]

OR

- Q8) a) Draw and explain AM transmitter. [6]
b) Draw and explain the block diagram of GSM system for mobile. [6]
c) Explain the concept of Cellular Network. [6]



[6178]-7

F.E.

ENGINEERING MECHANICS

(2019 Pattern) (Semester - I) (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) A 1.5 m cable placed around a crate as shown in Fig. 1 a. If the mass of the crate is 300 kg, determine the tension in the cable. [7]
- b) A rectangular plate is supported horizontally by three cables at A, B and C as shown in Fig. 1 b. If weight of the plate is 350 N, determine the tensions in the cables at A, B and C. [7]

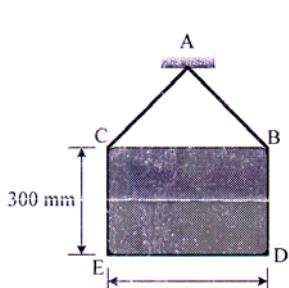


Fig. 1 a

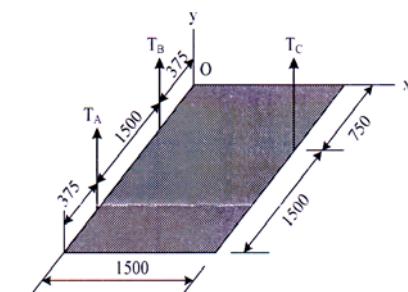


Fig. 1 b

- c) State the component of reaction at roller, hinged, fixed and rocker support. [4]

- Q2)** a) The boom is intended to support two vertical loads, F_1 and F_2 as shown in Fig. 2 a. If the cable CB can sustain a maximum load of 1500 N before it fails, determine the critical loads F_1 and F_2 if $F_1 = 2F_2$. Also determine the reaction at A. [7]

P.T.O.

- b) Three parallel bolting forces act on the rim of the circular plate as shown in Fig. 2 b. Determine the magnitude, nature and point of application of the resultant force with respect to origin O. [7]

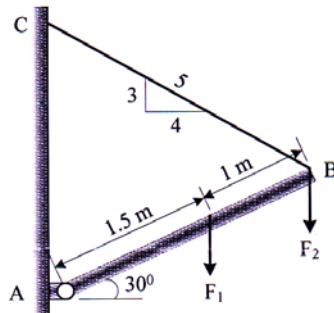


Fig. 2 a

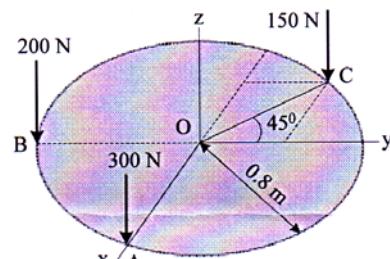


Fig. 2 b

- c) Find support reaction at A and B for the beam AB as shown in Fig. 2 c. [4]

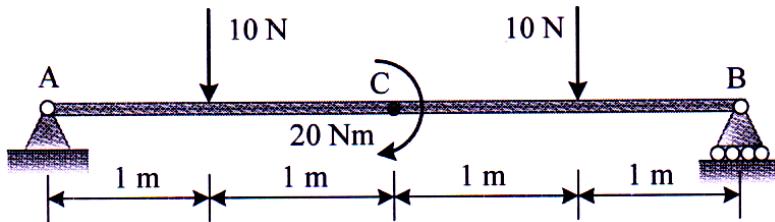


Fig. 2 c

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

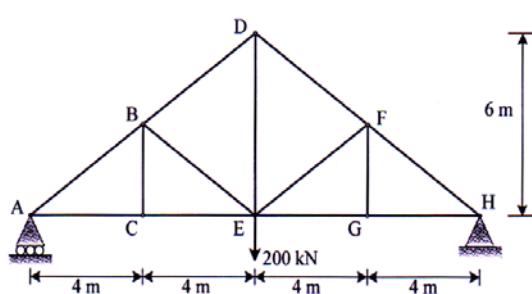


Fig. 3 a

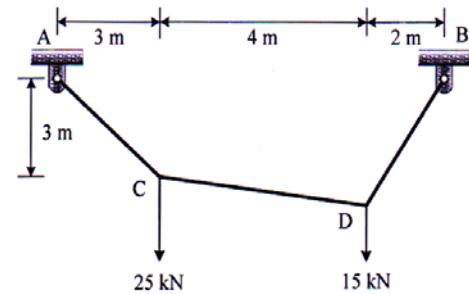


Fig. 3 b

OR

- Q4)** a) Determine the forces in the members CE, BE and BD of the truss as shown in Fig. 3 a. [7]
- b) Determine the components reaction acting on each members AB and BC of a frame as shown in Fig. 4 b. [7]
- c) The maximum tension is 200 N for the cable profiles ABCD as shown in Fig 4 c. Determine the force P at B and C to keep the segment BC in horizontal position. Also find tension in segment BC. [4]

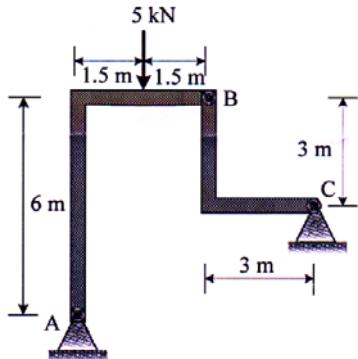


Fig. 4 b

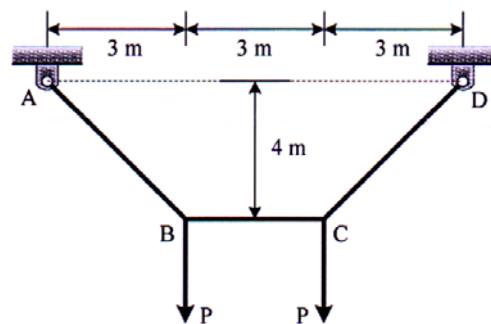


Fig. 4 c

- Q5)** a) A car comes to rest from an initial speed of 80 km/h in a distance of 30 m. With the same constant acceleration, determine the distance 's' for which the car comes to rest from an initial speed of 110 km/h. [5]
- b) A particle moves along the path $x = (8t^2)$ and $y = (t^3 + 5)$, where x and y is in m and t is in seconds. Determine the magnitude of the particle's velocity and acceleration when $t = 3$ s. [6]
- c) A projectile is launched with a speed of $v_0 = 25$ m/s at an angle of $\theta = 30^\circ$ with horizontal as shown in Fig. 5 c. Determine the maximum distance travel by projectile along horizontal and vertical direction. [6]

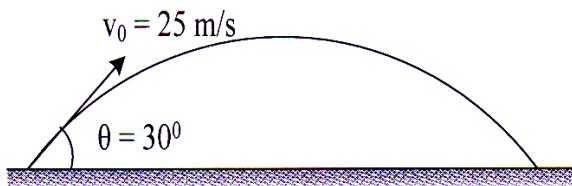


Fig 5 c
OR

- Q6)** a) The motion of a particle is defined by $x = 2t^3 - 15t^2 + 24t + 4$, where x is in m and t is in s. Determine when the velocity is zero and find position at which acceleration is zero. [5]
- b) A car is traveling along a circular curve that has a radius of 50 m. If its speed is 16 m/s and tangential component of acceleration a_t is 8 m/s², determine the magnitude of its total acceleration at this instant. [6]

- c) A projectile is thrown in the air with a speed of 8 m/s and at an angle $\theta = 30^\circ$ with the horizontal, as shown in Fig. 6 c. Determine the horizontal distance it must travel to reach its highest point B. [6]

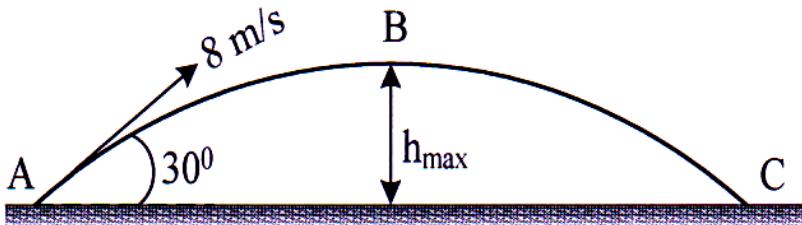


Fig. 6 c

- Q7)** a) An 80 kg block rests on a plane as shown in the Fig. 7 a. Find the acceleration with which block slides down using Newton's second law if coefficient of kinetic friction is, $\mu_k = 0.20$. [6]
- b) The pendulum bob has a mass m and is released from rest as shown in Fig. 7 b when $\theta = 0^\circ$. Determine the tension in the cord as function of the angle of descent θ . Neglect the size of bob. [6]

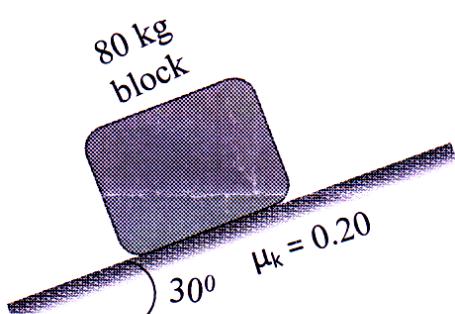


Fig. 7 a

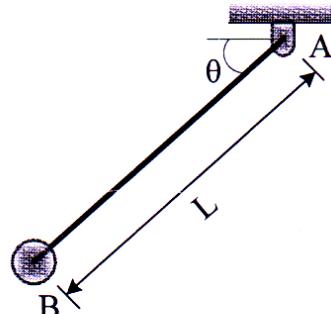


Fig. 7 b

- c) A 20 Mg railroad car moving with 0.5 m/s speed to the right collides with a 35 Mg car which is at rest. If the coefficient of restitution between the two cars is $e = 0.65$, determine the speed of the cars after the collision. [5]

OR

- Q8)** a) The system shown in Fig. 8 a is initially at rest. Neglecting axle friction and mass of pulley, determine the acceleration of 200 kg block A. [5]

- b) The man has a mass of 80 kg and sits 3 m from the center of the rotating platform as shown in Fig. 8 b. Due to rotation his speed is increase from rest by $a_t = 0.4 \text{ m/s}^2$. If the coefficient of static friction between the clothes and the platform is $\mu_s = 0.3$, determine the time required to cause him to slip. [6]

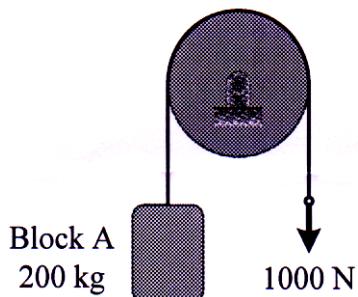


Fig. 8 a

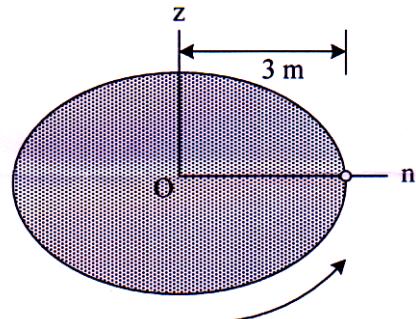


Fig. 8 b

- c) A ball has a mass of 30 kg and is thrown upward with a speed of 15 m/s. Determine the time to attain maximum height using impulse momentum principle. Also find the maximum height. [6]

□□□

Total No. of Questions : 8]

SEAT No. :

P-9073

[Total No. Of Pages : 3

[6178] - 8

F.E.

**Programming and Problem Solving
(2019 Pattern) (Semester - I) (110005)**

Time : 2½ Hours]

[Max. Marks : 70]

- Instructions:**
- 1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
 - 2) *Figures to the right indicate full marks.*
 - 3) *Neat Diagrams must be wherever necessary.*
 - 4) *Assume suitable data wherever necessary.*

- Q1)** a) Define a function with suitable example? Explain need for a function. [6]
b) Differentiate between local and global variables. [6]
c) Write a program using function to find square of a number. [5]

OR

- Q2)** a) Explain the following types of function arguments with examples: [6]
i) default arguments ii) keyword arguments
b) Explain user defined module and package in Python. [6]
c) Write a program to perform addition of two numbers using lambda function. [5]

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

- c) What is the output of the following statement for the given string?
st = "Python is an interpreted programming language" [5]

- i) print(st[12:20])
- ii) print(st[::-1])
- iii) print("an" not in st)
- iv) print(st[17])
- v) print(st[0:23])

P.T.O.

OR

- Q4)** a) Explain string format method with suitable example. [6]
- b) Explain following string methods with example. [6]
- i) title()
 - ii) capitalize()
 - 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 2 employees. [6]

OR

- Q6)** a) Explain the following features [6]
- i) Class
 - ii) Inheritance
 - iii) Polymorphism
- 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 3 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) write()

ii) tell()

iii) seek()

c) Explain the following file access modes [6]

i) r ii) w iii) a iv) rb v) wb vi) r+

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. :

P-9074

[Total No. of Pages : 4

[6178]-9

F.E.

ENGINEERING MATHEMATICS - II
(2019 Pattern) (Semester - II) (107008)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question 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, Q. No. 8 or Q. No. 9.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of electronic pocket calculator is allowed.*
- 6) *Assume suitable data, if necessary.*

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

a) $\int_0^{2\pi} \sin^3 \theta \cos^4 \theta d\theta$ [2]

- | | |
|-------------------|-----------------------|
| i) $\frac{2}{35}$ | ii) $\frac{1}{15}$ |
| iii) 0 | iv) $\frac{2\pi}{35}$ |

b) The equation of tangents to the curve $3ay^2 = x(x - a)^2$, at the origin, if exist is [2]

- | | |
|--------------|--------------------|
| i) $x = a$ | ii) $x = 0, y = 0$ |
| iii) $x = 0$ | iv) $y = 0$ |

c) $\int_{\theta=0}^{\pi/2} \int_{r=0}^2 r dr d\theta =$ [2]

- | | |
|----------|---------------------|
| i) π | ii) 1 |
| iii) 2 | iv) $\frac{\pi}{2}$ |

P.T.O.

- d) Radius r of a sphere $x^2 + y^2 + z^2 - 2x - 4y + 2z - 3 = 0$ is [2]
- i) $r = 9$
 - ii) $r = 2$
 - iii) $r = 4$
 - iv) $r = 3$
- e) The total number of loops for the curve $r = a \sin 3\theta$ are [1]
- i) 2
 - ii) 3
 - iii) 6
 - iv) 4
- f) $\iint \rho P^2 dx dy$ where ρ -density and P^2 is distance of particle from axis, represents [1]
- i) Area
 - ii) Mass
 - iii) Moment of Inertia
 - iv) Volume

- Q2)** a) If $u_n = \int_0^{\pi/4} \sin^{2n} x dx$ then prove that $u_n = \left(1 - \frac{1}{2n}\right) u_{n-1} - \frac{1}{n2^{n+1}}$. [5]
- b) Prove that : $\beta(m, n) = \beta(m, n+1) + \beta(m+1, n)$ [5]
- c) If $f(x) = \int_0^x (x-t)^2 G(t) dt$ then prove that $\frac{d^3 f}{dx^3} = 2G(x)$ [5]

OR

- Q3)** a) If $U_n = \int_0^{\pi/4} \tan^n \theta d\theta$, then prove that $n[U_{n+1} + U_{n-1}] = 1$ [5]
- b) Evaluate : $\int_0^\infty 2^{-9x^2} dx$ [5]
- c) Evaluate :

i) $\frac{d}{dt} \left[\operatorname{erf}(\sqrt{t}) \right]$

ii) $\frac{d}{dt} \left[\operatorname{erfc}_c(\sqrt{t}) \right]$

- Q4)** a) Trace the curve $y^2(2a - x) = x^3$, $a > 0$. [5]
 b) Trace the curve $r = a(1 - \cos\theta)$ [5]
 c) Find the arc length of cycloid $x = a(t + \sin t)$, $y = a(1 - \cos t)$ from one cusp to another cusp. [5]

OR

- Q5)** a) Trace the curve $xy^2 = a^2(a - x)$, $a > 0$ [5]
 b) Trace the curve $r = a\cos 3\theta$. [5]
 c) Trace the curve [5]

$$x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$$

- Q6)** a) Show that the plane $2x + y + 2z = 6$ touches the sphere $x^2 + y^2 + z^2 - 6x - 6y - 6z + 18 = 0$. Also find the point of contact. [5]
 b) Find the equation of right circular cone whose vertex is at origin, axis is the line $\frac{x}{1} = \frac{y}{1} = \frac{z}{1}$ and has a semi-vertical angle of 30° . [5]
 c) Find the equation of right circular cylinder of radius 4 and axis is the line $\frac{x}{1} = \frac{y}{-1} = \frac{z}{1}$ [5]

OR

- Q7)** a) If the sphere $x^2 + y^2 + z^2 + 2\lambda x + 3\lambda y + 4\lambda z - 1 - 5\lambda = 0$ cuts the sphere $x^2 + y^2 + z^2 + 3x - 3y + 3z - 56 = 0$, orthogonally, then find the value of λ . [5]
 b) Find the equation of right circular cone whose vertex is at origin, generator is the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ and axis is the line $\frac{x}{-1} = \frac{y}{1} = \frac{z}{2}$. [5]
 c) Find the equation of right circular cylinder of radius 2, whose axis passes through the origin and has direction ratios 1, 1, 1. [5]

- Q8)** a) Change order of integration and evaluate $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y} dx dy$ [5]
 b) Find the area of cardioid $r = a(1 + \cos\theta)$ using double integration. [5]

- c) Prove that moment of inertia of the area included between curves $y^2 = 4ax$ and $x^2 = 4ay$ about x -axis is $\frac{144}{35} Ma^2$, given that density $\rho = \frac{3M}{16a^2}$ and M is the mass. [5]

OR

- Q9)** a) Change following double integration to its polar form and evaluate

$$\iint_R \frac{x^2 y^2}{x^2 + y^2} dx dy, \text{ where } R \text{ is annulus between } x^2 + y^2 = 4 \text{ and } x^2 + y^2 = 9.$$

[5]

- b) Prove that the volume bounded by cylinders $y^2 = x$ and $x^2 = y$ and planes

$$z = 0, x + y + z = 2 \text{ is } \frac{11}{30}. \quad [5]$$

- c) Find the x - co-ordinate of centre of gravity of a loop of $r = a \sin 2\theta$ in

$$\text{first quadrant, given that area of loop is } A = \frac{\pi a^2}{8}. \quad [5]$$



Total No. of Questions : 8]

SEAT No. :

P-9075

[Total No. of Pages : 3

[6178]-10

F.E.

ENGINEERING GRAPHICS - I
(2019 Pattern) (Semester - II) (102012)

Time : 2½ Hours]

[Max. Marks : 50]

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) 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) Construct a Parabola by focus-directrix method, if the distance of focus from the directrix is 70 mm. [8]

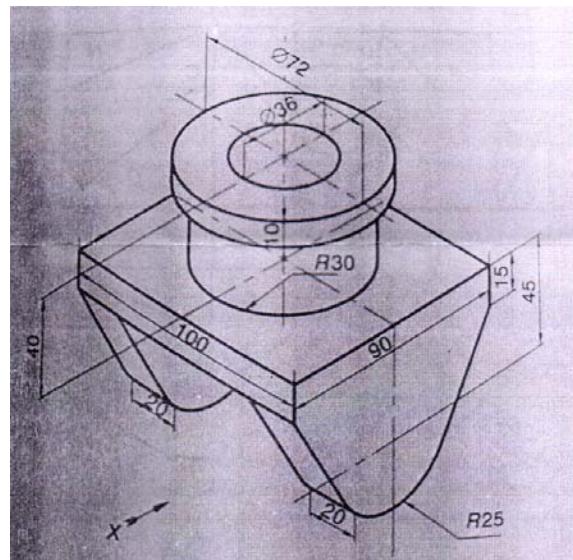
OR

Q2) End P of inelastic thread, 160 mm long is attached to the circumference of a circular disc of 50 mm diameter. Draw the locus of free end Q of the thread, if it is completely unwound from the disc, keeping the thread always tight. Name the curve. [8]

Q3) Fig. shows pictorial view of an object (consider diameter 36 hole is throughout the 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]

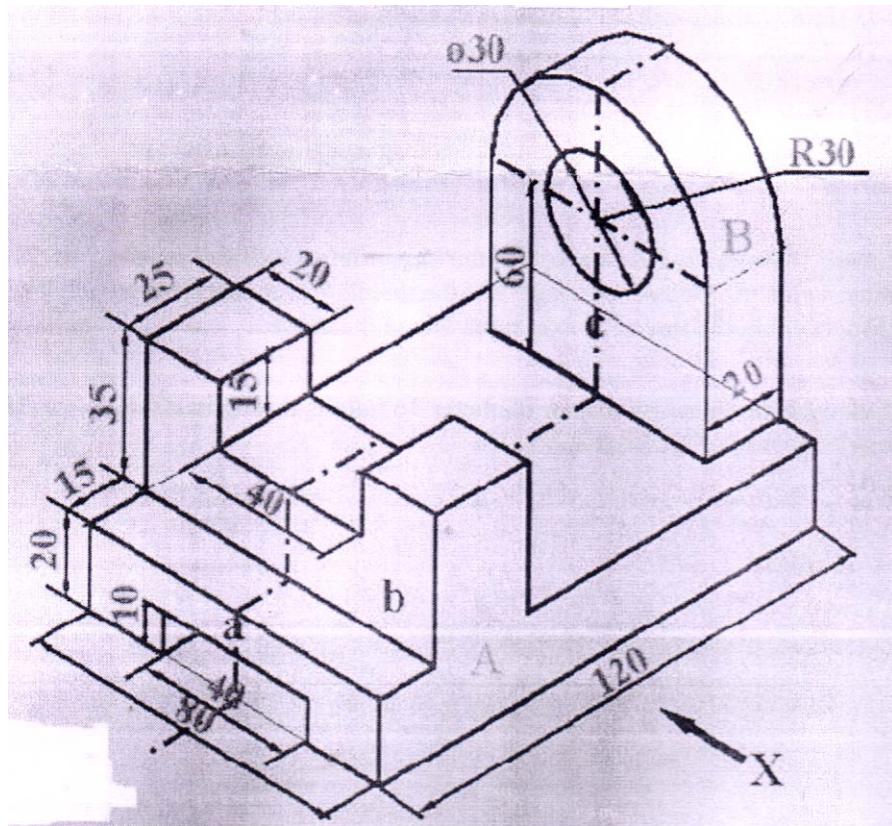
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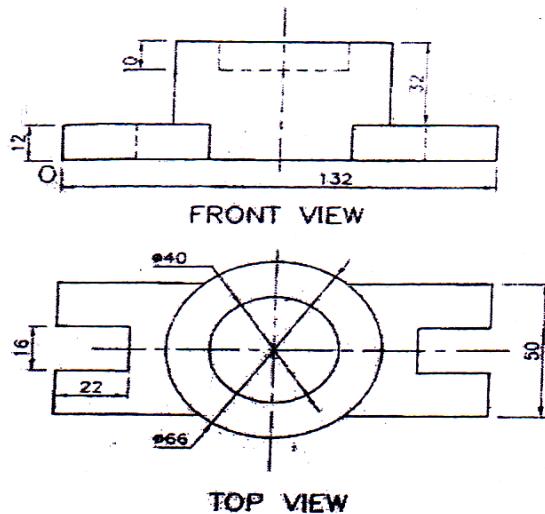
OR

Q4) Fig. shows pictorial view of an object. Using first angle method of projection draw :

- a) Sectional front view along symmetry line in the x direction [5]
- b) Top view [5]
- c) Left hand side view [5]
- d) Give dimensions [1]

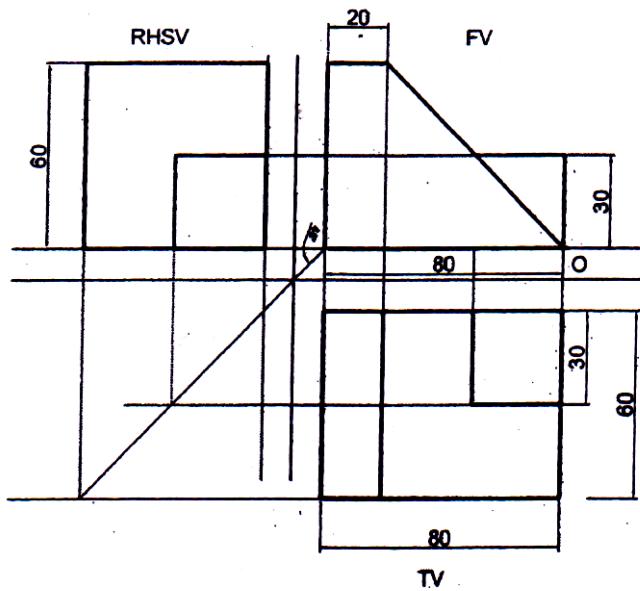


Q5) Figure show orthographic views of an object by first angle method of projection.
Draw its isometric view. [16]



OR

Q6) Figure show orthographic views of an object by first angle method of projection.
Draw its isometric view. [16]



Q7) Draw the development of lateral surface of a hexagonal pyramid having base edge 30 mm, axis height 80mm, is kept on HP in such a way that one of its base edges is perpendicular to VP. [10]

OR

Q8) A right cylinder of 50mm diameter and 70mm height of axis is cut by a section plane inclined at 30° to HP and passes 30 mm from base along the axis. Draw a development of truncated cylinder. [10]



Total No. of Questions : 9]

SEAT No. : _____

PB3586

[6260]-1

[Total No. of Pages : 5

F.E.

ENGINEERING MATHEMATICS-I
(2019 Credit Pattern) (Semester -I/II) (107001)

Time : 2½ Hours]

[Max. Marks : 70]

Instructions to the candidates:

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

Q1) Write the correct option for the following MCQs. [10]

a) If $u = x^3 + y^3$ then $\frac{\partial^2 u}{\partial x \partial y} = \dots ?$ [2]

- i) 3 ii) -3
iii) 2 iv) 0

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

- i) $\frac{-2u}{v}$ ii) uv
iii) $\frac{v}{2u}$ iv) $\frac{-v}{2u}$

c) Rank of matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & -1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ is? [2]

- i) 0 ii) 1
iii) 2 iv) 3

d) Using Cayley Hamilton theorem A^{-1} for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ is given by; [2]

- i) $\frac{1}{5}(A+4I)$
- ii) $\frac{1}{4}(A+5I)$
- iii) $\frac{1}{4}(A-5I)$
- iv) $\frac{1}{5}(A-4I)$

e) If $A^{-1} = A'$ then matrix A is? [1]

- i) Orthogonal
- ii) Singular
- iii) Non-Singular
- iv) None of above

f) If $u = x^3 + 4y - 3x$, $\frac{\partial u}{\partial x} = \dots?$ [1]

- i) 4
- ii) $3x^2 - 3$
- iii) $3x^2 + 4y$
- iv) $3x^2 + 1$

Q2) a) If $u = x^y + y^x$, find $\frac{\partial^2 u}{\partial x \partial y}$ [5]

b) If $u = \log\left(\frac{x^3 + y^3}{x^2 + y^2}\right)$, find the value of $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ [5]

c) If $u = f(y-z, z-x, x-y)$, Prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$ [5]

OR

Q3) a) If $x^2 = au + bv$ and $y^2 = au - bv$, prove that $\left(\frac{\partial u}{\partial x}\right)_y \left(\frac{\partial x}{\partial u}\right)_v = \frac{1}{2}$ [5]

b) If $u = \sin^{-1}\left(\frac{y}{x}\right) + \sqrt{x^2 + y^2}$, find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ [5]

c) If $x = \frac{\cos \theta}{u}, y = \frac{\sin \theta}{u}$ and $z = f(x, y)$, then show that
 $u \frac{\partial z}{\partial u} - \frac{\partial z}{\partial \theta} = (y-x) \frac{\partial z}{\partial x} - (y+x) \frac{\partial z}{\partial y}$ [5]

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

b) Examine for functional dependence:

$u = \frac{x+y}{1-xy}, v = \tan^{-1} x + \tan^{-1} y$. If dependent find the relation between them. [5]

c) Discuss maxima and minima of $f(x,y) = x^3 + y^3 - 3axy$ $a > 0$. [5]

OR

Q5) a) Prove that $JJ' = 1$ for the transformation $x = u \cos v, y = u \sin v$ [5]

b) Find the percentage error in computing the parallel resistance r of two resistances r_1 and r_2 from the formula $\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$ where r_1 and r_2 are both in error by +2% each. [5]

c) Find maximum value of $u = x^2y^3z^4$ such that $2x + 3y + 4z = a$ by Langrange's method. [5]

Q6) a) Find for what values of k , the set of equations [5]

$$2x - 3y + 6z - 5t = 3$$

$$y - 4z + t = 1$$

$$4x - 5y + 8z - 9t = k$$

has i) No solution

ii) An infinite number of solutions.

b) Examine for linear dependence of vectors [5]
 $(1, -1, 1), (2, 1, 1)$ and $(3, 0, 2)$

c) Show that $A = \frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ is orthogonal. [5]

OR

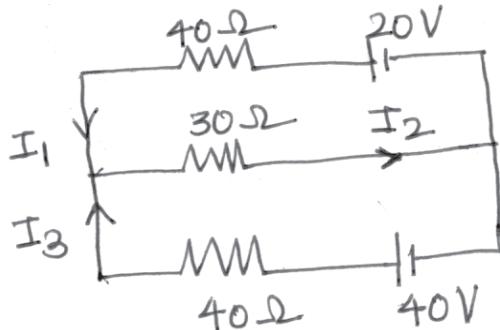
- Q7) a)** Examine for consistency the following set of equations and obtain the solution if consistent. [5]

$$\begin{aligned}2x - y - z &= 2 \\x + 2y + z &= 2 \\4x - 7y - 5z &= 2\end{aligned}$$

- b)** Examine for linear dependence of vectors [5]

(1,2,4),(2,-1,3),(0,1,2).

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



- Q8) a)** Find the eigen values and eigen vectors of the following matrix. [5]

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ 0 & 0 & 3 \end{bmatrix}.$$

- b)** Verify Cayley - Hamilton theorem for $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ and use it to

Find A^{-1} [5]

- c)** Find the modal matrix P which transform the matrix

$$A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix} \text{ to the diagonal form.} [5]$$

OR

Q9) a) Find the eigen values and eigen vectors of the following matrix

$$A = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}. \quad [5]$$

b) Verify cayley Hamilton theorem for $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -3 & 3 \end{bmatrix}$. Hence find A^{-1} .

[5]

c) Reduce the following quadratic form to the Sum of the squares form.

$$3x^2 + 3y^2 + 3z^2 + 2xy + 2xz - 2yz. \quad [5]$$

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Total No. of Questions : 9]

SEAT No. :

PB3587

[6260]-2

[Total No. of Pages : 4

F.E. (Common)

ENGINEERING PHYSICS

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q. 1 is compulsory. Answer Q2 or Q3, Q4 or Q5, Q6 or Q7, Q8 or Q9.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagram must be drawn wherever necessary.*
- 4) *Use of non-programmable Electronic pocket calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

Physical Constants:

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

Q1) Write the correct option with answers for the following questions (1mark each) [10]

- a) De Broglie wavelength for matter waves associated with a matter particle is _____ its Energy.
 - i) Inversely proportional to square of
 - ii) Directly proportional to
 - iii) Inversely proportional to the square root of
 - iv) Directly proportional to the square root of
- b) A well behaved wave function satisfies which mathematical conditions.
 - i) Finite
 - ii) Single valued
 - iii) Normalizable
 - iv) All of the above
- c) According to Heisenberg Uncertainty principle, in a narrow wave packet of de Broglie wavelength _____ of a particle can be predicted correctly.
 - i) Position
 - ii) Momentum
 - iii) Position and momentum both
 - iv) Neither position nor momentum

P.T.O.

- d) At absolute zero ($T = 0$ k), a semiconductor would be
- i) Perfect semiconductor ii) Insulator
 - iii) Conductor iv) Intrinsic semiconductor
- e) The Hall effect is true for
- i) Semiconductors only and not metals
 - ii) Metals only and not semiconductors
 - iii) Both metals and semiconductors
 - iv) Insulators
- f) The relation between magnetization (M), susceptibility (χ) and Magnetic field strength (H) is
- i) $\chi = M \times H$ ii) $\chi = H/M$
 - iii) $\chi = M + H$ iv) $\chi = M/H$
- g) The relation between magnetic induction (B), Magnetic flux (ϕ), area (A) and is
- i) $\phi = B/A$ ii) $\phi = BA$
 - iii) $\phi = B - A$ iv) $\phi = A/B$
- h) The expulsion of magnetic flux from within the superconductor below Critical temperature is known as
- i) Magnetic effect ii) Expulsion effect
 - iii) Meissner effect iv) Josephson effect
- i) X rays or gamma rays are used in radiography testing technique due to which of their property.
- i) High frequency ii) High wavelength
 - iii) High velocity iv) Low frequency
- j) A quantum dot (nanoparticle) has all dimensions in the range of
- i) 100 nm to 1 μ m ii) 1 - 100 nm
 - iii) 1 μ m to 100 μ m iv) 100 μ m and above

- Q2)** a) Derive schrodinger's time independent equation. [6]
 b) What is the Heisenberg uncertainty Principle/ Explain it using narrow and broad wave packets. [5]
 c) The lowest energy of an electron trapped in a potential well is 4.2 eV. Determine the width of the potential well in AU. [4]

OR

- Q3)** a) For a particle enclosed in a rigid box of infinite potential well, derive the equation for energy of the particle. Why is this energy quantized? [6]
 b) What is the de Broglie hypothesis? Explain in brief properties of matter waves (any four). [5]
 c) An electron is confined to a potential well of length 1.5 AU. Calculate the minimum uncertainty in its velocity (assume product of uncertainties equal to 'h'). [4]
- Q4)** a) With a neat and labeled diagram explain the Hall effect. Derive expression for Hall voltage. [6]
 b) Define Fermi level for a semiconductor. Draw a neat and labeled energy diagram for a PN junction diode showing Fermi levels when it is in
 (i) Zero bias (equilibrium)
 (ii) Forward bias [5]
 c) A sample of intrinsic germanium has a carrier concentration of $4.41 \times 10^{22} / \text{cm}^3$. If the donor impurity is added in the ratio 1:10⁷ atoms / cm³, determine resistivity of the sample. [Given, mobility of electrons, $\mu_e = 3800 \text{ cm}^2/\text{V.s.}$] [4]

OR

- Q5)** a) Derive the expression for electrical conductivity of a semiconductor. Discuss how this equation is modified for intrinsic, N-type and p-type semiconductors. [6]
 b) Define efficiency of solar cell. Explain any four ways by which the efficiency of solar cell can be improved. [5]
 c) An n-type semiconductor has a thickness of 0.15 mm and a current of 1mA is flowing along its length. Calculate Hall voltage developed along its width if a magnetic field of 2T is applied perpendicular to its thickness. [Hall coefficient, $R_H = 3.68 \times 10^{-4} \text{ m}^3/\text{C}$]. [4]

- Q6)** a) Differentiate between diamagnetic, paramagnetic and ferromagnetic materials. (Any three points). [6]
- b) What is super conductivity? Explain any two applications of superconductors in brief. [5]
- c) For Lead, the critical magnetic field at 0K , $H_c(0)$ is 8×10^5 A/m. and it has a transition temperature (T_c) of 7.26 K. In a certain application, Lead has to be used as a superconductor subjected to a magnetic field of $H_c(T) = 4 \times 10^4$ A/m. At what maximum temperature it can be operated? [4]

OR

- Q7)** a) What is the Meissner effect? Discuss the reason why it is observed? Show that superconductors exhibit perfect diamagnetism below the critical temperature. [6]
- b) Explain the process of recording and retrieving (reading) data in magnetic storage devices. [5]
- c) Explain brief:
- i) Magnetic Susceptibility (χ)
 - ii) Absolute permeability (μ)
- [4]

- Q8)** a) What is echo sounding? Using this technique, explain how ultrasonic waves can be used for flaw detection. [6]
- b) What is quantum confinement? On its basis explain why nanoparticles exhibit different properties than corresponding bulk materials. [5]
- c) State applications of nanotechnology in the field of electronics (any four). Explain any one application in brief. [4]

OR

- Q9)** a) Explain optical and electrical properties of nanoparticles. [6]
- b) State the objectives of Non-Destructive Testing. Differentiate between destructive and non-destructive testing (any two points). [5]
- c) An ultrasonic pulse of frequency 100 kHz is sent through a block of aluminum with velocity 6320 m/s and. The echo is recorded after 1.45 microseconds. Calculate the thickness of the block and the wavelength of the ultrasonic pulse. [4]

Total No. of Questions : 8]

SEAT No. :

PB3588

[Total No. of Pages : 2

[6260]-3

F.E.

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Attempt question Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Assume suitable data if necessary.

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

OR

- Q2)** a) Explain various components of S. I engine with neat sketch. [7]
- b) Explain electric vehicle with neat sketch. Mention its components. [7]
- c) Write a short note on cost analysis of the vehicle. [4]

- Q3)** a) A pinion 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. [7]
- i) Gear ratio
 - ii) Number of teeth on gear and
 - iii) Speed of the gear.
- b) State importance of suspension system. Explain telescopic suspension system with neat sketch. [7]
- c) Draw a block diagram of fuel supply system for petrol engines with its components. [3]

OR

P.T.O.

- Q4)** a) Explain various components mounted on the chassis with neat sketch.[7]
b) State types of steering system? Explain Ackerman steering mechanism with neat sketch. [7]
c) Explain working of water-cooling system in vehicle with neat diagram.[3]

- Q5)** a) Explain sand casting process with neat sketch. State its advantages and disadvantages. [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]

OR

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

- Q7)** a) With the help of block diagram, explain working of electric geyser. State various specifications for an electric geyser. [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) State various applications of springs in domestic appliances. With neat sketch, explain any one mechanism making use of spring. [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 20 m 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 $g = 9.81 \text{ m/s}^2$) [3]



Total No. of Questions : 9]

SEAT No. :

PB-3589

[Total No. of Pages : 4

[6260]-4

F.E.

ENGINEERING CHEMISTRY

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question No. 1 is compulsory.
- 2) Solve any one of Q2 or Q3, Q4 or Q5, Q6 or Q7, Q8 or Q9.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Use of logarithmic table slide rule, molar charts, electronic pocket calculator and steam tables is allowed.
- 6) Assume Suitable data, if necessary.

Q1) Multiple Choice Questions :

[10]

- i) CDs, DVDs can be made from -
 - a) Polycarbonate
 - b) Polypropylene
 - c) Polyacetylene
 - d) Kevlar
- ii) Matrix phase in a composite is formed by -
 - a) Fibers
 - b) Particulars
 - c) Polymer
 - d) Flakes
- iii) Which of the following is used for N-doping in conducting polymers -
 - a) Iodine
 - b) Chloride
 - c) Sodium
 - d) Fluoride
- iv) $NCV = GCV - \text{_____} \times 587 \text{ kcal/kg}$
 - a) 0.90H
 - b) 9.0H
 - c) 0.9H
 - d) 0.09H

P.T.O.

- v) Cooling correction should be _____ during calculation of GCV of a fuel by bomb calorimeter, correctly
- a) added
 - b) subtracted
 - c) multiplied
 - d) neglected
- vi) According to lambert's law
- a) $A \propto x$
 - b) $A \propto c$
 - c) $A = -\log \frac{1}{T}$
 - d) $A = -\log T$
- vii) Which of the following is a chromophore
- a) $C = C$
 - b) $C - OH$
 - c) $C - NH_2$
 - d) $C - Br$
- viii) The possible number of fundamental mode of vibration in case of H_2O molecule is
- a) 2
 - b) 3
 - c) 4
 - d) 5
- ix) Rate of corrosion _____ with decrease in pH of metal
- a) Decrease
 - b) Increase
 - c) Remain same
 - d) Initially increase and then remain constant
- x) Corrosion between the dissimilar metal is called as -
- a) Galvanic corrosion
 - b) Dry corrosion
 - c) Concentration corrosion
 - d) Oxidation corrosion

- Q2)** a) What are biodegradable polymer. Explain three factors responsible for biodegradation. Give the structure of PHBV and its application. [6]
- b) Define nanomaterials. How are nanomaterial classified on the basis of dimension? Give example of each. [5]
- c) What are Quantum dots? Give properties and application of quantum dots. [4]

OR

Q3) a) What is conducting polymer? Explain intrinsically and extrinsically conducting polymer with example. how the conductivity of trans polyacetylene can be improved? [6]

b) Explain structure of graphene with diagram. Give its four application. [5]

c) Give structure, properties and applications of PPV as an electroluminiscent polymer. [4]

Q4) a) Explain steam reforming of coke and methane with reaction conditions for industrial production of hydrogen. Give process of CO₂ removal. [6]

b) Give the principle of fractional distillation of petroleum crude with diagram. Write composition and boiling range and use of any one fraction obtained during refining of petroleum. [5]

c) The following observations were noted in the Boy's gas calorimeter experiments - [4]

Volume of gas burnt at STP = 0.15 m³

Mass of cooling water used = 27 kg

Temperature of Inlet water = 24.1°C

Temperature of outlet water = 29.8°C

Mass of steam condensed = 0.04 kg

Find GCV and NCV of the fuel

OR

Q5) a) Draw net labeled diagram with principle of Bomb calorimeter. Give construction and working of Bomb calorimeter to determine GCV of a fuel. State the formula of GCV. [6]

b) What is power Alcohol. Give procedure for preparation of ethanol with reaction. Give any two advantages of power alcohol. [5]

c) A sample of coal was analysed as follows - Exactly 1.50 gm coal sample was heated for 1 hr at 105–110°C, the residue weight 1.435 gm. The crucible next was covered with a vented lid and strongly heated for exactly 7 min at 950° ± 20°C. The residue weight 1.027 gm. The crucible was then heated without cover, until a constant weight was obtained. The last residue was found to weight 0.117 gm. Calculate the percentage results of above analysis. [4]

- Q6)** a) Give the principle of IR spectrophotometer with help of block diagram. Explain any four application of IR spectroscopy. [6]
b) Explain mode of vibration with stretching and bending vibrations. [5]
c) Define -
i) Hypochromic shift ii) Bathochromic shift
iii) Beer's law iv) Chromophore

OR

- Q7)** a) Explain different types of electronic transitions with diagram which occurs an absorption of uv-visible radiations by an organic molecule. State the forbidden transition. [6]
b) Give any five application of uv-visible spectroscopy. [5]
c) What are conditions of absorption of IR radiations by the molecule. [4]

- Q8)** a) Explain Hydrogen evolution and oxygen absorption mechanism of wet corrosion. [6]
b) Explain cathodic protection method using sacrificial anode with respect to principle diagram, method and applications. [5]
c) Discuss any four factors w.r.t. nature of metal affecting rate of corrosion. [4]

OR

- Q9)** a) State the pilling-Bedworth Ratio with their significance. Give reaction involved and mention the type of oxide film formed on the oxidation corrosion of Fe, Al, Ag and Mo. [6]
b) What is galvanization? Explain process with diagram. Give any two application of galvanization. [5]
c) Distinguish between anodic and cathodic coating. [4]



Total No. of Questions : 8]

SEAT No. :

PB3590

[Total No. of Pages : 3

[6260]-5

F.E. (All Branches)

BASIC ELECTRICAL ENGINEERING

(2019 Pattern) (Semester - I & II) (Credit System) (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) 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 a series RLC circuit. [4]
b) Prove that a pure inductor excited by sinusoidal voltage source never consumes any power. Draw the circuit diagram and write all necessary equations in steps. [6]
c) A voltage given by $v = 200 \sin \omega t$ is applied across 50Ω pure resistor. Obtain the expressions for instantaneous current and instantaneous power for this circuit. Also calculate rms value of current and power consumed. [8]

OR

- Q2)** a) Define admittance of a circuit and hence draw the admittance triangle for a capacitive circuit. [4]
b) Obtain the expressions for instantaneous power and average power in a series R-L circuit excited by purely sinusoidal voltage. [6]
c) An R-C series circuit dissipates 100 W at 0.75 leading power factor when connected across single phase, 230 V, 50 Hz sinusoidal AC supply. Calculate:
i) current drawn
ii) impedance in polar and rectangular form
iii) resistance of the circuit and
iv) value of capacitance

P.T.O.

- Q3)** a) Define the following terms in the context of polyphase AC circuits: [3]
- Symmetric AC supply
 - Phase sequence
 - Balanced Load
- b) Derive the emf equations of a single phase transformer. [6]
- c) A delta connected balanced load consists of three coils; each of resistance 6Ω and inductive reactance 8Ω supplied by 400V, 3-phase AC. Determine [8]
- impedance per phase
 - phase current and line current
 - power factor of the circuit
 - total power absorbed

OR

- Q4)** a) State any three advantages offered by an autotransformer. [3]
- b) A direct loading test is performed on a 1 KVA, 230V/115 V, 50 Hz single phase transformer. Draw the connection diagram showing all necessary measuring instruments with appropriate ranges and determine the rated primary and secondary current. [6]
- c) Obtain the relationship between line current and phase current, line voltage and phase voltage for 3-phase star connected balanced inductive load with the help of neat circuit diagram and phasor diagram. Assume phase sequence as RYB. [8]

- Q5)** a) A practical voltage source supplies a load resistance R_L . Draw the circuit representation and the $V_L - I_L$ characteristics of this arrangement. [4]
- b) Obtain the formulae for converting a delta connection of resistors into its equivalent star connection. [6]
- c) Write the Kirchhoffs Voltage Law equations for the circuit shown in Fig. below and hence find the current through branch AB. All resistance values are in Ω . [8]

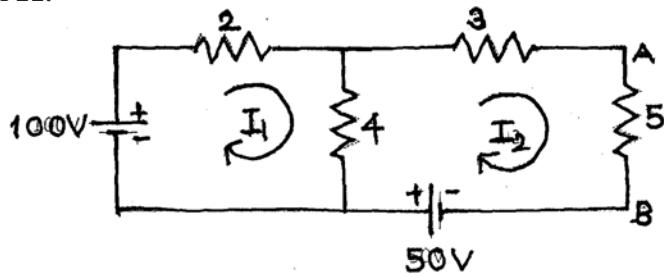


Fig. Q.5 (c)

OR

- Q6)** a) State and explain Kirchhoff's Laws for DC circuits. [4]
 b) Find the equivalent resistance obtained across B and C terminals for the circuit shown in Fig. below. All resistance values are in Ω . [6]

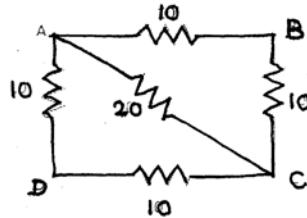


Fig. Q. 6 (b)

- c) State Superposition Theorem. Explain the steps to apply Superposition Theorem for finding the current through branch A B of the circuit shown in fig. below. [8]

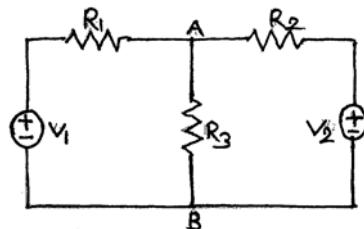


Fig. Q. 6 (c)

- Q7)** a) Specify the following in case of a Lithium Ion Battery: [3]
 i) Cathode material
 ii) Anode material
 iii) Electrolyte material
 b) Prove that $\alpha_2 = \frac{\alpha_1}{1 + \alpha_1(t_2 - t_1)}$ where all terms have their usual meaning. [6]
 c) Define insulation resistance and hence derive an expression for insulation resistance of a single core cable. [8]

OR

- Q8)** a) Define resistance temperature coefficient (RTC) and write its unit. [3]
 b) An electric pump lifts 72 m^3 of water per hour to a height of 15 m. If the overall efficiency of the system is 70 %, find the input power. If the pump is used for 4 hours in a day, find the daily cost of energy at Rs. 10 per unit. [6]
 c) Explain the following in case of a Lead Acid Battery: [8]
 i) Construction and working
 ii) Maintenance procedure
 iii) Any two applications

X X X

Total No. of Questions : 8]

SEAT No. :

PB3591

[6260]-6

[Total No. of Pages : 2

F.E.

BASIC ELECTRONICS ENGINEERING

(2019 Pattern) (Semester-I/II) (Credit System) (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) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 5) Assume suitable data if necessary.

Q1) a) i) Convert $(436)_8$ to Hexadecimal.

ii) Convert $(4CA)_{16}$ to octal.

iii) $(4C8.2)_{16}$ to Decimal.

iv) Perform (7-5) using 2's complement method.

v) $(1101 * 110)$

vi) Perform $(111011.11 + 100100.01)$

[6]

b) With the help of truth table, Give the expression of AND, OR, NOT, NAND, NOR, EX-OR gates. [6]

c) Explain SR-Flip-Flop with the help of their truth table, logic diagram. [6]

OR

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

b) Draw and Explain the working of Full Adder using two half adders with a Truth Table and give its sum and carry equation. [6]

c) Compare Microprocessor and Microcontroller. [6]

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

b) Draw and explain block diagram Digital Storage Oscilloscope. [6]

c) Explain the block diagram of regulated DC power supply. [5]

OR

P.T.O.

- Q4)** a) Draw and explain block diagram of Function Generator. [6]
b) Explain Auto transformer and list its applications? [6]
c) Explain how to convert Galvanometer to Analog voltmeter and how to use it as multi-range voltmeter? [5]

- Q5)** a) Explain working of LVDT. Draw its construction diagram. Write advantages, disadvantages and its application. [6]
b) Explain operation of bio-sensor. State its application. [6]
c) Define Selection Criteria of Sensors. [5]

OR

- Q6)** a) Explain Thermocouple with its construction, working, advantages, disadvantages and application. [6]
b) Explain the working of LDR. State its Applications. [6]
c) Explain working of RTD. Draw its construction diagram. State its Application. [5]

- Q7)** a) Explain need of modulation. State different types of modulation techniques used in electronics communication. [6]
b) Draw and explain block diagram of basic communication system. [6]
c) Explain block diagram of high level AM transmitter. [6]

OR

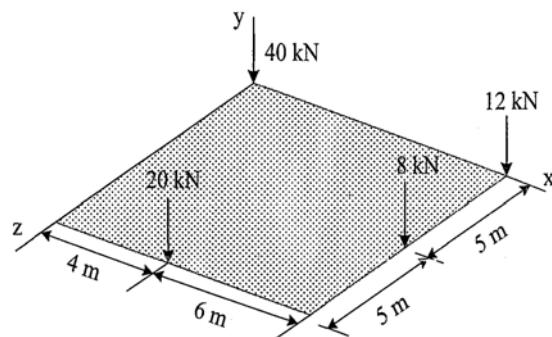
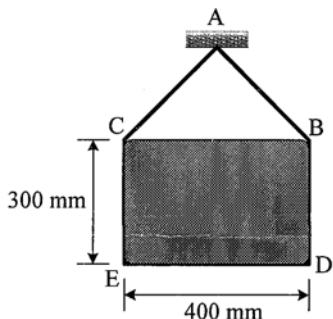
- Q8)** a) Draw and explain different types of cables used in electronics communication. [6]
b) Draw and explain Super heterodyne FM receiver. [6]
c) Draw and explain block diagram of GSM System. [6]



[6260]-7**F.E. (Common)****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, 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) A 1.5 m cable placed around a crate as shown in Fig. 1 a. If the mass of the crate is 300 kg, determine the tension in the cable. [7]
- b) A square mat foundation supports four column as shown in Fig. 1 b. Determine the magnitude and point of application of the resultant with respect to origin. [7]



- c) Explain in brief free body diagram, active and reactive forces with suitable sketch. [4]

OR**P.T.O.**

- Q2) a)** The boom is intended to support two vertical loads, F_1 and F_2 as shown in Fig. 2 a. If the cable CB can sustain a maximum load of 1500 N before it fails, determine the critical loads F_1 and F_2 if $F_1 = 2F_2$. Also determine the reaction at A. [7]
- b)** The square steel plate has a mass of 1800 kg with mass center G as shown in Fig. 2 b. Determine the tension in each cable so that the plate remains horizontal. [7]

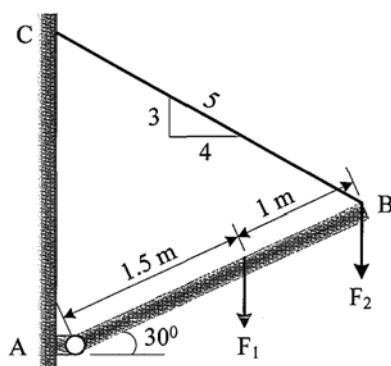


Fig. 2 a

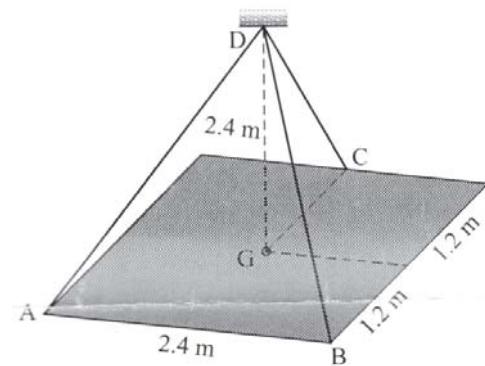


Fig. 2 b

- c) Find support reaction at A and B for the beam AB as shown in Fig. 2 c.[4]

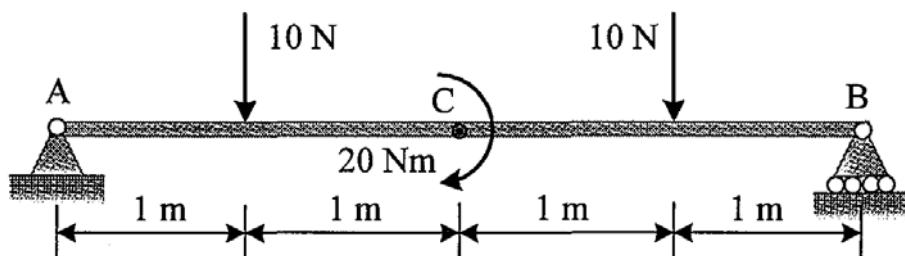


Fig. 2 c

- Q3) a)** Determine the forces in the members AB, AE and BE of the truss as shown in Fig. 3 a.
- b)** The cable segment supports the loading as shown in Fig. 3 b. Determine the component of reactions at A and B. Also find maximum tension in segment of the cable. [7]

- c) Differentiate truss and frame with suitable sketch. [4]

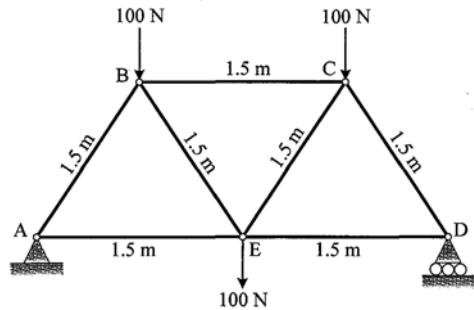


Fig. 3 a

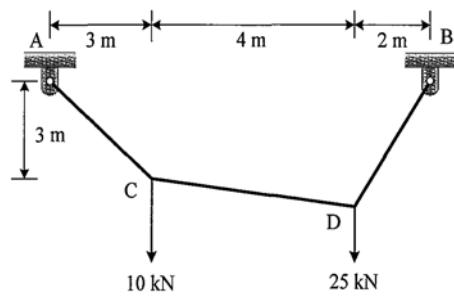


Fig. 3 b

OR

- Q4)** a) Determine the forces in the members BC, BE and AE of the truss as shown in Fig. 3 a. [7]
- b) Determine the components of reactions at supports A and B for the frame loaded and supported as shown in Fig. 4 b. [7]
- c) The maximum tension is 100 N for the Cable profiles ABCD as shown in Fig 4 c. Determine the force P at B and C to keep the segment BC in horizontal position. Also find tension in segment BC. [4]

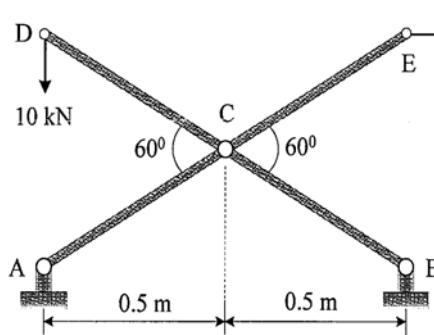


Fig. 4 b

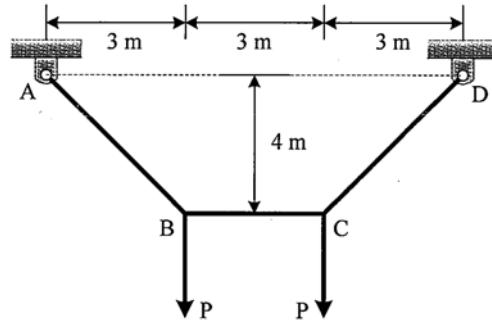


Fig. 4 c

- Q5)** a) A car comes to rest from an initial speed of 80 km/h in a distance of 30 m. With the same constant acceleration, determine the distance 's' for which the car comes to rest from an initial speed of 110 km/h. [5]
- b) 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 $a_t = (0.05s)$ m/s², where s is in meters. Determine the speed and magnitude of its acceleration when it has moved s = 10 m. [6]

- c) A projectile is launched with a speed of $V_0 = 25 \text{ m/s}$ at an angle of $\theta = 30^\circ$ with horizontal as shown in Fig. 5 c. Determine the maximum distance travel by projectile along horizontal and vertical direction. [6]

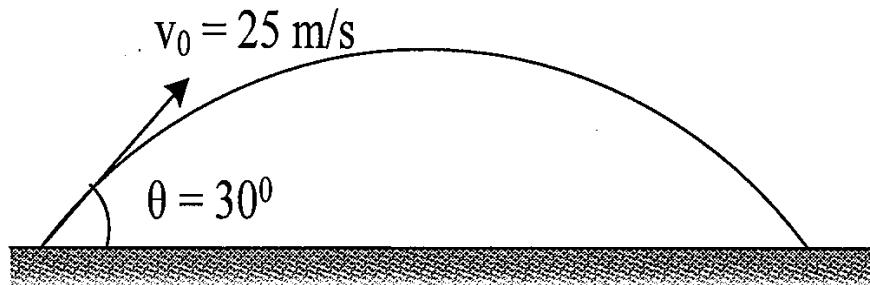


Fig 5 c

OR

- Q6)** a) The motion of a particle is defined by $x = 2t^3 - 15t^2 + 24t + 4$, where x is in m and t is in s. Determine when the velocity is zero and find position at which acceleration is zero. [5]
- b) A motorist is traveling on a curve road of radius 760 m with 25 m/s. If he applies breaks to slow down to 20 m/s in 8 s. Determine the total acceleration of the vehicle at 20 m/s. [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 attains. [6]

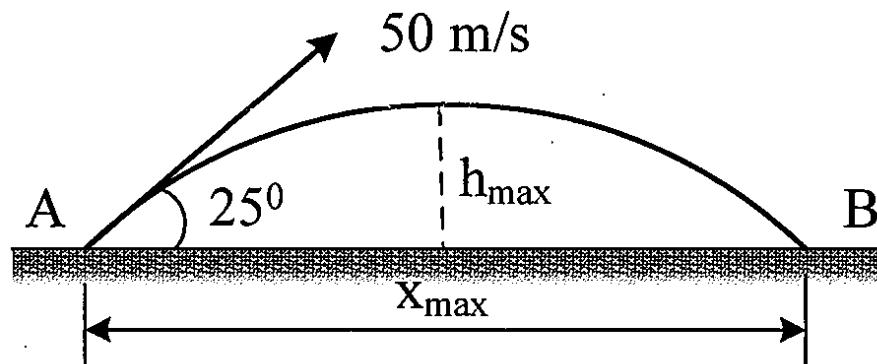


Fig. 6 c

- Q7)** a) The system shown in Fig. 7 a is initially at rest. Neglecting axle friction and mass of pulley, determine the acceleration of 200 kg block A. [6]
- b) The pendulum bob has a mass m and is released from rest as shown in Fig. 7 b when $\theta = 0^\circ$. Determine the tension in the cord as function of the angle of descent θ . Neglect the size of bob. [6]

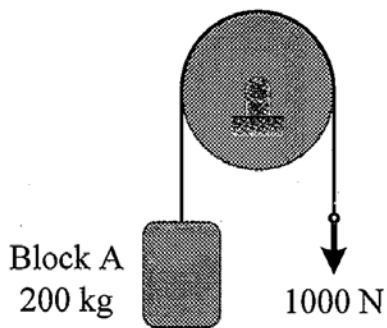


Fig. 7 a

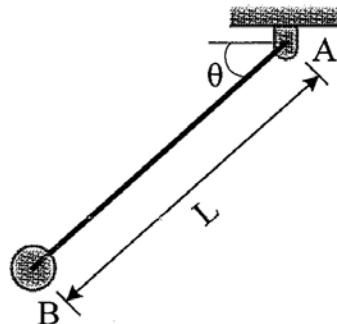


Fig. 7 b

- c) A 20 Mg railroad car moving with 0.5 m/s speed to the right collides with a 35 Mg car which is at rest. If the coefficient of restitution between the two cars is $e = 0.65$ determine the speed of the cars after the collision. [5]

OR

- Q8)** a) A block of weight 200 N is kept on an incline plane and a force $P = 200 \text{ N}$ is applied to move the block as shown in Fig. 8 a. Determine the acceleration of the block, if coefficient of static and kinetic friction between block and plane are 0.3 and 0.25 respectively. [5]
- b) The man has a mass of 80 kg and sits 3 m from the center of the rotating platform as shown in Fig. 8 b. Due to rotation his speed is increase from rest by $a_t = 0.4 \text{ m/s}^2$. If the coefficient of static friction between the clothes and the platform is $\mu_s = 0.3$, determine the time required to cause him to slip. [6]

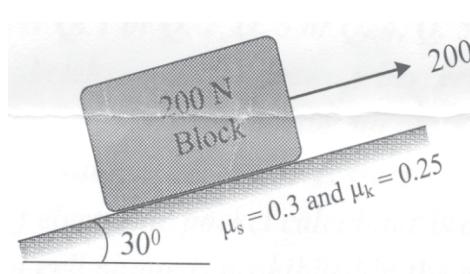


Fig. 8 a

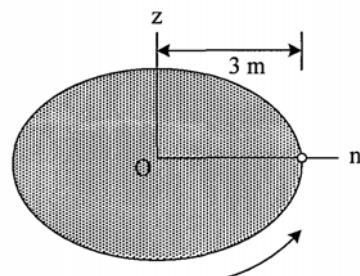


Fig. 8 b

- c) A 2 kg pellet is released from rest at A and slides without friction along the surface as shown in Fig. 8 c. Using work energy principle find velocity at B. Also find the normal forces exerted by the surface on the pellet as it crosses point B. [6]

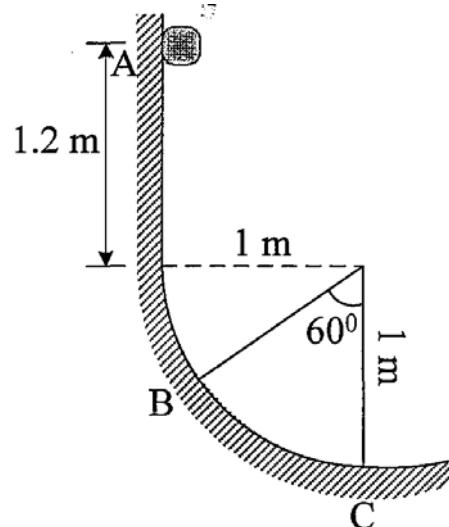


Fig. 8 c

x x x

Total No. of Questions : 8]

SEAT No. :

PB3593

[6260]-8

[Total No. of Pages : 3

F.E.

**PROGRAMMING AND PROBLEM SOLVING
(2019 Pattern) (Credit System) (Semester - I/II) (110005)**

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) Assume suitable data wherever necessary.

- Q1)** a) Write a short note on modules and package in python. [6]
b) Explain how we can pass command line arguments in python with a suitable example. [6]
c) Write a program to check whether a number is Armstrong number or not using a function. [5]

OR

- Q2)** a) Write syntax of function definition and function call. Give a suitable example for the same. [6]
b) Explain the following types of function arguments with examples. [6]
i) variable length arguments
ii) default arguments
c) Write a program using lambda function to print a message ‘even’ if number is even and ‘odd’ if number is odd. [5]

- Q3)** a) Explain the following string operations with examples. [6]
i) concatenation
ii) appending
iii) string multiplication
b) Explain string formatting operator with suitable example. [6]
c) Write a program that finds whether a given character is present in a string or not. In case it is present it prints the index in which it is present. Do not use built-in find functions to search it. [5]

OR

P.T.O.

- Q4)** a) Explain string module in python. [6]
b) Explain following string methods with example. [6]
 i) split()
 ii) zfill()
 iii) replace()
c) Write a program to reverse a string without using slicing operator. [5]

- Q5)** a) Explain the following programming Paradigms in detail. [6]
 i) Procedural
 ii) Structured
 iii) Object Oriented
b) Differentiate between class variable and object variable. [6]
c) Write a program to create a class ‘Book’ with members, title, author, publisher, and ISBN number. The functions of the class should read and display the data. [6]

OR

- Q6)** a) Explain the following features of OOP [6]
 i) Classes and Objects
 ii) Methods and Message Passing
 iii) Inheritance
b) Explain class methods with suitable example. [6]
c) Write a program to calculate area of square and rectangle using a class. [6]

- Q7)** a) What is a file? Explain different Access Modes. [6]
b) Explain the following file handling methods. [6]
 i) seek()
 ii) writelines()
 iii) readline()
c) Write a program that reads text from a file and writes in into another file but in the reverse order. (Hint: Make the first line in the original file as the last line in the copied file). [6]

OR

Q8) a) Explain the following method with suitable example [6]

- i) getcwd()
- ii) rmtree()
- iii) makedirs()

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

c) Explain the following dictionary methods. [6]

- i) fromkeys()
- ii) setdefault()
- iii) update()



Total No. of Questions : 9]

SEAT No. :

PB-3594

[Total No. of Pages : 4

[6260]-9

F.E. (All Branches)

ENGINEERING MATHEMATICS - II

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Q.No.1 is compulsory.
- 2) Solve Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.No.9.
- 3) Neat diagram must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Use of electronic pocket calculator is allowed.
- 6) Assume suitable data, if necessary.

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

a) $\int_0^\infty e^{-x} x^{\frac{1}{2}} dx$ is equal to [2]

i) $\frac{1}{2}$ ii) $\frac{\sqrt{\pi}}{2}$

iii) $\frac{\pi}{2}$ iv) $\sqrt{\pi}$

b) $\int_0^{\pi/2} \cos^4 0 dx$ do is equal to [2]

i) $\frac{3\pi}{16}$ ii) $\frac{3\pi}{4}$

iii) 0 iv) $\frac{3\pi}{8}$

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

i) $x > 0, x < 2a$ ii) $x < 0, x > 2a$
iii) $x < 0, x < 2a$ iv) $x > 0, x > 2a$

P.T.O.

- d) The centre and radius of sphere $x^2 + y^2 + z^2 - 2z - 3 = 0$ is [2]
- i) (0, 0, 1) and 2
 - ii) (0, 0, 0) and 3
 - iii) (1, 0, 0) and 2
 - iv) (0, 0, -2) and 3
- e) The value of $\int_0^1 \int_0^x dx dy$ is [1]
- i) $\frac{1}{3}$
 - ii) $\frac{1}{3}x$
 - iii) $\frac{1}{2}$
 - iv) $\frac{1}{3}y$
- f) $\int_0^1 x^{\frac{3}{2}}(1-x)^{\frac{1}{2}} dx$ is equal to [1]
- i) $\beta(\frac{5}{2}, \frac{1}{2})$
 - ii) $\beta(-\frac{1}{2}, \frac{1}{2})$
 - iii) $\frac{1}{2}\beta(\frac{5}{2}, \frac{3}{2})$
 - iv) $\beta(\frac{1}{2}, \frac{5}{2})$

- Q2)** a) If $\text{In} = \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \cot^n \theta d\theta$, then prove that $\text{In} = \frac{1}{n-1} - \text{In} - 2$. [5]
- b) Evaluate $\int_0^\infty x^8 e^{-2x^2} dx$. [5]
- c) Show that $\int_a^b e^{-x^2} dx = \frac{\sqrt{\pi}}{2} [\text{erf}(b) - \text{erf}(a)]$. [5]

OR

- Q3)** a) If $\text{In} = \int_0^{\frac{\pi}{2}} x^n \cos x dx$, then show that $\text{In} = \left(\frac{\pi}{2}\right)^n - n(n-1) \text{In} - 2$. [5]
- b) Show that $\int_0^1 x^{m-1} (1-x^2)^{n-1} dx = \frac{1}{2} \beta\left(\frac{m}{2} | n\right)$. [5]
- c) Evaluate $\int_0^1 \frac{x^a - x^b}{\log x} dx$ $0 < a < 1, 0 < b < 1$. [5]

Q4) a) Trace the curve $y^2(a - x) = x^3$. [5]

b) Trace the curve $r = \frac{a}{2}(1 + \cos \theta)$. [5]

c) Find the length of the upper arc of one loop of lemniscate $r^2 = a^2 \cos 2\theta$. [5]

OR

Q5) a) Trace the curve $xy^2 = a^2(a - x)$. [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]

Q6) a) Show that the plane $2x - 2y + z + 12 = 0$ touches the sphere $x^2 + y^2 + z^2 - 2x - 4y + 2z - 3 = 0$ and find the point of contact. [5]

b) Find the equation of right circular cone whose vertex is at $(1, 2, -3)$, semi-vertical angle $\cos^{-1}(\sqrt[3]{3})$ & axis is the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z+1}{-1}$. [5]

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

OR

Q7) a) Prove 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 and find the point of contact. [5]

b) Find the equation of right circular cone which passes through the point $(1, 1, 2)$ and has the axis as the line $6x = -3y = 4z$ and vertex at origin. [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]

Q8) a) Evaluate $\iint_R x^2 y^2 dy dx$ over positive quadrant of $x^2 + y^2 = 1$. [5]

b) Find the area between the curve $y = x^2 - 2x - 8$ and x -axis. [5]

c) Find the position of the centroid of the area bounded by the curve $y^2(2a - x) = x^3$ and its asymptote. [5]

OR

Q9) a) Change the order of integration $\int_0^2 \int_0^{2-x} y dy dx$ and then solve it. [5]

b) Evaluate $\iiint_V \frac{dxdydz}{\sqrt{1-x^2-y^2-z^2}}$ 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 (M.I.) of the area enclosed by $r = a(1 - \cos\theta)$

about the line $\theta = \frac{\pi}{2}$. [5]



Total No. of Questions : 8]

SEAT No. :

PB3595

[Total No. of Pages : 3

[6260]-10

FE.

ENGINEERING GRAPHICS - I

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

Time : 2½ Hours

/Max. Marks : 50

Instructions to the candidate:

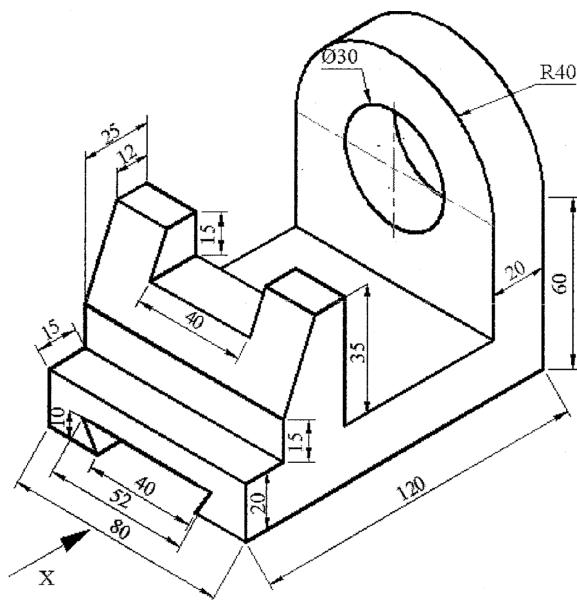
- 1) Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Figures to the right indicate full marks.
- 3) State clearly the assumptions made, if any.
- 4) Use of non-programmable calculator is allowed.
- 5) Assume suitable data if necessary.
- 6) Retain all the construction lines

Q1) Draw an ellipse when the distance of focus from directrix is equal to 64 mm and eccentricity is $3/5$. [8]

OR

Q2) Draw an involute of a circle having 50 mm diameter. [8]

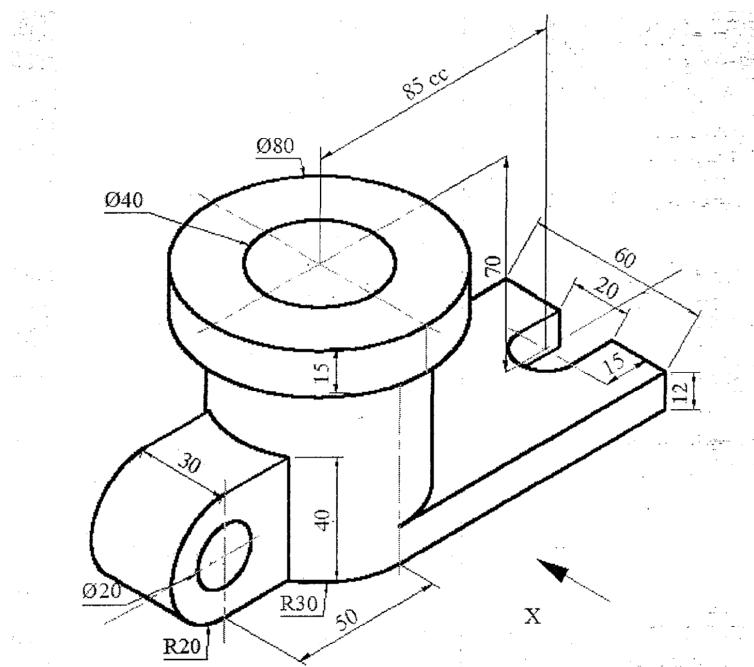
Q3) Figure shows a pictorial view of an object. By using first angle method of projection draw, front view looking in direction X, top view and side view. Give dimensions in all views. [16]



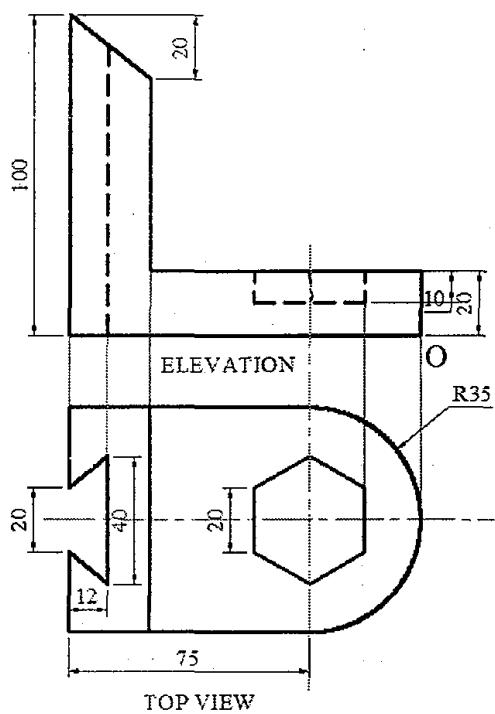
OR

P.T.O.

Q4) Figure shows a pictorial view of an object. By using first angle method of projection draw, sectional front view looking in direction X, section along line of symmetry, top view and side view. Give dimensions in all views. [16]

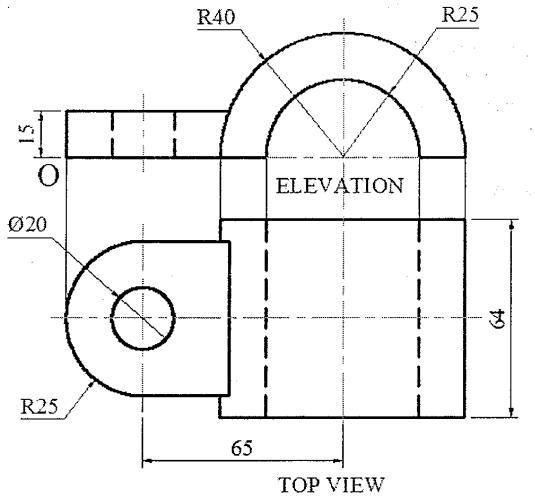


Q5) Figure shows front view and top view of an object. Draw isometric view. Give overall dimensions. [16]



OR

Q6) Figure shows front view and top view of an object. Draw isometric view. Give overall dimensions. [16]



Q7) A pentagonal pyramid, side of base edge 30 mm and height 60 mm, stands with its base on HP with an edge of base is parallel to VP and nearer to it. It is cut by a section plane perpendicular to VP, inclined at 45° to HP and passing through a point on axis, 32 mm above the base. Draw development of lower portion of the pyramid. [10]

OR

Q8) Draw the development of lower portion of pentagonal prism having side of base 35 mm and axis height 80 mm, rests on HP on its base with an edge of the base parallel to V.P., it is cut by a section plane inclined at 45° to HP and bisecting the axis of the prism. [10]



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 $u = \sin^{-1}(x^2 + y^2)^{1/5}$ 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 $T = \sin \left(\frac{xy}{x^2 + y^2} \right) + \sqrt{x^2 + y^2} + \frac{x^2 y}{x + y}$. Find the value of

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

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]

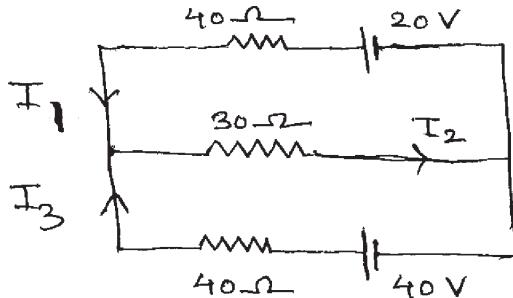
$$A = \begin{bmatrix} 1 & 2 & a \\ \frac{1}{3} & \frac{2}{3} & \\ \frac{2}{3} & \frac{1}{3} & b \\ \frac{2}{3} & \frac{-2}{3} & c \end{bmatrix}$$

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 1 Å 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 $11,000 \text{ \AA}$. [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 expression for conductivity of a semiconductor. Using this, find the expressions 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 $10\Omega\text{-cm}$. Given $\mu = 17000 \text{ cm}^2/\text{V.sec}$. [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:
 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 $3.3 \times 10^4 \text{ A/m}$. 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 recording and retrieving. [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 $1 \times 10^5 \text{ A/m}$ at 8K and $2 \times 10^5 \text{ A/m}$ 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 μ s. 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 pinion 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 with its components. [3]

Q5) a) Explain sand casting process with neat sketch. State its advantages and disadvantages. [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 $g = 9.81 \text{ m/s}^2$) [3]



Total No. of Questions : 9]

SEAT No. :

PC1678

[6351]-104

[Total No. of Pages : 4

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) I₂, reduction ii) Na, oxidation
iii) I₂, 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

- 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 °C gave a residue of 0.85 g. The residue was then ignited to a constant weight of 0.12 g. In another experiment, 1.0 g of the same coal sample was heated at 950 I 20°C 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:

- 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 occurring 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.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.
- 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 $e = 200 \sin 100\pi t$ is applied to a load having $R = 200 \Omega$ in series with $L = 638 \text{ mH}$. 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 10Ω is connected in series with a pure capacitor of $150 \mu\text{F}$. The circuit is connected across a $100\text{V}, 50\text{Hz}$ 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]
- Symmetric AC supply
 - Phase sequence
 - 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 6Ω resistance and 8Ω 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]
- Full load primary and secondary current
 - Range of ammeters and voltmeters
 - Range of wattmeters

- Q5)** a) State and explain Kirchhoff'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 10Ω resistor in following circuit. [8]

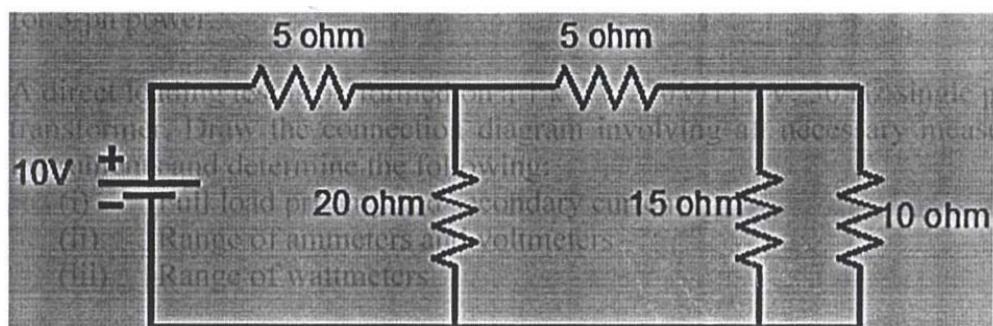


Fig. Q.5 (c)

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]

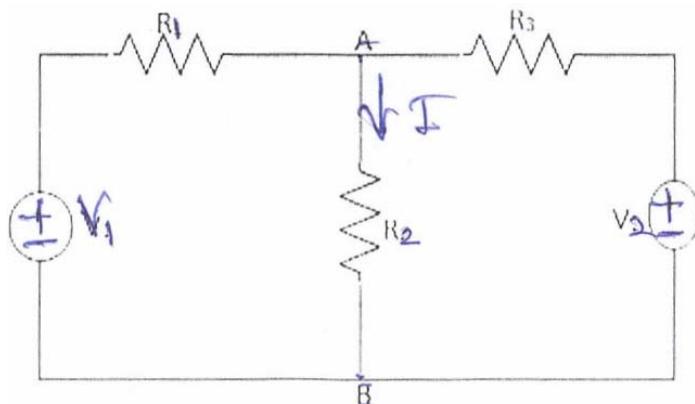


Fig 6(b)

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

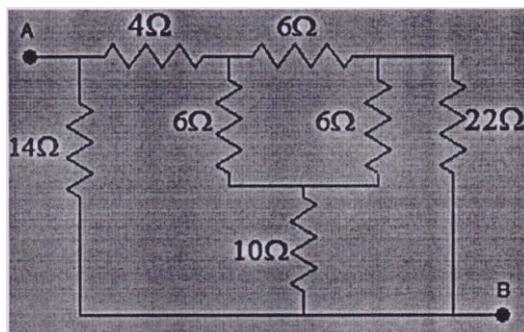


Fig. Q.6(c)

- 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, 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. $(43)_{10} = (?)_2$ - Decimal to Binary.
- ii. $(45)_8 = (?)_{10}$ - Octal to Decimal.
- iii. $(10101101)_2 = (?)_8$ - Binary to Octal.

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

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

OR

Q2) a) What 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]

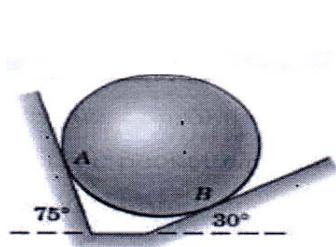
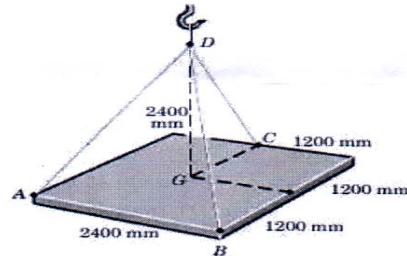


[6351]-107
F.E. (Common)
ENGINEERING MECHANICS
(2019 Pattern) (Semester - I) (101011)

*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 \times 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]

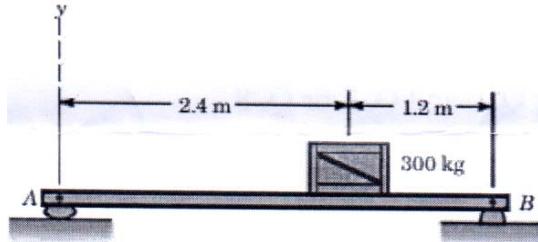


Fig. 2 a

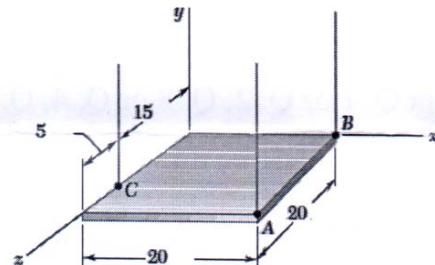


Fig. 2 b

- 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]

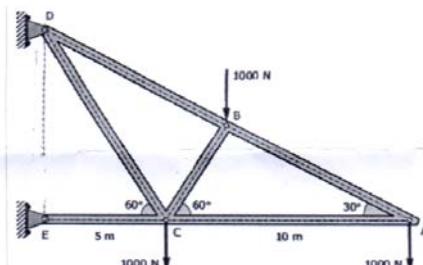


Fig. 3 a

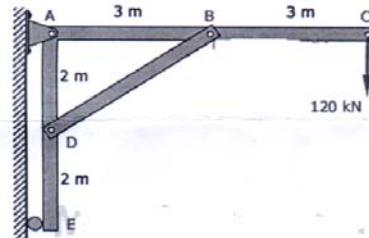


Fig. 3 b

- 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 $m_C = 50 \text{ kg}$, 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]

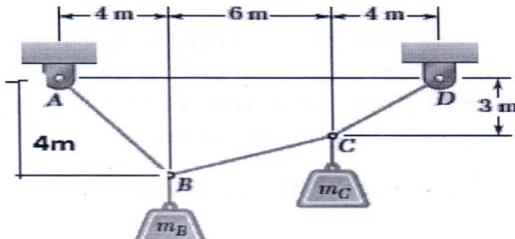


Fig. 4 b

- 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 $t=0 \text{ sec}$, the velocity is 2 m/s and displacement is 7 m . Determine velocity and displacement of particle at $t=3 \text{ seconds}$. [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]

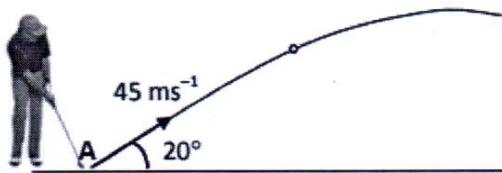


Fig. 5 c

OR

Q6) a) The acceleration of a particle is given by an expression, $a = k \cdot t^2$. At $t = 0$, velocity of the particle is -12 m/s . Knowing that $v = 0$ and $x = 15 \text{ m}$ when $t = 4 \text{ s}$, 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 $t = 0\text{ s}$, 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]

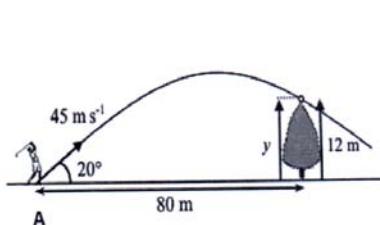


Fig. 6 b

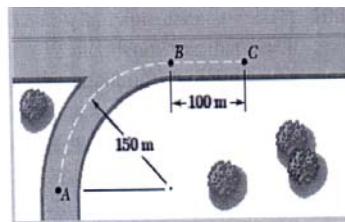


Fig. 6 c

- 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]

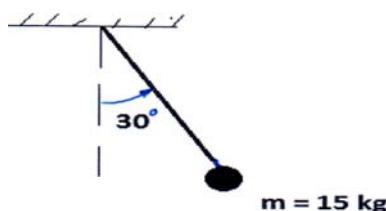


Fig. 7 a

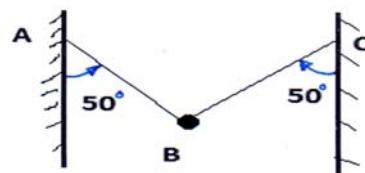


Fig. 8 a

- 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 $k = 3\text{kN/m}$. 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) $\iint_R f(r, \theta) \frac{1}{2} r dr d\theta$

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 $I_n = \int_0^{\frac{\pi}{2}} x^n \cos x dx$ 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 $\frac{d}{dx} \operatorname{erf}(\sqrt{x})$. [5]

OR

Q3) a) If $I_n = \int_0^{\frac{\pi}{4}} \sec^n x dx$ then prove that $I_n = \frac{(\sqrt{2})^{n-2}}{n-1} + \frac{n-2}{n-1} I_{n-2}$. [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 $\iint_R xy \, dx \, dy$ 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

$$x = 0, y = 0, z = 0 \text{ and the plane } \frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1. \quad [5]$$

c) Prove that the moment of inertia of the area between the curves $y^2 = ax$

$$\text{and } x^2 = ay \text{ about x-axis is } \frac{9}{35} Ma^2.$$

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



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 :

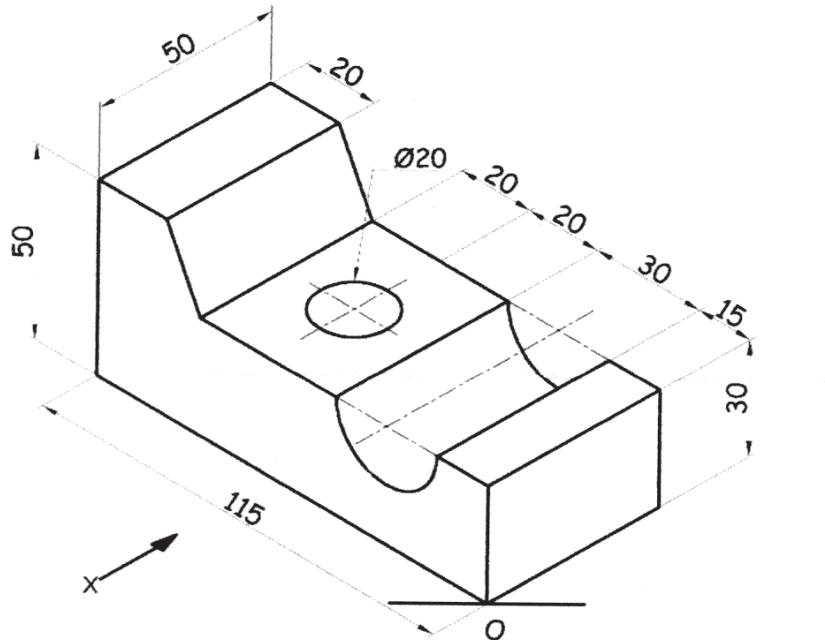
- 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Assume suitable data, if necessary.
- 3) Retain all the construction lines.

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]

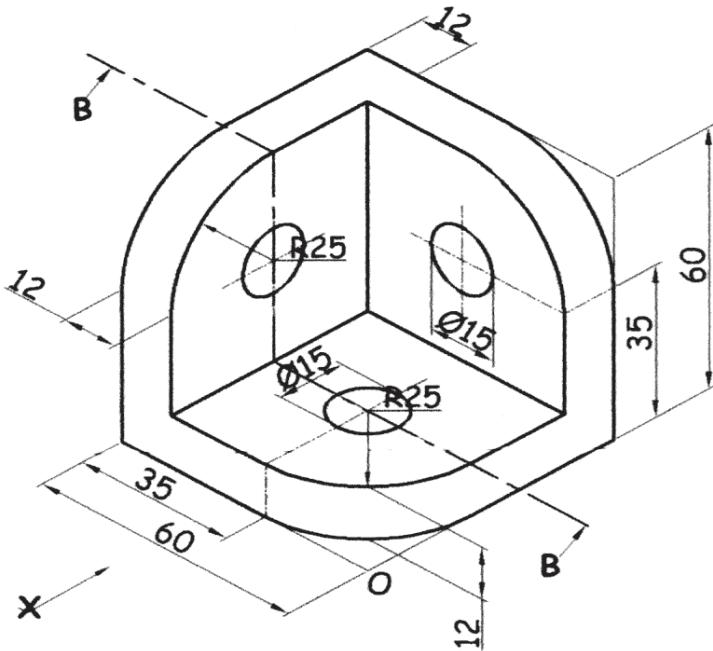
Q3) Figure shows a pictorial view of an object. By using first angle method of projection draw, Front View in the direction of X, Top View and Right-Hand Side View. Give dimensions in all views. [16]



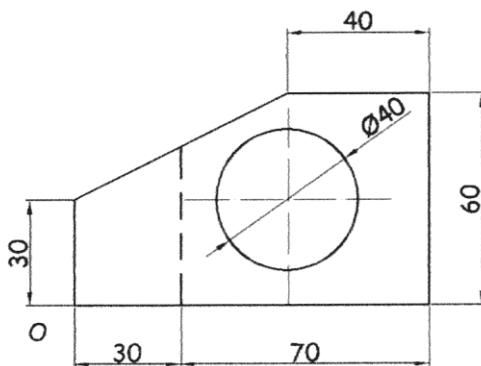
OR

P.T.O.

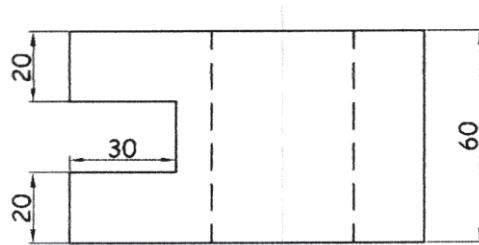
Q4) Figure shows a pictorial view of an object. By using first angle method of projection draw, Sectional Front View in the direction of X along B-B, Top View and Right-Hand Side View. Give dimensions in all views. [16]



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



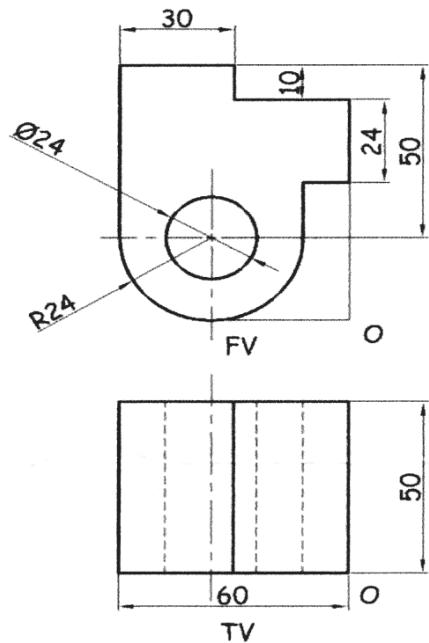
FV



TV

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 45°. 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]

