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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 $\dfrac{\partial^2 u}{\partial x \partial y}$ 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 $\dfrac{\partial(x, y)}{\partial(r, \theta)}$ is **[1]**

   i) $\dfrac{1}{r}$ 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 $u = \sin^{-1} \dfrac{\sqrt{x^2 + y^2}}{x + y}$ then $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ is equal to   [2]

    i) u ii) $2u$

    iii) 0   iv) None

f) If $x = u(1-v)$, $y = uv$ then $\dfrac{\partial(x, y)}{\partial(u, v)}$ [2]

    i) u ii) $\dfrac{1}{u}$

    iii) uv iv) $u - uv$

Q2) a) If $u = x^2 \tan^{-1}\dfrac{y}{x} - y^2 \tan^{-1}\dfrac{x}{y}$ then show that $\dfrac{\partial^2 u}{\partial x \partial y} = \dfrac{x^2 - y^2}{x^2 + y^2}$.   [5]

b) If $f(x, y) = \dfrac{1}{x^2} + \dfrac{\ln x - \ln y}{x^2 + y^2}$, using Euler's theorem find $xf_x + yf_y$.   [5]

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

OR

Q3) a) If $x = u \tan v$, $y = u \sec v$, prove that $\left(\dfrac{\partial u}{\partial x}\right)_y \cdot \left(\dfrac{\partial v}{\partial x}\right)_y = \left(\dfrac{\partial u}{\partial y}\right)_x \cdot \left(\dfrac{\partial v}{\partial y}\right)_x$.   [5]

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

c) If $z = f(u, v)$ and $u = x \cos\theta - y \sin\theta$, $v = x \sin\theta + y \cos\theta$ where θ is a constant, show that $x\dfrac{\partial z}{\partial x} + y\dfrac{\partial z}{\partial y} = u\dfrac{\partial z}{\partial u} + v\dfrac{\partial z}{\partial v}$.   [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 $u = \dfrac{x + y}{1 - xy}$, $v = \tan^{-1} x + \tan^{-1} y$.   [5]

c) Find the maximum and minimum values of $3x^2 - y^2 + x^3$.   [5]

OR

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Q5) a) If $x = v^2 + w^2$, $y = w^2 + u^2$, $z = u^2 + v^2$ find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$. **[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 betweem them $X_1 \equiv (3,1,1)$, $X_2 \equiv (2,0,-1)$, $X_3 \equiv (1,1,2)$. **[5]**
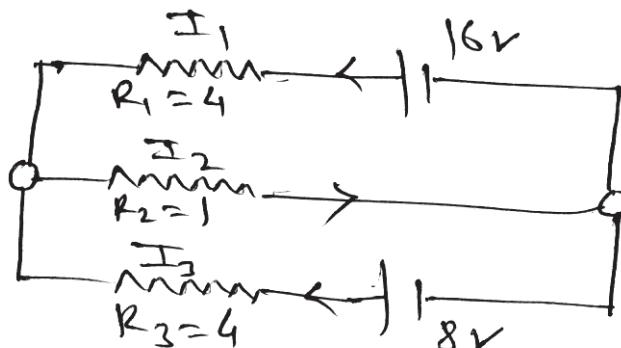
c) Show that $A = \begin{bmatrix} \dfrac{1}{\sqrt{2}} & 0 & \dfrac{1}{\sqrt{2}} \\ 0 & 1 & 0 \\ \dfrac{1}{\sqrt{2}} & 0 & \dfrac{-1}{\sqrt{2}} \end{bmatrix}$ is orthogonal matrix & hence find A^{-1}. **[5]**

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

$A = \begin{bmatrix} 1 & -2 \\ -3 & 0 \end{bmatrix}$. **[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

$A = \begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}$. **[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]**

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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 × 10^{-34} J.S*
- *Mass of electron m$_e$ = 9.1 × 10^{-31} Kg*
- *Charge on election e = 1.6 × 10^{-19} 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

iv) In Hall effect, when a specimen caring 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 A°. **[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 4 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 Ω-m and the Hall coefficient is 3.6 x 10^{-4} m^3/ 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 x 10^{10} per cc [μ_e=1500 cm^2/ V-sec, μ_h=500cm^2/V-sec. **[4]**

Q6) a) Differentiate between type I and type II superconductors. **[6]**

b) Define the terms: **[5]**
   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]**

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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 logritmic 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)	Rechargable 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)	$Kcal/m^3$	ii)	cal/g
iii)	Joules	iv)	J/m^3

e) The enzyme used for conversion of glucose to ethanol is _____. **[1]**

i)	lactase	ii)	maltase
iii)	invertase	iv)	zymase

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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) $A = -\log 1/T$ 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 colorimeter 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 an 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 : **[4]**

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 - **[4]**

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]**

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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]**

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]**

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

Q1) a) Derive the expression for resonant frequency in 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 power
   c) A coil of resistance 24 Ω has a reactance of 32 Ω 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

<div align="center">OR</div>

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 resonance
   b) Obtain the expression for power in an R-C series circuit when supplied
      with $v = V_m \sin wt$.   **[6]**
   c) A series R-L-C circuit consists of R = 10 Ω, L = 0.318 H and C = 63.6
      µF. 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

Q3) a) Define the following in the context of three phase AC systems: **[3]**

      i)   Symmetrical AC supply

      ii)   Phase Sequence

      iii)   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) Ω are connected in delta across a 3-phase. 230 V supply. Calculate: **[8]**

      i)   Phase and line currents

      ii)   Power factor of the load

      iii)   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]**

      i)   secondary induced emf

      ii)   number of turns in the primary

      iii)   cross sectional area of the core if the maximum value of flux density is 0.1 T

      iv)   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]**
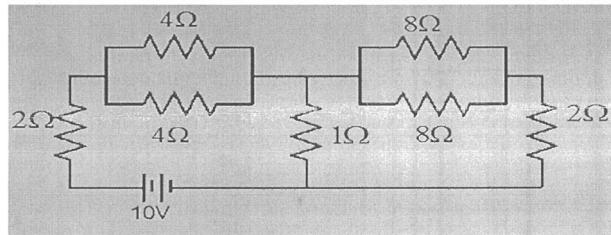
Fig.1

OR

Q6) a) Define the following terms: **[4]**

   i) Active Network and Passive Network

   ii) 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]**
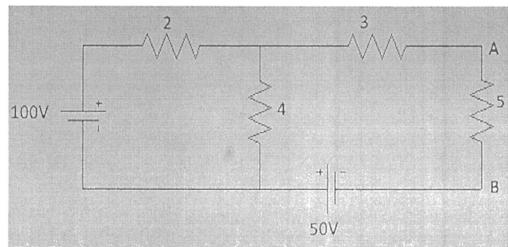
Fig.2

   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]**

   i) Mobile phone

   ii) Electric bike

   iii) 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]**

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F.E.
BASIC ELECTRONICS ENGINEERING
(2019 Pattern) (Semester - I/II) (104010)

Time : 2½ Hours]   *[Max. Marks : 70*

Instrictions 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]**

<div align="center">OR</div>

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]**

<div align="center">OR</div>

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]**

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[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. 3orQ. 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]**
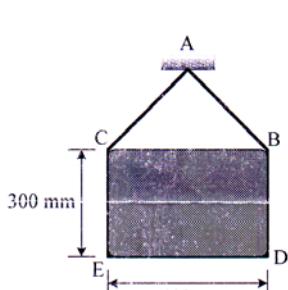
Fig. 1 a   Fig. 1 b
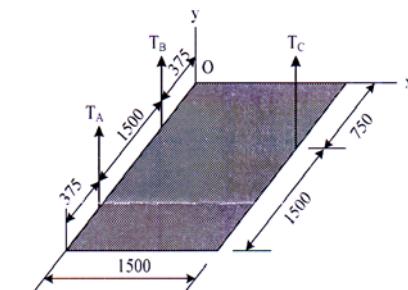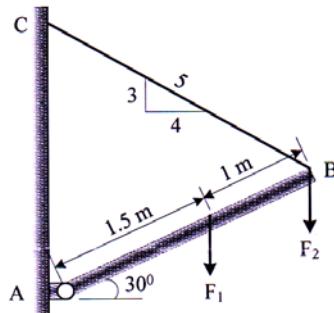
    c)   Sate the component of reaction at roller, hinged, fixed and rocker support.

                                                       [4]

OR
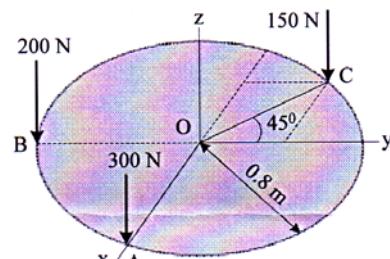
Q2) a)   The boom is intended to support two vertical loads, F_1 and F_2 as shown in Fig. 2 a. If the cable CB can sustain a maximum load of 1500 N before it fails, determine the critical loads F_1 and F_2 if $F_1 = 2F_2$. Also determine the reaction at A.   **[7]**

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]**
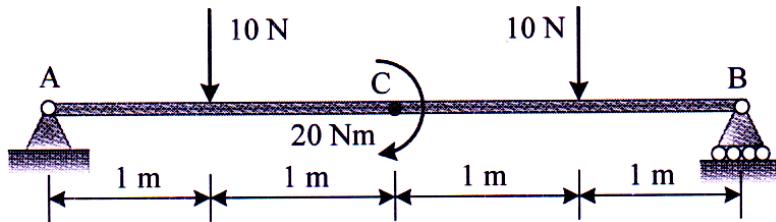

Fig. 2 a
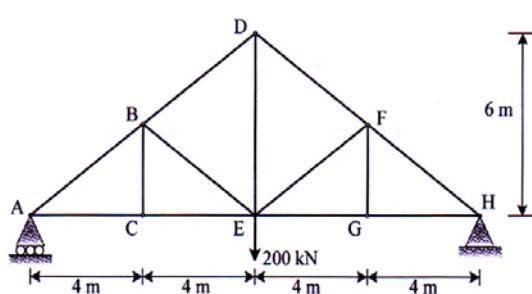
Fig. 2 b

c) Find support reaction at A and B for the beam AB as shown in Fig. 2 c. **[4]**
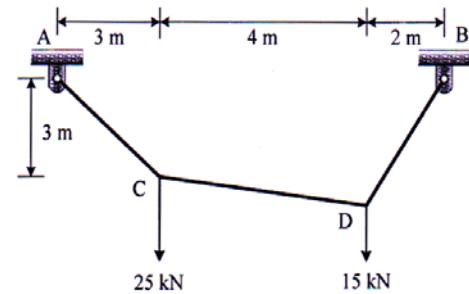

Fig. 2 c

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]**
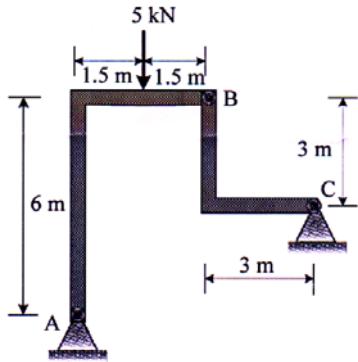

Fig. 3 a
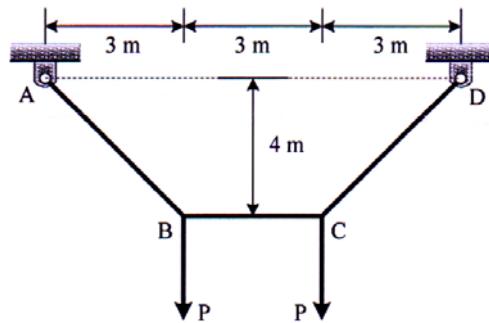
Fig. 3 b

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]**
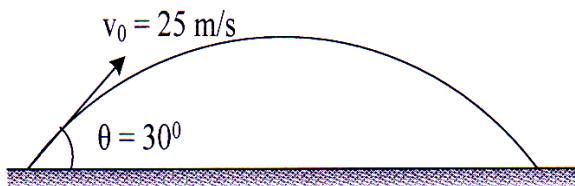

Fig. 4 b   **Fig. 4 c**
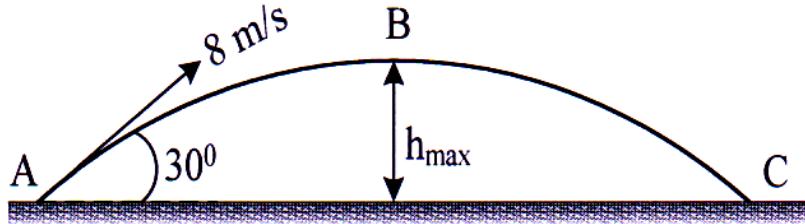
Q5) a) A car comes to rest from an initial speed of 80 km/h in a distance of 30 m. With the same constant acceleration, determine the distance 's' for which the car comes to rest from an initial speed. of 110 km/h. **[5]**

b) A particle moves along the path x = (8t²) and y = (t³ + 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 θ = 30° 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
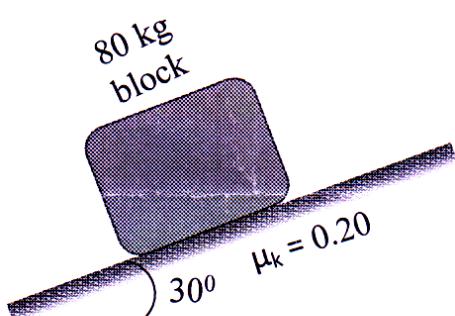
Q6) a) The motion of a particle is defined by x = 2t³ – 15t² + 24t + 4, where x is in m and t is in s. Determine when the velocity is zero and find position at which acceleration is zero. **[5]**

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 $\theta = 30°$ with the horizontal, as shown in Fig. 6 c. Determine the horizontal distance it must travel to reach its highest point B. **[6]**
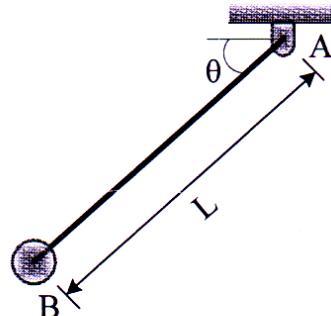

Fig. 6 c

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 $\theta = 0°$. Determine the tension in the cord as function of the angle of descent θ. Neglect the size of bob. **[6]**


Fig. 7 a
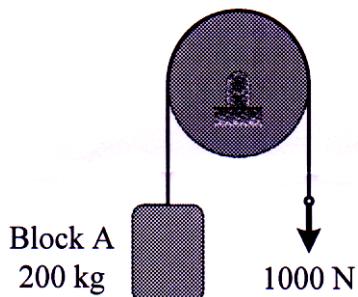
Fig. 7 b

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]**
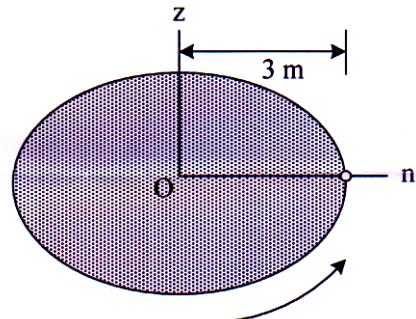
OR

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 $a_t = 0.4$ m/s². 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]

Block A
200 kg

1000 N

Fig. 8 a

z

3 m

n

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]

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[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])

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+

<div align="center">OR</div>

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]**

<div align="center">▶◀ ▶◀ ▶◀</div>

[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) $\dfrac{2}{35}$ ii) $\dfrac{1}{15}$

   iii)   0   iv) $\dfrac{2\pi}{35}$

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) $\dfrac{\pi}{2}$

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 $u_n = \int\limits_0^{\pi/4} \sin^{2n} x\, dx$ then prove that $u_n = \left(1 - \dfrac{1}{2n}\right) u_{n-1} - \dfrac{1}{n2^{n+1}}$. **[5]**

b) Prove that : $\beta(m, n) = \beta(m, n + 1) + \beta(m+1, n)$ **[5]**

c) If $f(x) = \int\limits_0^x (x-t)^2 G(t)\, dt$ then prove that $\dfrac{d^3 f}{dx^3} = 2G(x)$ **[5]**

OR

Q3) a) If $U_n = \int\limits_0^{\pi/4} \tan^n \theta\, d\theta$, then prove that $n\left[U_{n+1} + U_{n-1}\right] = 1$ **[5]**

b) Evaluate : $\int\limits_0^{\infty} 2^{-9x^2}\, dx$ **[5]**

c) Evaluate : **[5]**

i) $\dfrac{d}{dt}\left[erf\left(\sqrt{t}\right)\right]$

ii) $\dfrac{d}{dt}\left[erf_c\left(\sqrt{t}\right)\right]$

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]**

<div align="center">OR</div>

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 $\dfrac{x}{1} = \dfrac{y}{1} = \dfrac{z}{1}$ 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 $\dfrac{x}{1} = \dfrac{y}{-1} = \dfrac{z}{1}$ **[5]**

<div align="center">OR</div>

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 $\dfrac{x}{1} = \dfrac{y}{2} = \dfrac{z}{3}$ and axis is the line $\dfrac{x}{-1} = \dfrac{y}{1} = \dfrac{z}{2}$. **[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 $\int_0^\infty \int_x^\infty \dfrac{e^{-y}}{y} dx\, dy$ **[5]**

b) Find the area of cardioide $r = a(1 + \cos\theta)$ 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 $\dfrac{144}{35}$ Ma^2, given that density $\rho = \dfrac{3M}{16a^2}$ and M is the mass. **[5]**

OR

Q9) a) Change following double integration to its polar form and evaluate $\iint\limits_{R} \dfrac{x^2 y^2}{x^2 + y^2} \, dx\, dy$, where R is annulus between $x^2 + y^2 = 4$ and $x^2 + y^2 = 9$. **[5]**

b) Prove that the volume bounded by cylinders $y^2 = x$ and $x^2 = y$ and planes $z = 0$, $x + y + z = 2$ is $\dfrac{11}{30}$. **[5]**

c) Find the x - co-ordinate of centre of gravity of a loop of $r = a\sin 2\theta$ in first quadrant, given that area of loop is $A = \dfrac{\pi a^2}{8}$. **[5]**

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[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]**
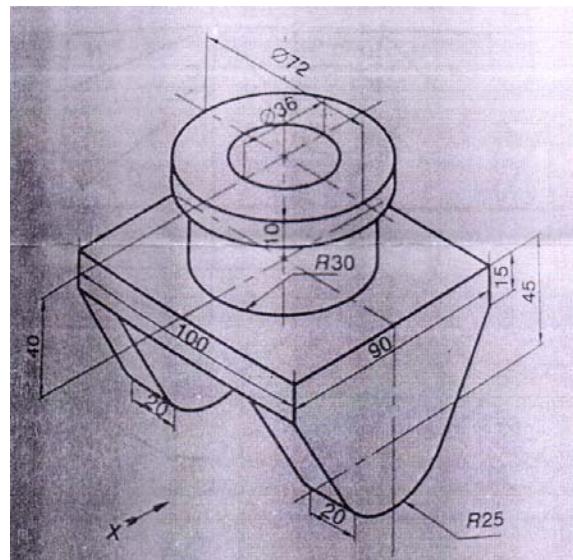
OR

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]**
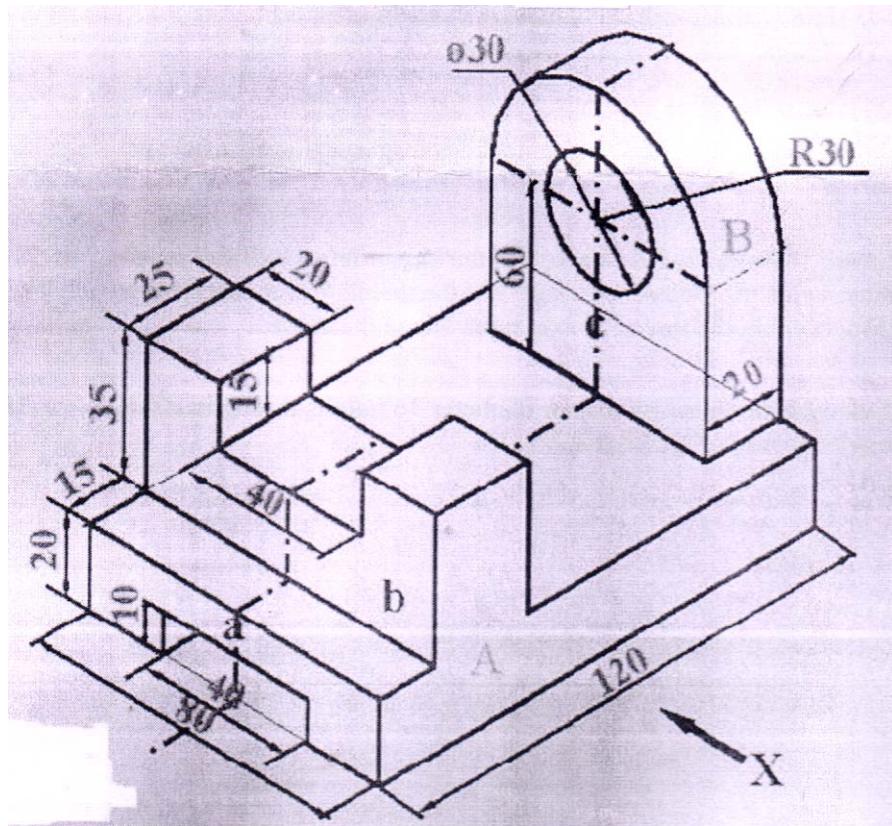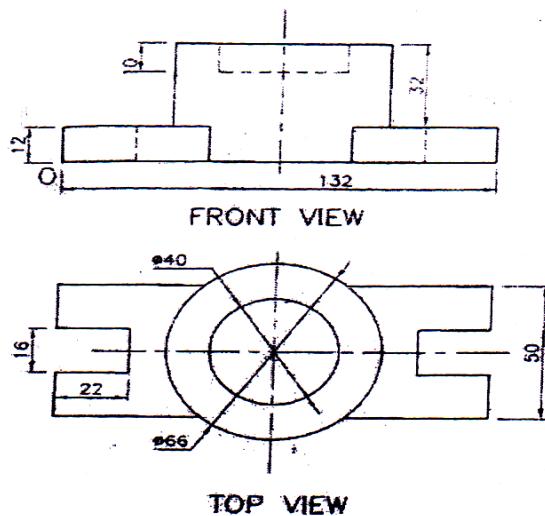
OR

Q4) Fig. shows pictorial view of an object. Using first angle method of projection draw : **[16]**

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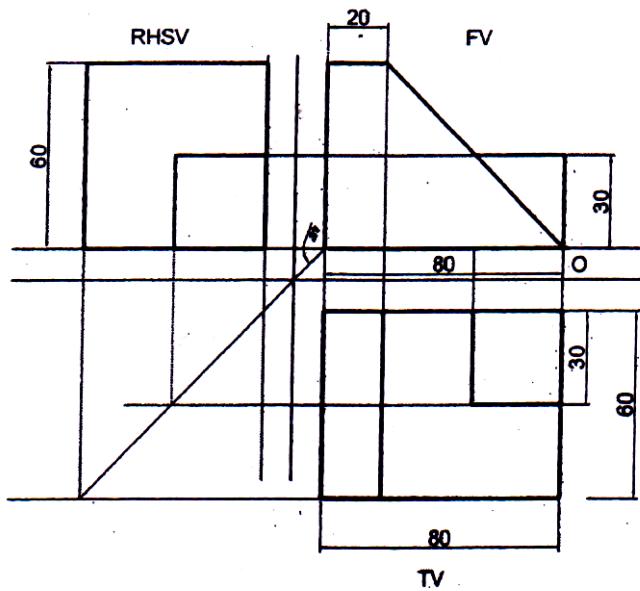
Q5) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view. **[16]**

FRONT VIEW

TOP VIEW

OR

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

RHSV   FV

TV

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]**

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