[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) $\dfrac{15}{8}$ ii) 0

        iii) $\dfrac{8}{15}$ iv) $\dfrac{8}{15}\dfrac{\pi}{2}$

    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

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 $x = t^2, y = t - \dfrac{t^3}{3}$ 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 $I_n = \displaystyle\int_0^{\pi/4} \tan^n \theta\, d\theta$ then show that $I_n = \dfrac{1}{n-1} - I_{n-2}$ [5]

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

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

OR

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

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

c) Prove that $\int_0^\infty e^{-x^2-2bx} \, dx = \dfrac{\sqrt{\pi}}{2} e^{b^2} [1 - erf(b)]$ **[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 : $r = a\left(\sqrt{2} + \sin\theta\right)$. **[5]**

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

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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 $\int_0^\infty \int_y^\infty \dfrac{e^{-x}}{x} dxdy$. **[5]**

b) Find the area of one loop of the curve $r = a\cos2\theta$. **[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 $A = \dfrac{9}{2}$ is the area of the region bounded by the given curves. **[5]**

OR

Q9) a) Evaluate $\iint x^2 y^2\, dxdy$ 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 $\dfrac{11}{30}$. **[5]**

c) Find the x-co-ordinate of the centre of gravity of one loop of $r = a\sin2\theta$, (in first quadrant). Given that the area of loop is $A = \dfrac{\pi a^2}{8}$. **[5]**

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[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 Q8.

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]**
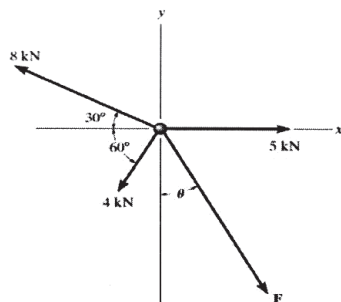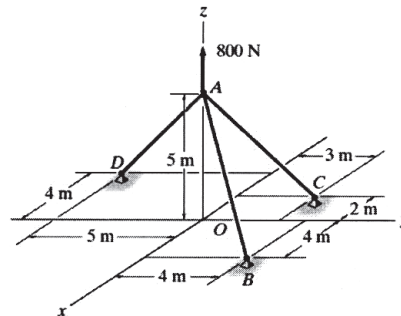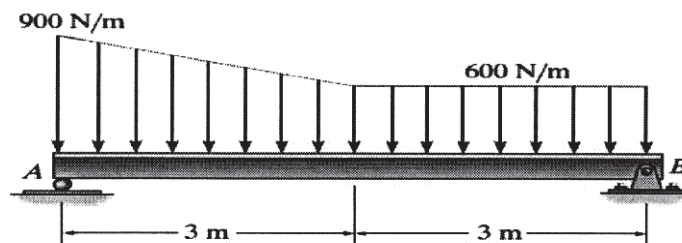

Fig. 1a   Fig. 1b

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

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]**
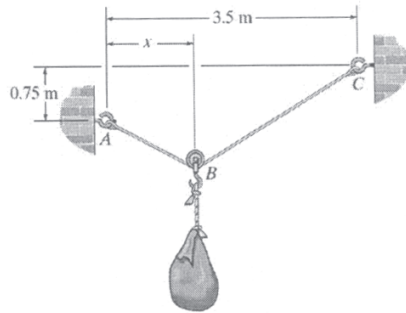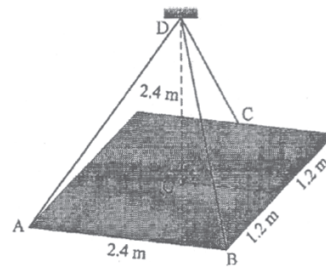

Fig. 2a

Fig. 2b

b) The square 2.4m × 2.4m, 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]**
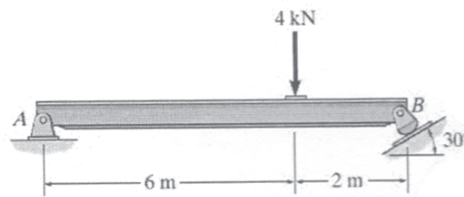

Fig. 2c

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]**
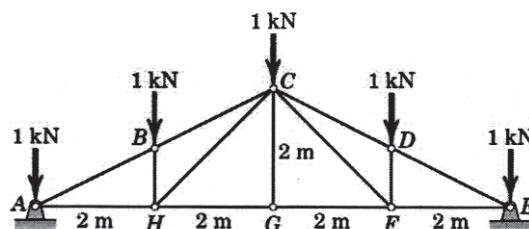

Fig. 3a

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]**
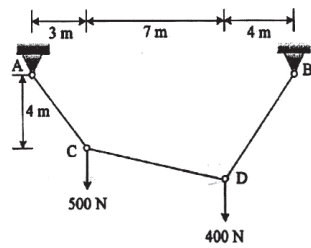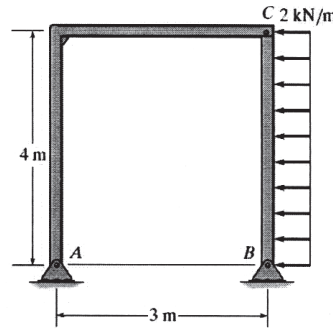
Fig. 3b

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]**
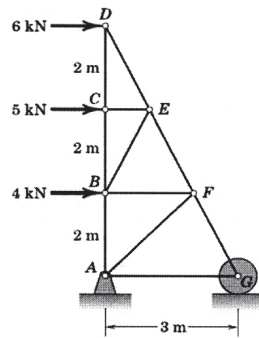
Fig. 4a

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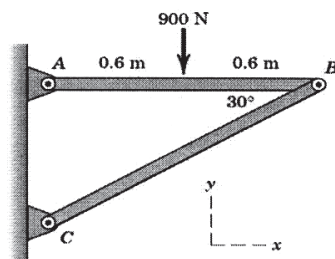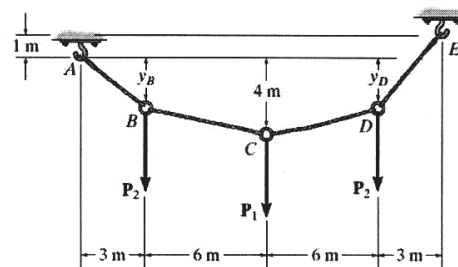
Fig. 4c

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 30º with horizontal as shown in Fig. 5b. Determine the maximum distance travelled by projectile along horizontal and vertical direction.**[6]**
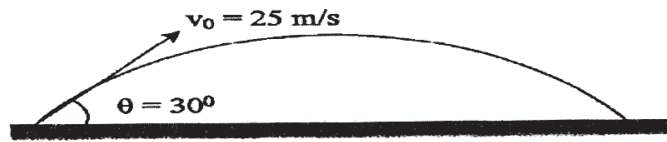
Fig. 5b

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 μ_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]**
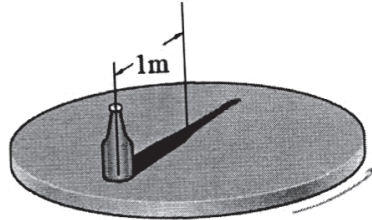

Fig. 7a

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 $h_1 = 81$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]**
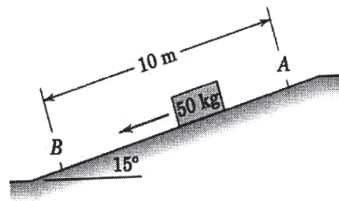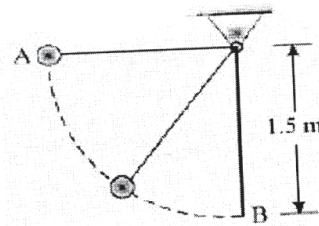
Fig. 8A   **Fig. 8b**

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]**

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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 a   Fig. 1 b
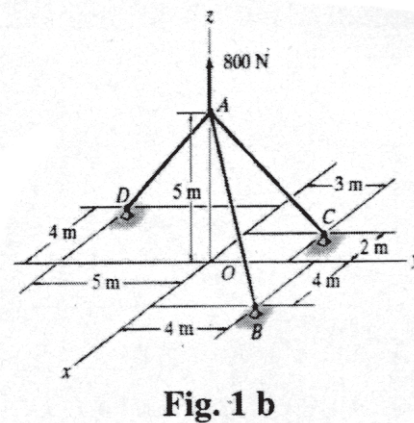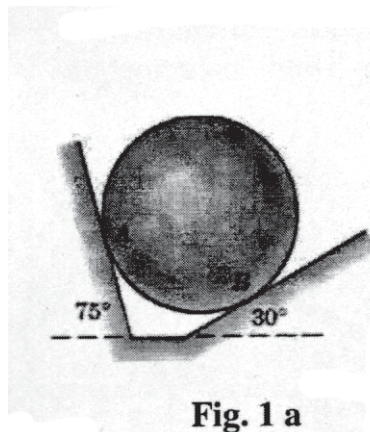
   c) Explain how uniformly distributed load (UDL) and uniformly varying load (UVL) is converted in to a point load with sketch. **[4]**

OR

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 $F_1 = 8$kN and $F_2 = 9$kN.**[7]**
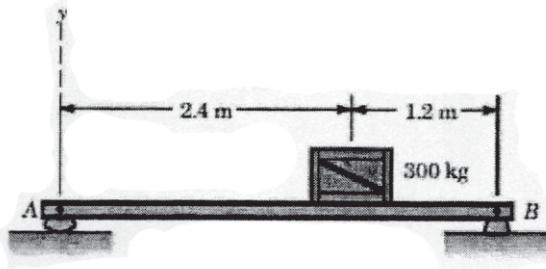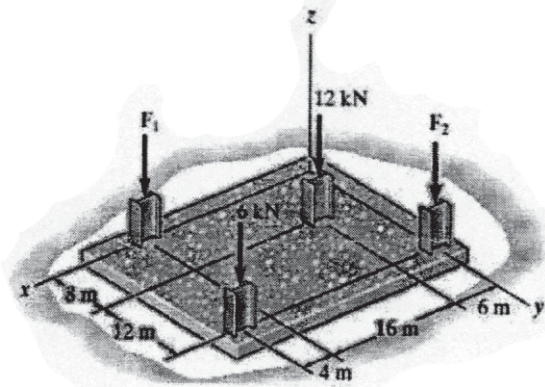
Fig. 2 a   Fig. 2 b

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]**
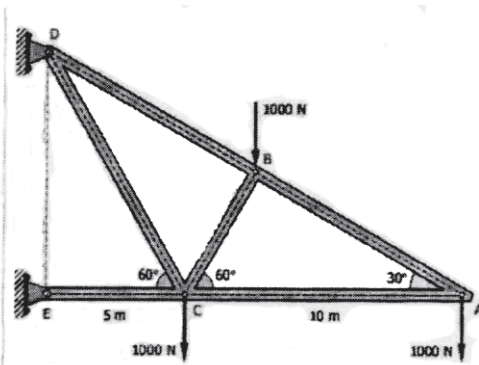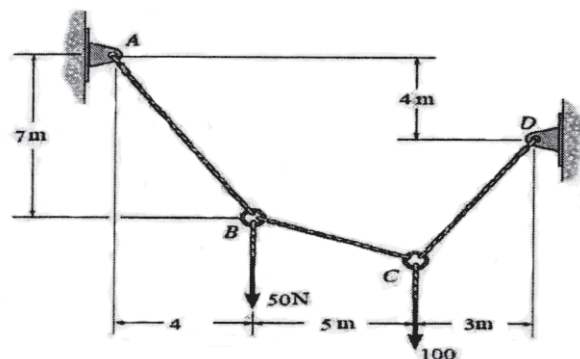
Fig. 3 a   Fig. 3 b

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

OR

[5924]-10A   2

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 N and d = 1 m, for the **Fig. 4 b.** **[6]**
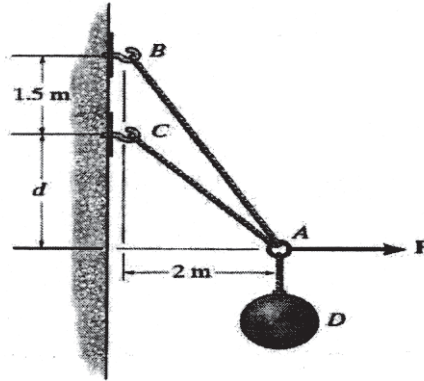
Fig. 4 b

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/s² and 't' is time in seconds. Initially, then t = 0 sec, the velocity is 2 m/s and displacement is 7m. Determine velocity and displacement of particle at t = 3 seconds. **[6]**

b) A stone thrown vertically upward with 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]**
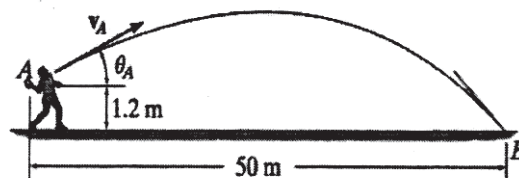
Fig. 5 c

OR

Q6) a) The car moves in a straight line such that for a short time its velocity is defined by V = 3t² + 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]**
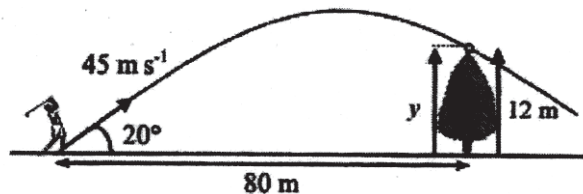
Fig. 6 b

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/s² for some time. Determine the time and velocity when the total acceleration of the racing car reaches to 8 m/s². **[6]**
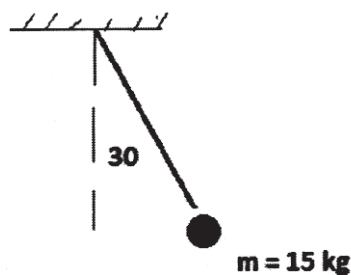
Fig. 7 a

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 $x = \mathbf{1.5}$ **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 $v_{A1} = 5$ m/s when it strikes the 4-kg disk B, which is sliding towards A at $v_{B1} = 2$ 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]**
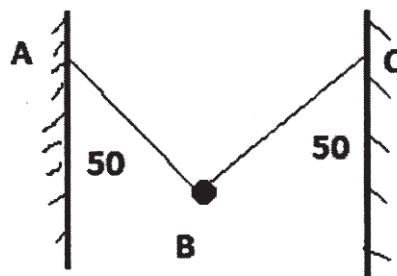
Fig. 8 a

Fig. 8 b

Fig. 8 c

▽ ▽ ▽ ▽

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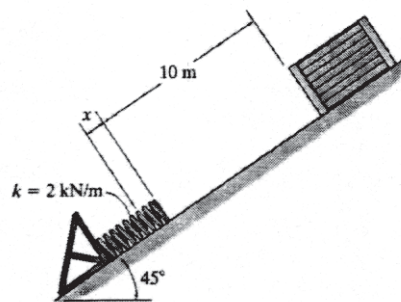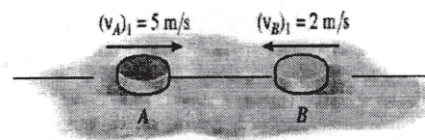
[5924]-2

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
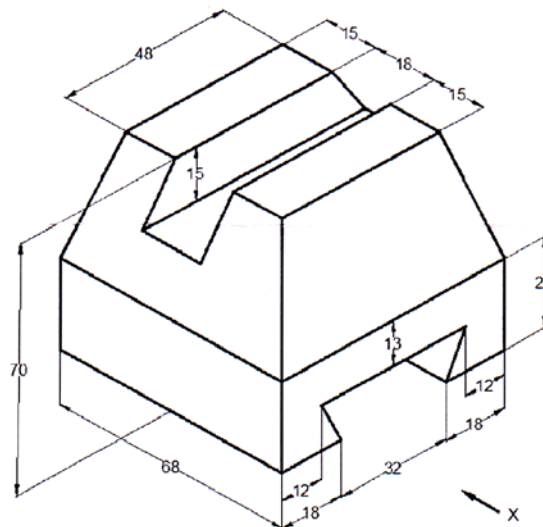
Q4) Figure shows a pictorial view of an object. By using first angle method of projection draw, Sectional Front View along section P-Q looking in the direction of X, Top View and RHSV. Give dimensions in all views. **[16]**
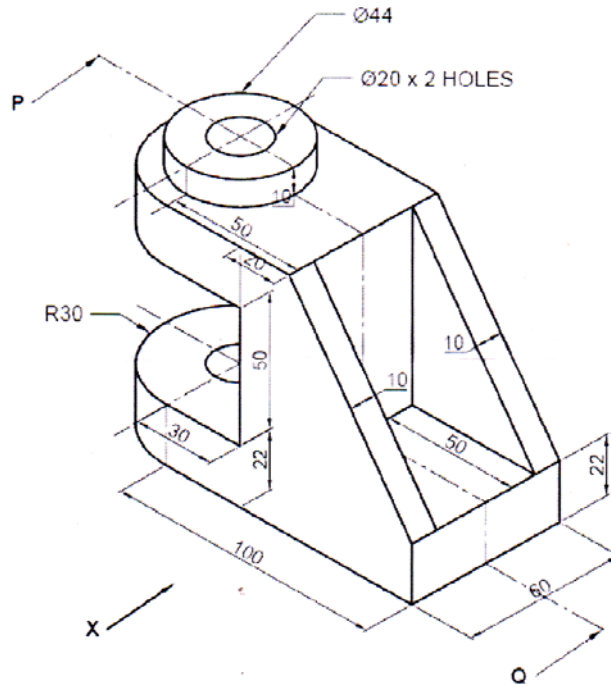
Q5) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. **[16]**

RHSV   FV
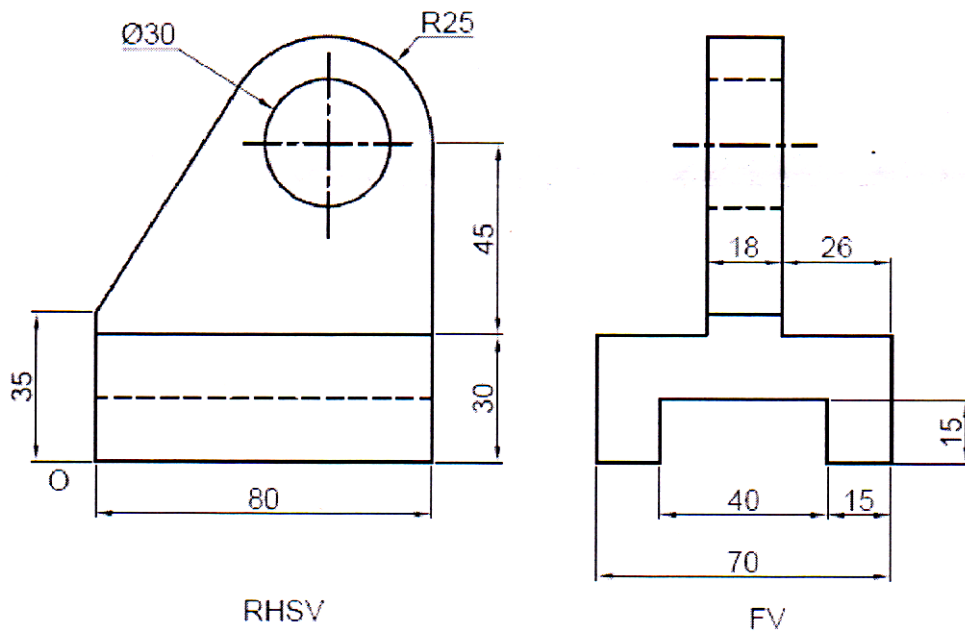
OR

Q6) Figure show orthographic views of an object by first angle method of projection. Draw its isometric view and give all the dimensions. **[16]**
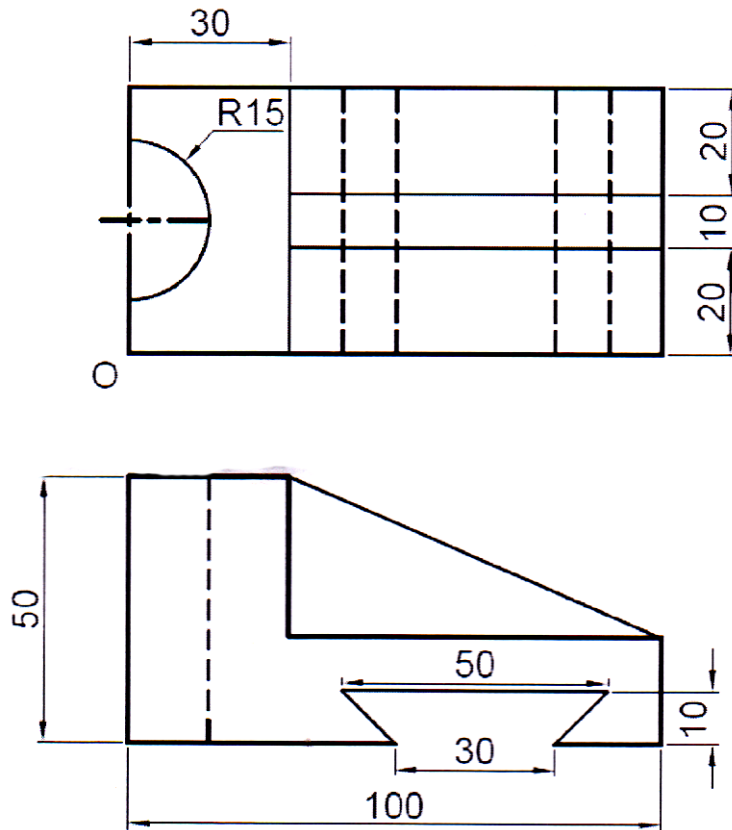
Q7) A right circular cone having diameter of base 40 mm and axis length 60 mm is resting on its base in HP. It is cut by an AIP inclined at 45° to HP and bisecting the axis. Draw the development of the lateral surface of the cone. **[10]**

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]**

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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 – _____ × H × 587 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 protectitve? **[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 O_2 was found to increase weight of $CaCl_2$ 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 streching vibrations. **[5]**

c) Define the following terms : **[4]**
   i) Auxochrome
   ii) Chromophore
   iii) Bathochromic shift
   iv) Hyperchromic shift

OR

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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]**

    i) H_2O
    ii) NH_3
    iii) CH_4
    iv) NO

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]**

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SEAT No. :

[Total No. of Pages : 3

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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) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7or 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 × 10⁸ 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 1.75Å. 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 donar atoms which must be added to an intrinsic semiconductor to obtain a resistivity of 12 ohm-cm (Mobility of electrons, $\mu_c = 500$ cm^2/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 instrinsic, 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, $R_H = 3.68 \times 10^{-4}$ m^3/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_e 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 = 4.2K. **[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]**

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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 $\dfrac{\partial^2 u}{\partial x \partial y}$ is equal to   **[2]**

        i)   3   ii)   −3

        iii)   2   iv)   0

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

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

        iii) $\dfrac{1}{4(u^2 + v^2)}$ 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) $c_1 = 0, c_2 = 0$

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

e) If $u = x^2 + y^2 + 2x$, $\dfrac{\partial u}{\partial y}$ 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 $\left(\dfrac{\partial u}{\partial x}\right)_y \left(\dfrac{\partial x}{\partial u}\right)_v \left(\dfrac{\partial y}{\partial v}\right)_x \left(\dfrac{\partial v}{\partial y}\right)_u$.

[5]

b) If $u = \operatorname{cosec}^{-1}\sqrt{\dfrac{x^{1/2} + y^{1/2}}{x^{1/3} + y^{1/3}}}$ then prove that

$x^2 \dfrac{\partial^2 u}{\partial x^2} + 2xy \dfrac{\partial^2 u}{\partial x \partial y} + y^2 \dfrac{\partial^2 u}{\partial y^2} = \dfrac{\tan 4}{144}\left[\tan^2 u + 13\right]$.

[5]

c) If $x = u + v + w$, $y = uv + vw + uw$, $z = uvw$ and ϕ is function of x, y, z

then prove that $u \cdot \dfrac{\partial \phi}{\partial u} + v \dfrac{\partial \phi}{\partial v} + w \dfrac{\partial \phi}{\partial w} = x \cdot \dfrac{\partial \phi}{\partial x} + 2y \dfrac{\partial \phi}{\partial y} + 3z \dfrac{\partial \phi}{\partial z}$.

[5]

OR

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

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

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

Q4) 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 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. **[5]**

OR

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

b) Examine for functional dependence :

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

c) Find stationary value of $u = x^2 + y^2 + z^2$ under the condition $\dfrac{1}{x} + \dfrac{1}{y} + \dfrac{1}{z} = 1$

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 $A = \dfrac{1}{9}\begin{bmatrix} -8 & 4 & a \\ 1 & 4 & b \\ 4 & 7 & c \end{bmatrix}$. **[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]**
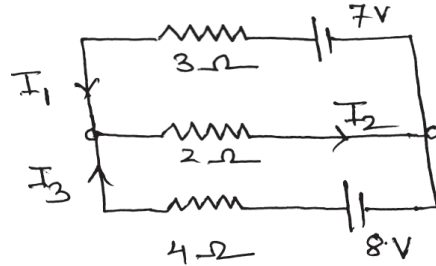
Q8) a) Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 14 & -10 \\ 5 & -1 \end{bmatrix}$. **[5]**

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 $x_1^2 + 2x_2^2 + 3x_3^2 + 2x_1 x_2 - 2x_1 x_3 + 2x_2 x_3$ to the canonical form by using congruent transformations. Also write the canonical form. **[5]**

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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]**

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

c) Prove that $\cos\left[i\log\left(\dfrac{a+ib}{a-ib}\right)\right] = \dfrac{a^2 - b^2}{a^2 + b^2}$ **[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 $e^{x\cos x}$ in ascending powers of x up to the term containing x^3. **[4]**

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

OR

Q4) a) Solve any <u>ONE</u>. **[4]**

i) Evaluate $\lim\limits_{x \to \frac{\pi}{2}} (\sec x - \tan x)$.

ii) Evaluate $\lim\limits_{x \to 0} (1 + \tan x)^{\cot x}$

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 <u>TWO</u>.

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

$$x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy} + x u_x + y u_y .$$ **[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 $\left(\dfrac{\partial z}{\partial x}\right)^2 + \left(\dfrac{\partial z}{\partial y}\right)^2 = \left(\dfrac{\partial z}{\partial u}\right)^2 + \left(\dfrac{\partial z}{\partial v}\right)^2$. **[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 $u = \tan^{-1}\left(\dfrac{\sqrt{x^3+y^3}}{\sqrt{x}+\sqrt{y}}\right)$ then prove that **[7]**

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

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

Q7) a) If $u = \dfrac{yz}{x}, v = \dfrac{zx}{y}, w = \dfrac{xy}{z}$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$. **[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 $\dfrac{\partial x}{\partial u}$. **[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 $x^m y^n z^p$. **[5]**

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[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 $AgNO_3$. **[3]**

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

Q2) a)   Explain potentiometric titration between Fe^{2+} and Ce^{4+}. 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 $Caco_3$ 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]**

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

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]**

<div align="right">*P.T.O.*</div>

b) State purpose with example of following ingredients of compounding of plastic process **[3]**
   i) Filler
   ii) Lubricant
   iii) 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]**
   i) methane (CH_4) and
   ii) 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]**
   i) Mg
   ii) Mo
   iii) Cr

b) Explain how nature of metal affect rate of corrosion in general **[4]**

c) Explain electroless platting with example and appplications (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]**

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[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 × 10^{11}N/m^2, ρ = 7.23 × 10^3 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 an 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 × 10^{-34} J-sec, C = 3 × 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 tis role in losing? **[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 × 10^{-19}c, h = 6.63 × 10^{-34}j-sec, m = 9.1 × 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]**

   i) Zero electrical resistance

   ii) 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]**

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[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. orQ4, 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=100KΩ, R_1=10KΩ, V_{cc}=±
            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]**

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]**

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[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 µF 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]**
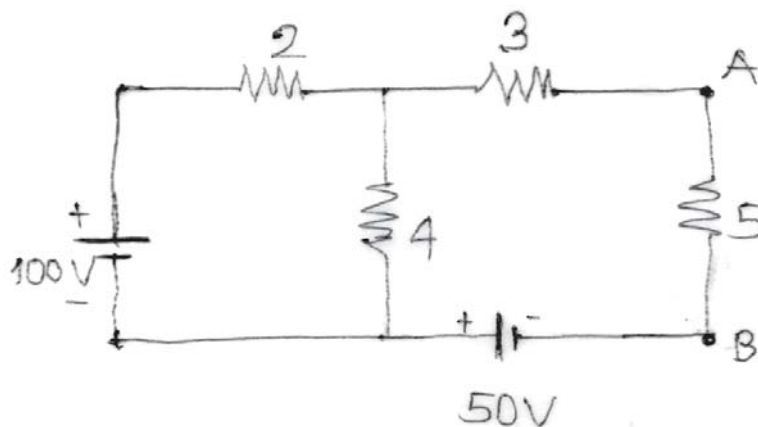
OR

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]**
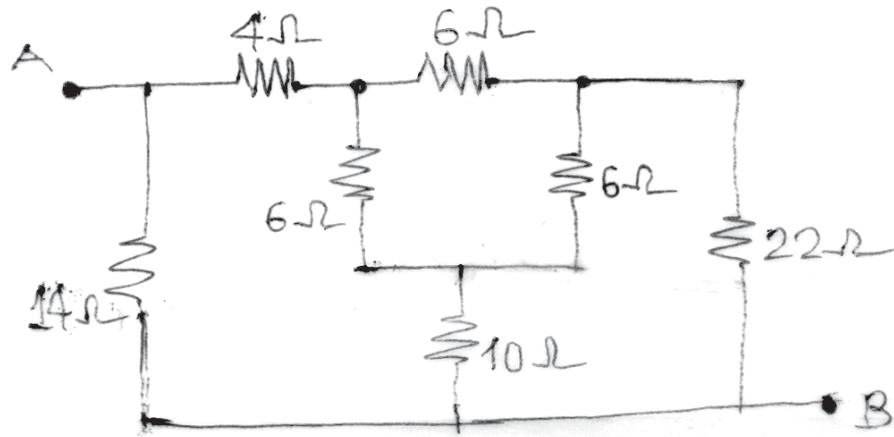
[5924]-506

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]**

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[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 tis 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 suface of hexagonal prism of base side 23mm and axis height 69mm. **[6]**

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]**
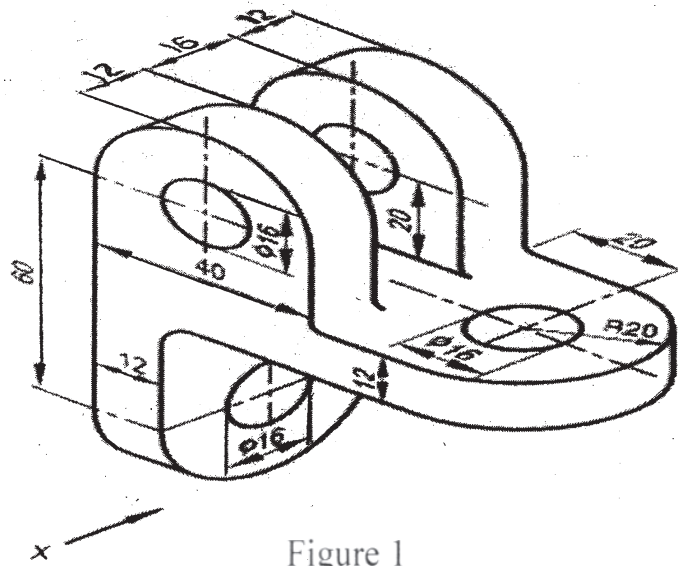   c)   Top view   **[4]**
   d)   Dimensions   **[1]**

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]**

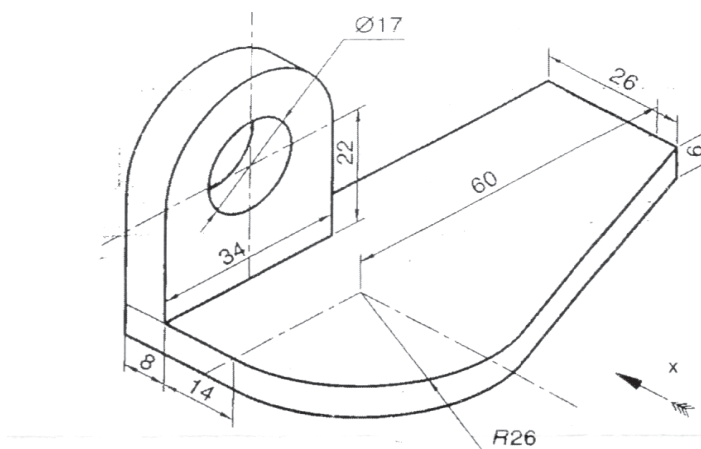Figure 2

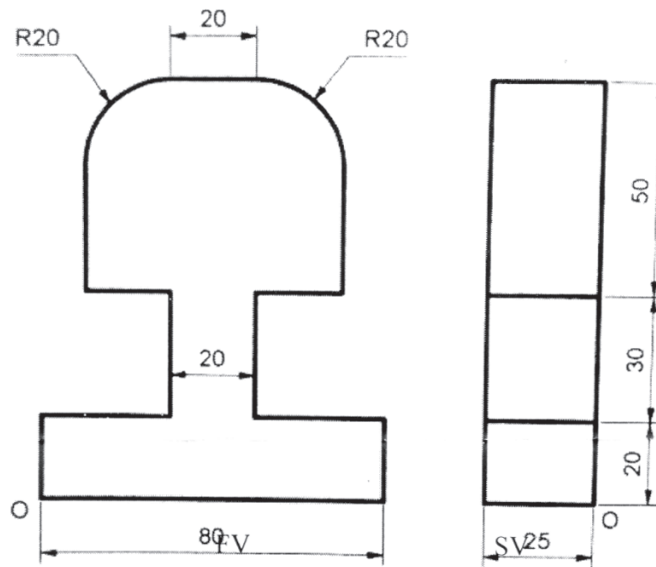*Q7)* Figure 3 shows front view and end view of an object. Draw isometric view and show overall dimensions. **[12]**

Figure 3

OR

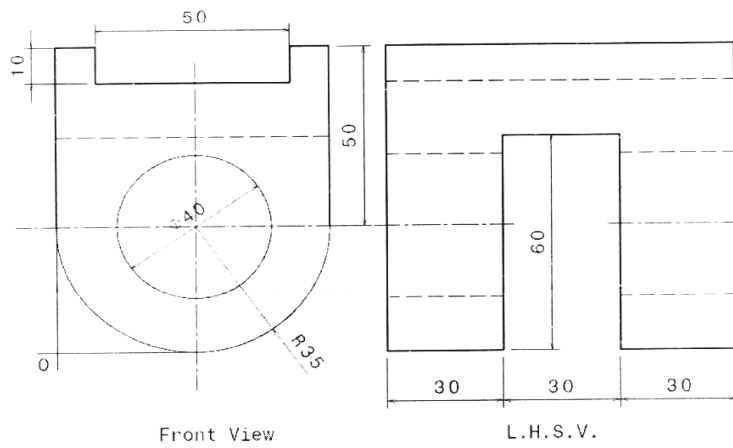*Q8)* Figure 4 shows front view and end view of a bracket. Draw isometric view and show overall dimensions. **[12]**

Figure 4

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

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

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

OR

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

b) Solve the following :

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

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 '$\dfrac{L}{R}\log 2$' 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 $\displaystyle\int_0^1 (x\log x)^4 dx = \dfrac{4!}{5^5}$ **[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 $U_n = \displaystyle\int_0^\pi x\cos^n x\, dx$, with U_{n-2}, where n is an even integer. **[4]**

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

c) Show that in the astroid $x = a\cos^3 t,\ y = a\sin^3 t\ \ s^3 \alpha x^2$, s being measured from cusp which lies on y - axis $\left(t = \pi/2\right)$ to any point $t = 0$. **[4]**

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

b) Find the equation of the right circular cone which passes through the point (1, 1, 2) has its axis as the line $\dfrac{x}{2} = \dfrac{y}{-4} = \dfrac{z}{3}$ 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 $x = \dfrac{-y}{2} = -z$ 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 $\displaystyle\int\limits_{0}^{\infty} \int\limits_{0}^{x} x\, e^{-\left(x^2/y\right)} dy\, dx$. **[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 $\dfrac{M}{6}\left(\dfrac{a^2 b^2}{a^2 + b^2}\right)$ 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 $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} + \dfrac{z^2}{c^2} = 1$. **[7]**

c) Find centre of gravity of the loop of the curve $9x^2 = (2y - 1)(y - 2)^2$. **[6]**

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[5924]-509

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]**
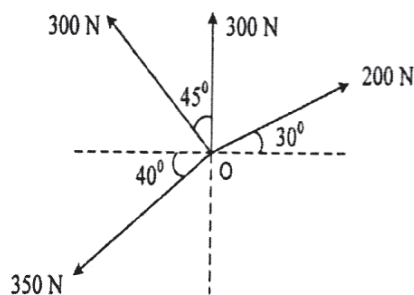

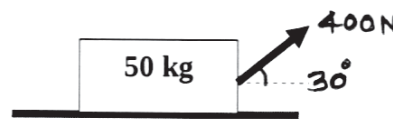**Fig. 1 a**   **Fig. 1b**

    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]**
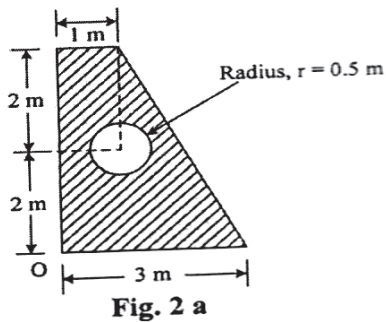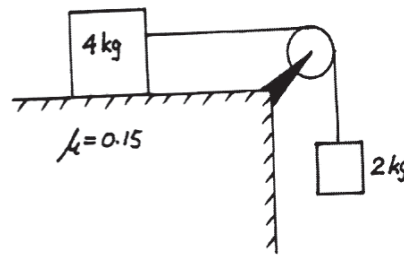

Fig. 2 a

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:
i) The greatest elevation above the ground reached by the projectile;
ii) Horizontal distance from the gun to the point, where the projectile strikes the groud.

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 bean AB of span 7.5 m, as shown in Fig. 3a. Determine the support reactions at hinge B and roller D. **[5]**
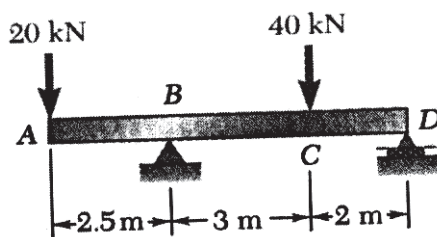

Fig. 3a

b) A square foundation 5 m x 5 m, supports four loads as shown in Fig. 3b. Determine magnitude, direction and point of application of the resultant of four forces. **[6]**
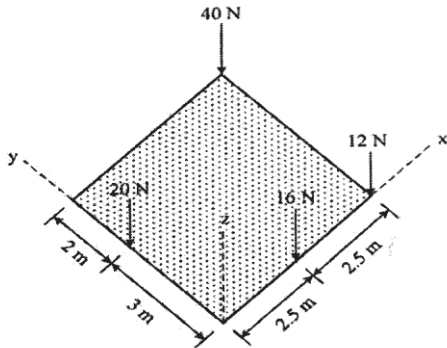
Fig. 3b
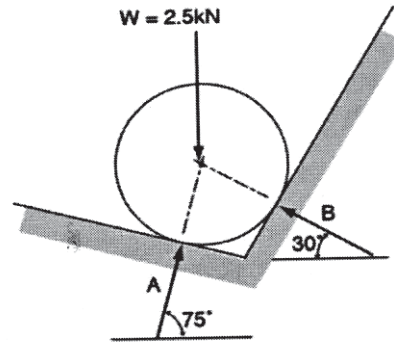
Fig. 3c

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 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]**

Fig. 4a

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]
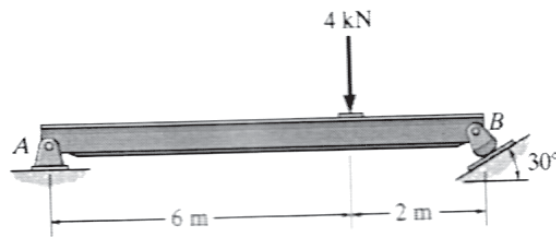
Fig. 4c

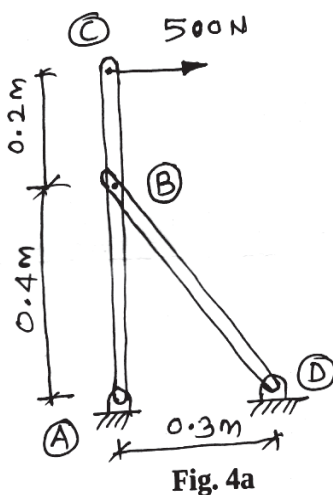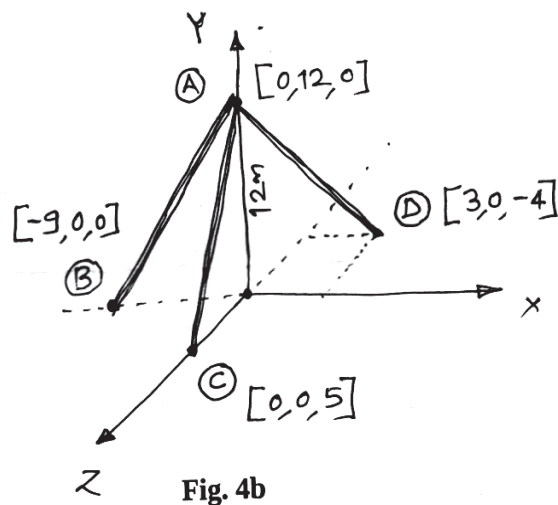**Q5)** a)   Determine the forces in all the members of the truss loaded and supported
as shown in the Fig. 5a. Tabulate the result with magnitude and nature of
force in the members.   **[6]**
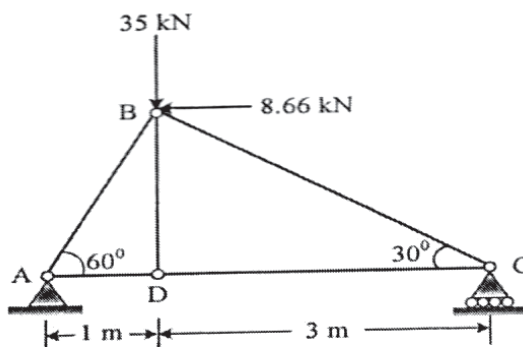
Fig. 5 a
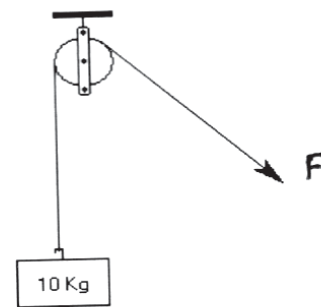
Fig. 5a   Fig. 5b

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 degress. (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]**
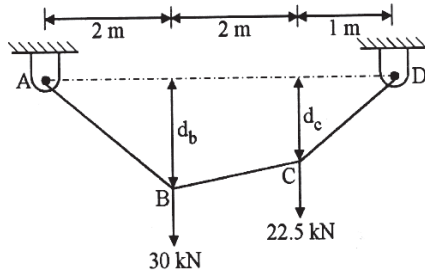
Fig. 6a
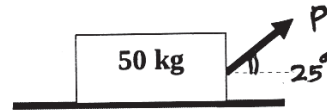
Fig. 6b

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]**

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[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]**

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.

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

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 condenses 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]**

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

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]**

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[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

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]**

<p style="text-align:center">OR</p>

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]**

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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 digram 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 trhough circuit

   iii)   Voltage drop across each element

   iv)   Active power

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

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 100μF is conncted across single phase voltage given by $v = 100 \sin(314t)$ volts. Find **[6]**

     i) Frequency of supply in Hz

     ii) Capacitive reactance

     iii) Equation of current

c) A resistance 20Ω. inductance of 50mH and capacitor of 75μF are connected in series across 230V, variable frequency supply. **[8]**

     Calculate :

     i) The frequency at which resonance will occur

     ii) Current flowing through circuit

     iii) 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 minisie 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 :

     i) Line and phase voltage

     ii) Line and phase current

     iii) Power factor and power factor angle

     iv) Active, reactive power

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

Q4) a) State following statements are true or false with justification. **[3]**

     i) In transformer, as the load current increases, iron losses increase.

     ii) 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]**
  i) Active and passive network
  ii) Linear and non-linear network

b) Find the current following through 2Ω resistance using KVL. (Refer Fig. 5(b) **[6]**
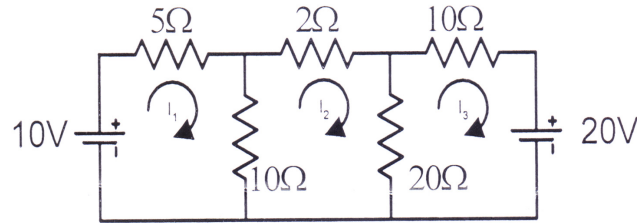
Figure 5b)

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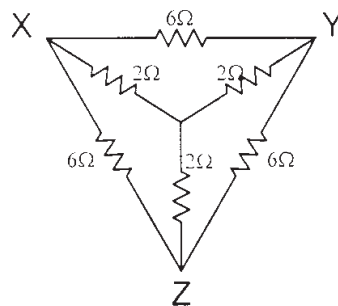

Figure Q5c)

OR

Q6) a) State and explain KCL and KVL. **[4]**

b) i) Three resistance each 60Ω are connected in delta, draw its equivalent star.
  ii) 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]**
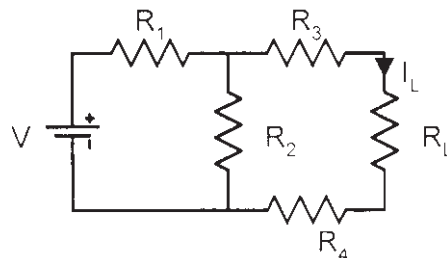
Fig Q6c)

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 battary. **[3]**

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

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

      i) RTC at $20^{o}C$

      ii) Resistance of wire at $50^{o}C$

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

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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 Morgon'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

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]**

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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]**

   a)   Which of the following keyword is used in user defined function header
        in Python?

        i)   define   ii)   def

        iii)   function   iv)   fun

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

        i)   f_name()   ii)   call f_name()

        iii)   return f_name()   iv)   function f_name()

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

        i)   ord()   ii)   chr()

        iii)   input()   iv)   output()

   d)   What is the correct file extension for python files?

        i)   .pt   ii)   .pyt

        iii)   .py   iv)   .cpp

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

        i)   toupper()   ii)   upper()

        iii)   uppercase()   iv)   touppercase()

   f)   Which method is automatically executed when an object of a class is
        created?

        i)   _init_()   ii)   _call_()

        iii)   _repr_()   iv)   _del_()

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]**

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