

Total No. of Questions—8]

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[4756]-101

F.E. (I Sem.) EXAMINATION, 2015

ENGINEERING MATHEMATICS—I

(2012 COURSE)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Attempt *All* questions.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of logarithmic tables, electronic pocket calculator is allowed.

(v) Assume suitable data, if necessary.

1. (A) Find the eigen values and eigen vector corresponding to minimum eigen value for the matrix : [4]

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

P.T.O.

(B) Determine the value for λ for which the equations :

$$3x_1 + 2x_2 + 4x_3 = 3,$$

$$x_1 + x_2 + x_3 = \lambda,$$

$$5x_1 + 4x_2 + 6x_3 = 15,$$

are consistent. Find also the corresponding solution. [4]

(C) If z_1, z_2, z_3 are the vertices of an isosceles triangle right angled at z_2 , prove that : [4]

$$z_1^2 + z_3^2 + 2z_2^2 = 2z_2(z_1 + z_3).$$

Or

2. (A) If [4]

$$2 \cos \theta = x + \frac{1}{x},$$

prove that :

$$2 \cos r\theta = x^r + \frac{1}{x^r}.$$

(B) If $Y = \log \tan x$, prove that : [4]

$$(i) \quad \sinh ny = \frac{1}{2}(\tan^n x - \cot^n x),$$

$$(ii) \quad 2 \cosh ny \operatorname{cosec} 2x = \cosh(n+1)y + \cosh(n-1)y.$$

- (C) Examine for linear dependence or independence for the given vectors and if dependence, find the relation between them : [4]

$$X_1 = (1, -1, 2, 2),$$

$$X_2 = (2, -3, 4, -1),$$

$$X_3 = (-1, 2, -2, 3).$$

3. (A) Test convergence of the series (any one) : [4]

$$(i) \sum_{n=1}^{\infty} \left(\frac{2n+1}{3n+4} \right) 5^n$$

$$(ii) \frac{1}{1+\sqrt{2}} + \frac{2}{1+2\sqrt{3}} + \frac{3}{1+3\sqrt{4}} + \dots$$

- (B) Prove that : [4]

$$\sin x \cosh x = x + \frac{1}{3}x^3 - \frac{1}{30}x^5 - \dots$$

- (C) Find n th derivative of : [4]

$$e^{2x} \sinh 3x \cos 4x.$$

Or

4. (A) Solve any one : [4]

$$(i) \lim_{x \rightarrow a} (x-a)^{(x-a)}$$

$$(ii) \lim_{x \rightarrow \pi/2} (\sec x - \tan x).$$

(B) Using Taylor's theorem, expand :

$$2x^3 + 3x^2 - 8x + 7$$

in powers of $x - 2$. [4]

(C) If $y = e^{\tan^{-1} x}$, then show that : [4]

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

5. Solve any two :

(A) Find the value of n for which : [6]

$$z = A e^{-gx} \sin(nt - gx),$$

satisfies the partial differential equation :

$$\frac{\partial z}{\partial t} = \frac{\partial^2 z}{\partial x^2}.$$

(B) If

$$u = \frac{x^4 + y^4}{x^2 y^2} + x^6 \tan^{-1} \left[\frac{x^2 + y^2}{x^2 + 2xy} \right],$$

find the value of :

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

at $x = 1, y = 2$. [7]

(C) If $z = f(u, v)$ and [6]

$$u = \log(x^2 + y^2), v = \frac{y}{x},$$

show that :

$$x \frac{\partial z}{\partial y} - y \frac{\partial z}{\partial x} = (1 + v^2) \frac{\partial z}{\partial v}.$$

Or

6. Solve any two :

(A) If [6]

$$x = \frac{\cos \theta}{r}, y = \frac{\sin \theta}{r},$$

find the value of :

$$\left(\frac{\partial x}{\partial r}\right)_\theta \left(\frac{\partial r}{\partial x}\right)_y + \left(\frac{\partial y}{\partial r}\right)_\theta \left(\frac{\partial r}{\partial y}\right)_x.$$

(B) If [7]

$$u = \sin^{-1} \sqrt{\frac{x^2 + y^2}{x + y}},$$

show that :

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{1}{4} \tan u [\tan^2 u - 1].$$

(C) If $z = f(u, v)$ and $u = x \cos t - y \sin t$, $v = x \sin t + y \cos t$, where t is a constant, prove that : [6]

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

7. (A) If $u^3 + v^3 = x + y$, $u^2 + v^2 = x^3 + y^3$, find $\frac{\partial(u, v)}{\partial(x, y)}$. [4]

(B) Determine whether the following functions are functionally dependent. If functionally dependent, find the relation between them : [4]

$$u = \sin x + \sin y, v = \sin(x + y).$$

- (C) Examine maxima and minima of the following function and find their extreme values : [5]

$$(x^2 + y^2 + 6x + 12).$$

Or

8. (A) If $x = u + v$, $y = v^2 + w^2$, $z = w^3 + u^3$, show that : [4]

$$\frac{\partial u}{\partial x} = \frac{vw}{vw + u^2}.$$

- (B) If $e^z = \sec x \cos y$ and errors of magnitude h and $-h$ are made in estimating x and y , where x and y are found to be $\frac{\pi}{3}$ and $\frac{\pi}{6}$ respectively, find the corresponding error in z . [5]

- (C) Find the minimum distance from origin to the plane : [4]

$$3x + 2y + z = 12.$$

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[4756]-102

F.E. (First Semester) EXAMINATION, 2015

ENGINEERING CHEMISTRY

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer *All* questions.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(v) Assume suitable data, if necessary.

1. (a) What are 'zeolites' ? Explain zeolite process of softening of water. Give regeneration reactions, advantages and disadvantages of the process. [6]

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

(c) Explain the following terms with suitable example : [3]

(i) Chromophore

(ii) Auxochrome.

P.T.O.

Or

2. (a) Explain the pH metric titration of mixture of H_3PO_4 (phosphoric acid) and HCl (hydrochloric acid) against std. NaOH , giving chemical reactions, procedure, titration curve and calculations. [6]
- (b) Explain any *three* principles of Green Chemistry. [3]
- (c) 50 ml of water sample requires 18 ml of 0.05 MEDTA during titration. Whereas 50 ml of boiled water sample requires 12.5 ml of same EDTA in the titration. Calculate total, temporary and permanent hardness of water sample. [3]
3. (a) What is vulcanization of rubber ? Explain chemical reaction involved in vulcanization process. Compare natural rubber with vulcanized rubber [6]
- (b) Define : [3]
- (i) Cetane no.
- (ii) Power alcohol
- (iii) N.C.V.
- (c) Calculate carbon, hydrogen and sulphur percentage present in the coal sample from the following data : [3]
- (i) 0.15 gm coal sample on burning in combustion chamber in current of pure O_2 was found to increase weight of CaCl_2 U-tube by 0.08 gm. and KOH U-Tube by 0.49 gm.
- (ii) 0.65 gm coal was combusted in Bomb calorimeter. Solution from bomb on treatment with BaCl_2 solution, forms 0.031 gm BaSO_4 dry ppt.

Or

4. (a) What are fuel cells ? Explain working of phosphoric acid fuel cell (PAFC) with figure and cell reactions. State its advantages. [6]
- (b) Explain with suitable diagram bulk polymerization technique to bring about addition polymerization. [3]
- (c) Give structure, properties and applications of polyphenylenevinylene (PPV). [3]
5. (a) What are carbon nanotubes ? Give types with respect to their structure. Give applications of CNTs. [5]
- (b) What are alanates ? Explain how hydrogen gas is released from sodium alanates when used for hydrogen storage. [4]
- (c) Give structure, one method of preparation and applications of silane. [4]

Or

6. (a) Explain industrial production of hydrogen by steam reforming of methane and coke. [5]
- (b) Explain the isotopes of carbon with their applications. [4]
- (c) Explain structure of diamond based on bonding. Give its applications. [4]

7. (a) What is dry corrosion ? Explain mechanism of oxidation corrosion with suitable figure and reactions. [5]
- (b) Explain how nature of metal affects the rate of corrosion. [4]
- (c) What are electroless coatings ? Explain with suitable example. Give its application. [4]

Or

8. (a) Define corrosion. State the conditions under which wet corrosion occurs. Explain oxygen absorption mechanism of wet corrosion. [5]
- (b) Explain cementation and cladding methods of applying metallic coatings on base metal. [4]
- (c) Compare : Cathodic protection and Anodic protection. [4]

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[4756]-103

F.E. (First Semester) EXAMINATION, 2015

BASIC ELECTRONICS ENGINEERING

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Figures to the right indicate full marks.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Use of electronic pocket calculator is allowed.

(iv) Assume suitable data, if necessary.

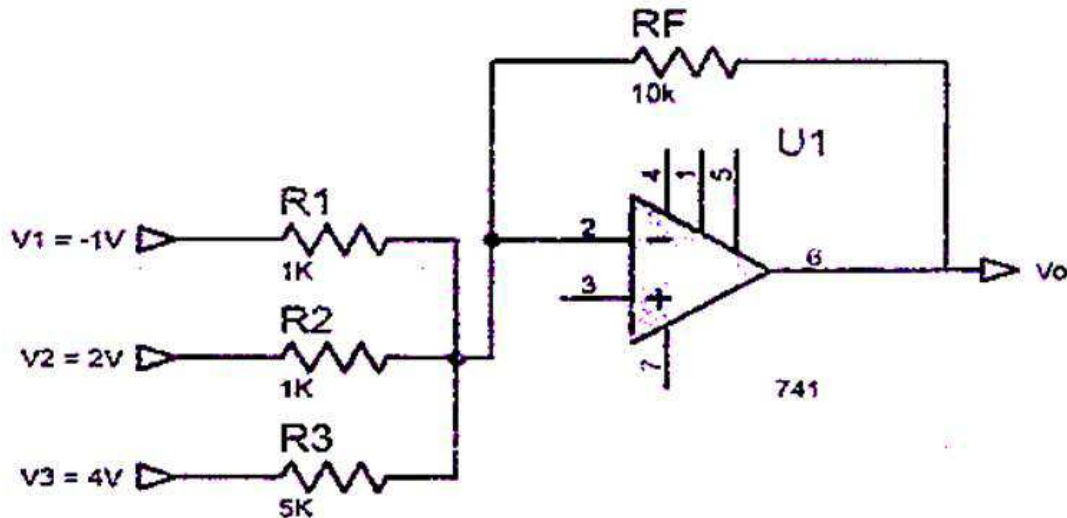
1. (a) Explain the working of positive clamper with its waveforms. [6]
- (b) What is dc load line ? Explain the role of Q-point on dc load line. [6]

Or

2. (a) Explain the working of positive biased shunt clipper with its input and output waveforms. [6]
- (b) Differentiate between CB, CE and CC configurations. [6]

P.T.O.

3. (a) In shown in the following Fig. let $R_1 = R_2 = 1 \text{ k}\Omega$, $R_3 = 5 \text{ k}\Omega$, $R_f = 10 \text{ k}\Omega$, $V_1 = -1\text{V}$, $V_2 = 2\text{V}$ and $V_3 = 4\text{V}$. Calculate V_o . [6]



- (b) State the IC number for the following two input logic gate : [6]
- (i) AND
 - (ii) NAND
 - (iii) OR
 - (iv) NOR
 - (v) EX-OR
 - (vi) NOT.

Or

4. (a) Define the following parameters of op-amp : [6]
- (i) BW
 - (ii) PSRR
 - (iii) CMRR.

- (b) Draw the explain full adder using two half adder with its truth table. [6]
5. (a) With a neat diagram explain the construction and working of LVDT. Give its advantages, disadvantages and applications. [7]
- (b) Draw a neat block diagram of a digital thermometer and explain its operation. [6]

Or

6. (a) Write a short note on Selection criterion for transducers. [7]
- (b) Compare : [6]
- (i) SCR and TRIAC
- (ii) DIAC and TRIAC.
7. (a) Draw and explain the electromagnetic spectrum or IEEE frequency spectrum. List its applications. [7]
- (b) Compare : AM and FM. [6]

Or

8. (a) What is modulation ? Explain AM technique in detail and write AM expression. [7]
- (b) Explain the basic structure of mobile phone system. [6]

Total No. of Questions—8]

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[4756]-104

F.E. (First Semester) EXAMINATION, 2015

BASIC CIVIL AND ENVIRONMENTAL ENGINEERING

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4
and Q. No. 5 or Q. No. 6 and Q. No. 7 or Q. No. 8.

(ii) Figures to the right indicate full marks.

(iii) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(iv) Neat diagrams must be drawn wherever necessary.

(v) Assume suitable data, if necessary.

1. (a) Explain in brief the role of civil engineer in construction of a Hydropower station. [4]
- (b) State comparison between first class bricks and second class bricks. [4]
- (c) Discuss in brief the practical applications of Transportation engineering. [4]

P.T.O.

Or

2. (a) Explain in brief the importance of construction management. [4]
- (b) With the help of a neat sketch differentiate between uniform settlement and differential settlement. [4]
- (c) Comment on a statement “Use of Recycle construction materials is the need of the time”. [4]
3. (a) The following consecutive readings were taken with a level and 4 m levelling staff at a common interval of 30 m. on a sloping ground the readings are 3.250, 2.805, 1.995, 0.655, 3.605, 2.985, 1.535, 0.875, 2.455 and 0.935 the first reading was taken on GTS Bench mark of RL 535.745 m. Calculate the reduced levels of remaining staff stations by Rise and Fall method. Apply usual arithmetic check. [5]
- (b) Write a short note on Hydrological cycle. [3]
- (c) State various methods of carrying out EIA. Explain any *one* in brief. [4]

Or

4. (a) State with a neat sketch any *four* characteristics of contour lines. [4]
- (b) Explain with a neat sketch basic principle of EDM. [4]
- (c) Write a short note on solid waste management. [4]

5. (a) Comment on statement “Privacy and circulation and complementary to each other”. [5]
- (b) Write a short note on Green building. [4]
- (c) Explain with a neat sketch of the following : [4]
- (1) Aspect
- (2) Roominess

Or

6. (a) A plot owner wants to construct a bungalow with G+1 floor, on a plot size of 14 m × 19 m. He proposes 150 m² construction on each floor. Find the ground coverage and FSI consumed, if the side margin is 2 m for all the sides. As per the rules FAR allowed is 1.0. State with reasons whether the plan will be sanctioned or not ? [5]
- (b) What is Roominess ? How is it achieved during planning of building ? [4]
- (c) What is building line ? Why is it necessary ? [4]
7. (a) State the advantages and disadvantages of conventional energy sources. [4]
- (b) State and explain primary and secondary air pollutants. [5]

- (c) What is land pollution ? What are the various sources of land pollution ? [4]

Or

8. (a) Write a short note on Wind energy. [4]
- (b) Explain in brief the mechanism of production of Biogas energy. [5]
- (c) Explain with a neat sketch “Green House Effect”. [4]

Total No. of Questions—8]

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[4756]-105

F.E. (First Semester) EXAMINATION, 2015

ENGINEERING GRAPHICS-I

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4,
Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.

(ii) Figures to the right indicate full marks.

(iii) Assume suitable data if necessary.

(iv) Retain construction lines.

(v) Marks are reserved for dimensioning and good presentation.

1. The TV of a 80 mm long line AB measures 50 mm. The point A is 50 mm in front of VP and 20 mm above HP. The point B is 20 mm in front of VP and is above HP. Draw the projection of line AB and find its inclination with the HP and VP also locate its traces. [12]

P.T.O.

Or

2. A thin rectangular plate of size 70 mm \times 40 mm appears as a square of side 40 mm in TV with one of its side inclined at 30° to VP and parallel to HP. Draw the projection of the plate and determine its inclination with HP. [12]
3. A pentagonal prism of base 30 mm side and axis 60 mm long is resting on a corner of its base on HP with a longer edge containing that corner inclined at 45° to the HP and vertical plane containing that edge and axis inclined at 30° to the VP. Draw its projection. [13]

Or

4. (a) Draw an involute of a circle of 50 mm diameter. [7]
- (b) A right circular cone of a base diameter 50 mm and axis height 60 mm has its base on HP. Draw the development of lateral surface of cone. [6]
5. The following Fig. 1 shows a Cast iron bracket. By using first angle projection method draw : [13]
- (i) Front View

(ii) Top View

(iii) Sectional LHSV along plane X-X.

Give all the dimensions

[13]

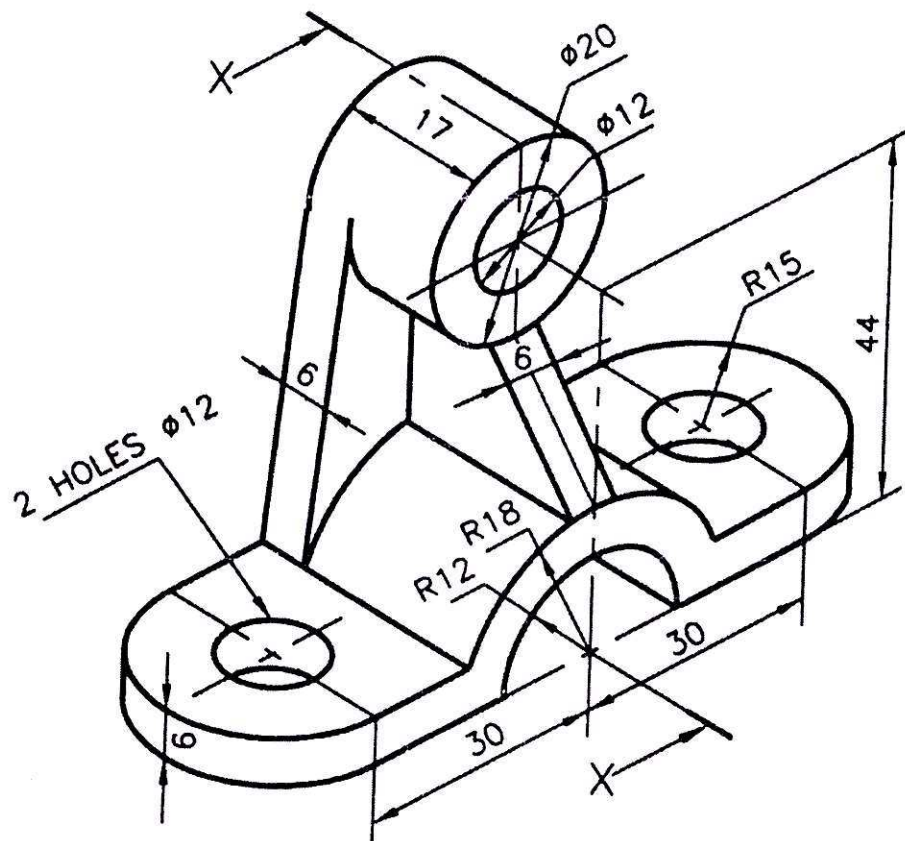


Fig. 1 C.I. Bracket

Or

6. The following Fig. 2 shows a cast iron bracket. By using first angle projection method, draw : [13]

(i) Sectional front view

(ii) Top view

(iii) RHSV

Give all the dimensions

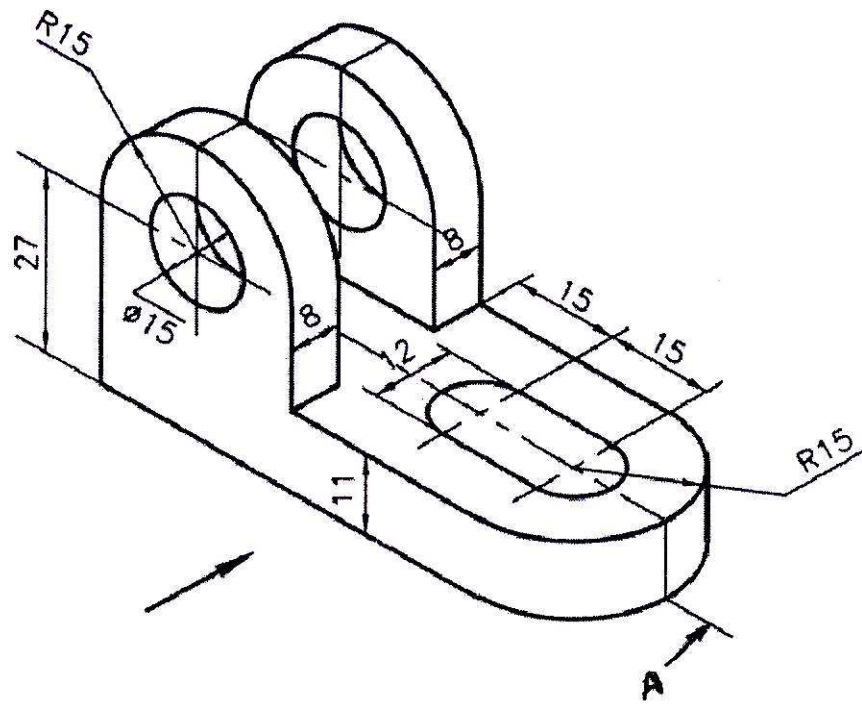


Fig. 2 C.I. Bracket

7. Fig. 3 shows the FV and LHSV of an object. Draw the isometric views using natural scale. [12]

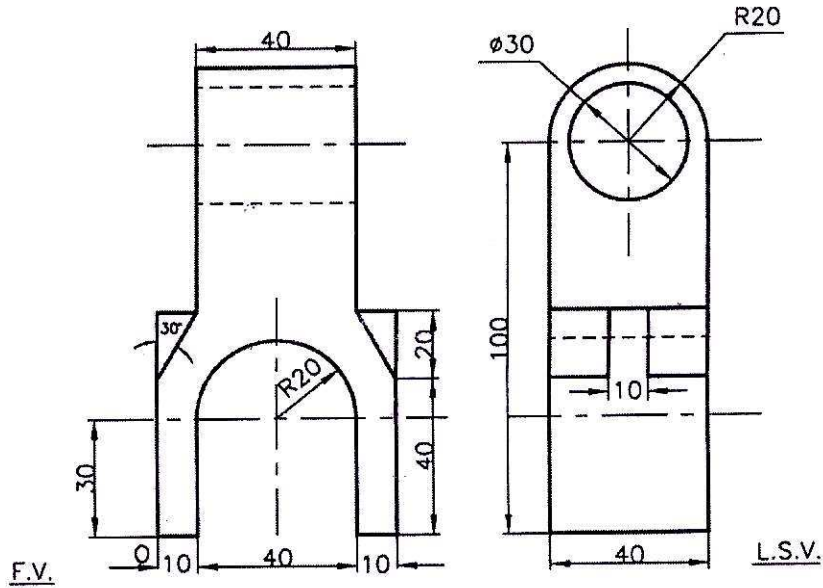


Fig. 3

Or

8. Fig. 4 shows the FV and RHSV of an object. Draw the isometric view using natural scale. [12]

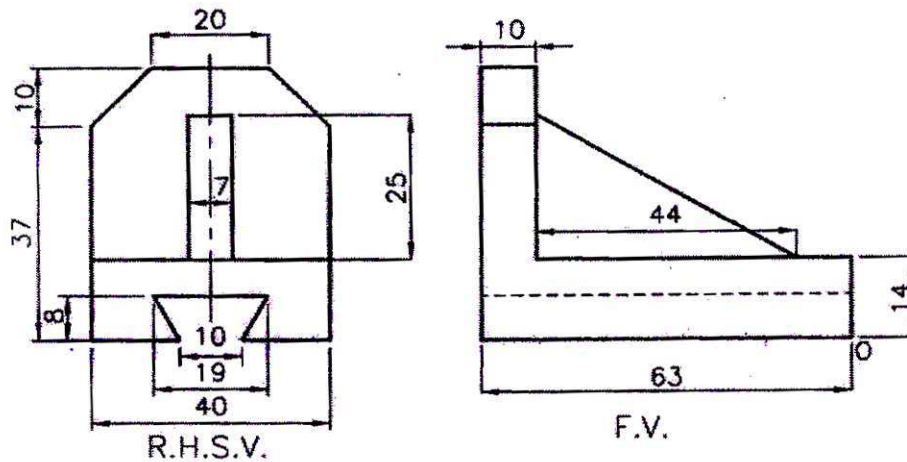


Fig. 4

Total No. of Questions—8]

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[4756]-201

F.E. (Second Semester) EXAMINATION, 2015

ENGINEERING MATHEMATICS-II

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Attempt *four* questions : 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.

(ii) Neat diagrams must be drawn whenever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of electronic non-programmable calculator is allowed.

(v) Assume suitable data whenever necessary.

1. (a) Solve the following differential equations : [8]

(i) $\frac{dy}{dx} = \cos x \cos y + \sin x \sin y$

(ii) $(x^2 + y^2 + 1)dx - 2xy dy = 0$.

(b) In a circuit containing inductance L, resistance R and voltage E, the current I is given by :

$$E = RI + L \frac{dI}{dt}.$$

P.T.O.

Given :

$L = 640 \text{ H}$, $R = 250 \text{ } \Omega$, $E = 500 \text{ Volts}$.

I being zero when $t = 0$. Find the time that elapses before it reaches 80% of its maximum value. [4]

Or

2. (a) Solve : [4]

$$x \frac{dy}{dx} + y = y^2 \log x$$

(b) Solve the following : [8]

(i) A body at temperature 100°C is placed in a room whose temperature is 20°C and cools to 60°C in 5 minutes. Find its temperature after a further interval of 3 minutes.

(ii) A steam pipe 20 cm in diameter is protected with a covering 6 cm thick for which the coefficient of thermal conductivity is $k = 0.003 \text{ cal/cm deg. sec}$ in steady state. Find the heat lost per hour through a meter length of the pipe, if the surface of pipe is at 200°C and outer surface of the covering is at 30°C .

3. (a) Find a half range cosine series of $f(x) = \pi x - x^2$ in the interval $0 < x < \pi$. [5]

- (b) Evaluate : [3]

$$\int_0^{\infty} \frac{x^3}{3^x} dx.$$

- (c) Trace the following curve (any one) : [4]

(i) $y^2 = x^5 (2a - x)$

(ii) $r = a \sin 2\theta$.

Or

4. (a) If [4]

$$I_n = \int_{\pi/4}^{\pi/2} \cot^n \theta d\theta$$

prove that $I_n = \frac{1}{n-1} - I_{n-2}$. Hence evaluate I_3 .

- (b) Using differentiation under Integral sign prove that : [4]

$$\int_0^{\infty} \frac{e^{-x} - e^{-ax}}{x \sec x} dx = \frac{1}{2} \log \left(\frac{a^2 + 1}{2} \right)$$

for $a > 0$

- (c) Find the length of the curve [4]

$$x = a(\theta - \sin \theta), y = a(1 - \cos \theta)$$

between $\theta = 0$ to $\theta = 2\pi$.

5. (a) Show that the plane $4x - 3y + 6z - 35 = 0$ is tangential to the sphere $x^2 + y^2 + z^2 - y - 2z - 14 = 0$ and find the point of contact. [5]

(b) Find the equation of the right circular cone whose vertex is given by $(1, -1, 2)$ and axis is the line $\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-2}{-2}$ and semi-vertical angle is 45° . [4]

(c) Find the equation of right circular cylinder of radius 2 and axis is given by : [4]

$$\frac{x-1}{2} = \frac{y-2}{-3} = \frac{z-3}{6}$$

Or

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

(b) Find the equation of right circular cone with vertex at origin making equal angles with the co-ordinate axes and having generator with direction cosines proportional to 1, -2, 2. [4]

- (c) Obtain the equation of the right circular cylinder of radius 5
where axis is : [4]

$$\frac{x - 2}{3} = \frac{y - 3}{1} = \frac{z + 1}{1}.$$

7. Attempt any *two* of the following :

- (a) Change the order of integration in the double integral : [6]

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

- (b) Evaluate : [7]

$$\int_0^2 \int_0^x \int_0^{2x+2y} e^{x+y+z} dx dy dz$$

- (c) Find the centroid of the loop of the curve : [6]

$$r^2 = a^2 \cos 2\theta.$$

Or

8. Attempt any *two* of the following :

- (a) Evaluate : [6]

$$\int_0^a \int_0^{\sqrt{a^2 - x^2}} e^{-x^2 - y^2} dx dy.$$

(b) Evaluate : [6]

$$\iiint \sqrt{1 - \frac{x^2}{a^2} - \frac{y^2}{b^2} - \frac{z^2}{c^2}} \, dx \, dy \, dz$$

throughout the volume of ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.

(c) Prove that the moment of inertia of the area included between the curves $y^2 = 4ax$ and $x^2 = 4ay$ about x -axis is $\frac{144}{35}Ma^2$, where M is the mass of the area included between the curves. [7]

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[4756]-202

F.E. (Second Semester) EXAMINATION, 2015

ENGINEERING MECHANICS

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

- N.B. :—** (i) Attempt Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6,
- (ii) Answers should be written in single answer-book.
- (iii) Neat diagram must be drawn wherever necessary.
- (iv) Figures to the right indicate full marks.
- (v) Assume suitable data, if necessary and clearly state.
- (vi) Use of cell phone is prohibited in the examination hall.

1. (a) Combine the two forces 800 N and 600 N, which act on the fixed dam structure at B, into a single equivalent force R if $AC = 3$ m, $BC = 6$ m and angle $BCD = 60^\circ$. Refer Fig. 1(a) : [4]

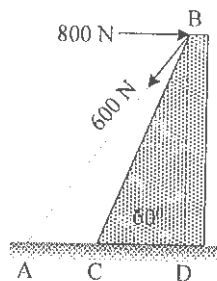


Fig. 1(a)

P.T.O.

- (b) A 50 kg crate shown in Fig. 1(b) rests on a horizontal plane for which the coefficient of kinetic friction is $\mu_k = 0.3$. If the crate does not tip over when it is subjected to a 400 N towing force as shown, determine the velocity of the crate in 5 s starting from rest. [4]

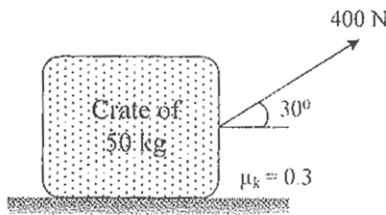


Fig. 1(b)

- (c) A projectile is fired from the edge of a 150 m cliff with an initial velocity of 180 m/s at an angle of 30° with the horizontal. Neglecting air resistance, find the horizontal distance from the gun to the point, where the projectile strikes the ground and the greatest elevation above the ground reached by the projectile. Refer Fig. 1 (c) [4]

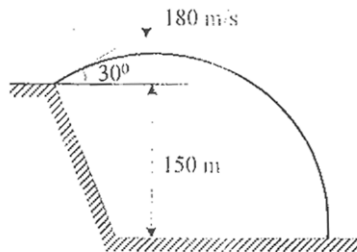


Fig. 1(c)

- (d) A 2 kg stone is dropped from a height h and strikes the ground with a velocity of 24 m/s. Find the kinetic energy of the stone as it strikes the ground and the height h from which it was dropped. [4]

Or

2. (a) Determine the x coordinates of the centroid with respect to the origin O of the shaded area as shown in Fig. 2(a) : [4]

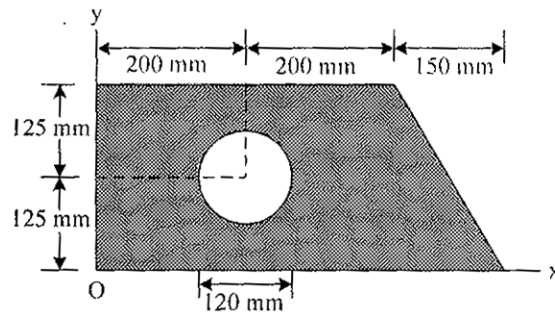


Fig. 2(a)

- (b) A car comes to complete stop from an initial speed of 50 kmph in a distance of 100 m. With the same constant acceleration, what would be the stopping distance s from an initial speed of 70 kmph. [4]

(c) If the crest of the hill has a radius of curvature $\rho = 60 \text{ m}$, determine the maximum constant speed at which the car of weight 17.5 kN can travel over it without leaving the surface of the road. [4]

(d) A 1.5 kg collar is attached to a spring and slides without friction along a circular rod in a horizontal plane. The spring has an undeformed length of 150 mm and a constant $k = 400 \text{ N/m}$. Knowing that the collar is in equilibrium at A and is given a slight push to get moving, determine the velocity of the collar as it passes point B. Refer 2(d) : [4]

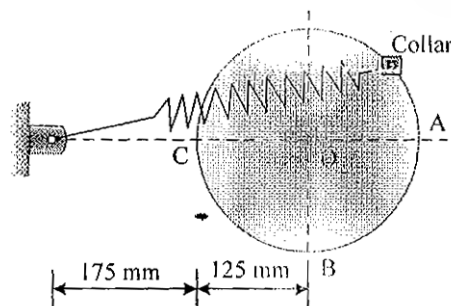


Fig. 2(d)

3. (a) Determine the resultant of the parallel force system which act on the plate as shown in Fig. 3(a) : [6]

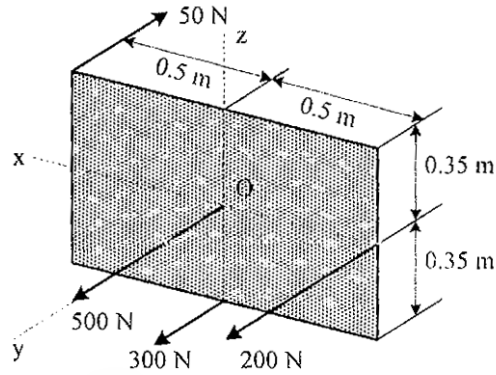


Fig. 3 (a)

- (b) The boom is intended to support two vertical loads F_1 and F_2 as shown in Fig. 3(b). If the cable CB can sustain a maximum load of 1500 N before it fails. Determine the critical loads if $F_1 = 2F_2$. Also determine the reaction at pin support A. [6]

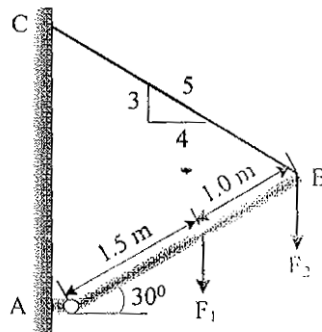


Fig. 3(b)

- (c) Determine the support reaction of the beam loaded and supported as shown in Fig. 3(c) : [5]

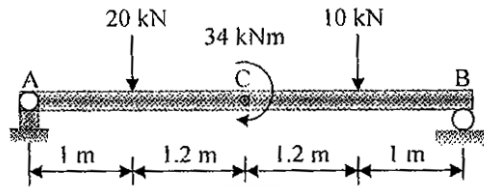


Fig. 3(c)

Or

4. (a) The square steel plate has a mass of 1500 kg with mass center at its center G. Calculate the tension in each of the three cables with which the plate is lifted while remaining horizontal.

Refer Fig. 4 (a). [6]

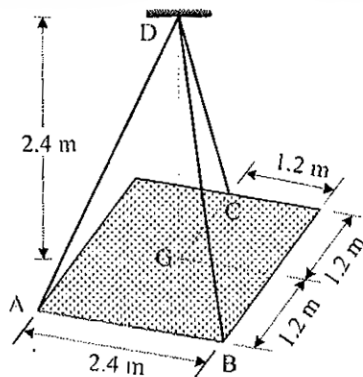


Fig. 4(a)

- (b) The 20 kg homogeneous smooth sphere rests on the two inclines as shown in Fig. (b). Determine the contact forces at A and B. [6]

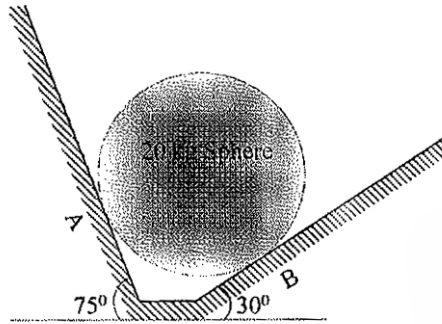


Fig. 4(b)

- (c) A beam supports a load varying uniformly from an intensity of w_1 kN/m at left end to w_2 kN/m at the right end as shown in Fig. 4(c). If the reactions $R_L = 6$ kN and $R_R = 12$ kN, determine the intensity of loading w_1 and w_2 : [5]

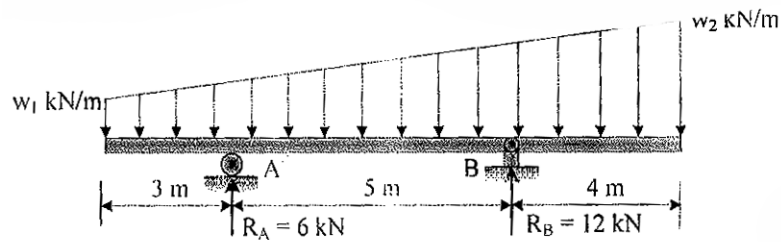


Fig. 4(c)

5. (a) Determine the force in members FE, FC and BC of the truss using method of sections and state if the members are in tension or compression. Given $P_1 = 2.22$ kN and $P_2 = 6.66$ kN. Refer Fig. 5 (a). [6]

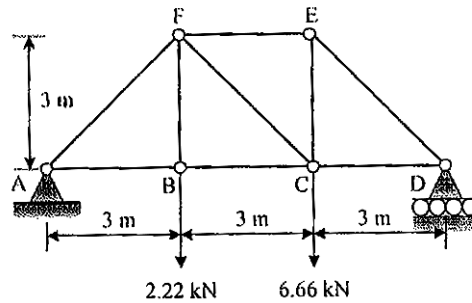


Fig. 5 (a)

- (b) Cable ABCD supports the 4 kN and 6 kN loads at points B and C as shown in Fig. 5 (b). Determine the maximum tension in cable and the sag of point B. [5]

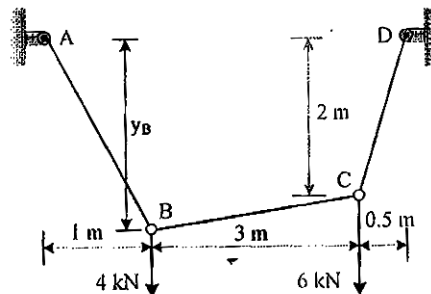


Fig. 5 (b)

- (c) Determine the distance 's' to which the 90 kg man can climb without causing the 4 m ladder to slip at its lower end. The top of the 15 kg ladder has a small roller and at the ground the coefficient of static friction is $\mu_s = 0.25$. The mass centre of the man is directly above his feet. [6]

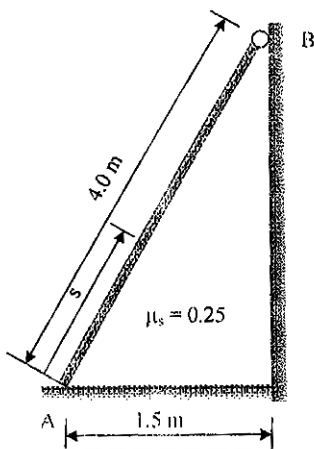


Fig. 5 (c)

Or

6. (a) Determine the horizontal force P needed to just start moving the 300 N crate up the plane as shown in Fig. 6 (a). Take $\mu_s = 0.1$. [6]

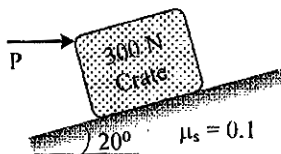


Fig. 6 (a)

- (b) Determine the minimum coefficient of static friction between the rope and the fixed shaft as shown in Fig. 6 (b) will prevent the unbalanced cylinder from moving. [5]

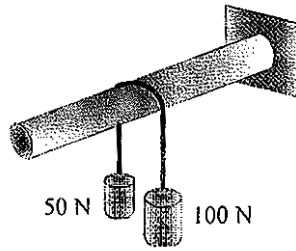


Fig. 6 (b)

- (c) Determine the reactions at the internal hinge C for the frame loaded and supported as shown in Fig. 6 (c). [6]

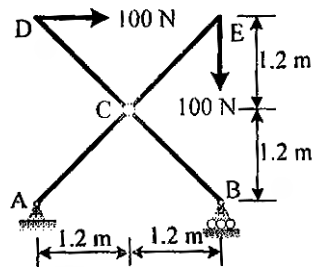


Fig. 6 (c)

Total No. of Questions—8]

[Total No. of Printed Pages—4+1

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[4756]-203

F.E. (Second Semester) EXAMINATION, 2015

BASIC MECHANICAL ENGINEERING

(2012 Pattern)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Attempt *four* questions out of eight. 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.

(ii) Figures to the right indicate full marks.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Use of non-programmable electronic calculator is permitted.

(v) Assume suitable data, if necessary.

1. (a) Explain the following machine elements : [4]

(1) Axle and Shaft

(2) Open belt drive and Cross belt drive.

(b) Differentiate between mechanism and machine. [4]

P.T.O.

- (c) How engineering materials are classified ? Write a short note on plain carbon steel. [4]

Or

2. (a) Explain working of disc brake with schematic (simple) sketch. [4]
- (b) Differentiate between V-belt drive and Gear drive. [4]
- (c) Explain any *four* mechanical properties of engineering material. [4]
3. (a) Identify and explain suitable process to join two copper tubes. [4]
- (b) Draw self-explanatory sketches of any *four* sheet metal cutting process. [4]
- (c) Explain boring operation performed on lathe machine and radial drilling machine. [4]

Or

4. (a) Draw neat sketch of sand casting process setup. State advantages, limitations and engineering applications of the process. [6]
- (b) Explain taper turning, parting and knurling operation performed on lathe machine. [6]

5. (a) Explain the following terms : [4]

(1) Zeroth law of thermodynamics

(2) Intensive properties

(3) Open system

(4) Heat Engine

(b) Explain measurement of pressure using simple U-tube manometer. [4]

(c) A refrigeration system is used to maintain a cold storage at 4 degree C. The heat leakage from surrounding into the cold storage is estimated to be 1800 kJ/min. If COP of the refrigeration system is 1.5. Find : [5]

(1) The amount of heat rejected to the surrounding and

(2) Power required to drive the refrigeration system

Draw the sketch of system.

Or

6. (a) The pressure of gas flowing through a pipe is to be measured with simple U-tube mercury manometer. Left arm of the U-tube is connected to gas pipe while right arm is open to atmosphere.

Calculate the absolute pressure to the gas when the level of mercury, in the arm open to atmosphere is : [6]

Case A) 300 mm higher than the level of mercury in left arm and

Case B) 200 mm lower than the level of mercury in left arm.

Draw sketch of the system for Case A) and Case B).

Given : Atmospheric pressure = 10 m of water column

Acceleration due to gravity = 9.81 m/sec^2

Density of mercury = 13600 kg/m^3

- (b) Explain “Kelvin-Planck and Clausius” statement of second law of thermodynamics. [4]
- (c) Draw a sketch of Heat Pump and Refrigerator using Heat source and Sink concept. [3]

Prove that : $(\text{COP})_{\text{Heat Pump}} = 1 + (\text{COP})_{\text{Refrigerator}}$

- 7. (a) Draw a layout of solar power plant. State the limitations of the plant. [4]
- (b) Differentiate between impulse and Reaction turbine (4 points). [4]
- (c) What do you mean by refrigeration ? Draw a neat sketch of vapour compression refrigeration system and state its application. [5]

Or

8. (a) Draw a layout of hydro-electric power plant and explain the energy extraction (energy conversion) process. [4]
- (b) Differentiate two-stroke and four-stroke cycle engine (4 points). [4]
- (c) What do you mean by air-conditioning ? Draw a neat sketch of window air-conditioning system. Show the direction of hot & cool air-flow. [5]

Total No. of Questions—8]

[Total No. of Printed Pages—4

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[4756]-204

F.E. (Second Semester) EXAMINATION, 2015

ENGINEERING PHYSICS

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

- N.B. :—**
- (i) Neat diagrams must be drawn wherever necessary.
 - (ii) Figures to the right indicate full marks.
 - (iii) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
 - (iv) Assume suitable data, if necessary.

Constants : $h = 6.63 \times 10^{-34}$ J.sec

$$c = 3 \times 10^8 \text{ m/s}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg.}$$

$$m_p = 1.67 \times 10^{-27} \text{ kg.}$$

1. (a) Derive an equation for path difference in reflected light when monochromatic light falls on the uniform thickness film and hence state the conditions for maxima and minima. [6]

P.T.O.

- (b) State any *two* factors affecting the acoustics of a hall and explain in brief remedies on that. [3]
- (c) Calculate the reverberation time of hall with volume of 1500 m^3 and total absorption is equivalent to 100 m^2 Sabine. [3]

Or

2. (a) What is Piezoelectric effect ? Draw a neat circuit diagram and explain Piezoelectric generator for the production of ultrasonic waves. [6]
 - (b) Explain the formation of Newton's rings in the laboratory. [3]
 - (c) A laser light of wavelength 6328 \AA falls normally on a grating which is 2 cm long. The first order spectrum is observed at an angle of 20° . Find the total number of slits on grating. [3]
3. (a) Explain with neat labeled diagram construction and working of Ruby laser. [6]
 - (b) What is Fermi level ? Show the position of Fermi level in P-type semiconductor at temperature $T = 0 \text{ K}$ and $T > 0 \text{ K}$. [3]
 - (c) Calculate the number of acceptors to be added to a germanium sample to obtain the resistivity of $10 \text{ } \Omega \text{ cm}$. [3]
($\mu = 1700 \text{ cm}^2/\text{V}\cdot\text{sec}$.)

Or

4. (a) What is Hall effect ? Derive the equation of Hall voltage. [6]
(b) State and prove Law of Malus. [3]
(c) A retardation plate of thickness 2.275×10^{-3} cm is cut with its faces parallel to optic axis. If the emergent beam of light is elliptically polarized. Find the wavelength of monochromatic light made incident normally on the plate. Given that, $\mu_o = 1.586$ $\mu_e = 1.592$. [3]
5. (a) State and explain Heisenberg's Uncertainty principle. Illustrate the same with electron diffraction at a single slit. [6]
(b) What is wave function ψ ? Give the physical significance of it. [4]
(c) An electron is trapped in a rigid box of width 2 A.U. Find its lowest energy in eV. [3]

Or

6. (a) Deduce Schrödinger's time independent wave equation. [6]
(b) Define phase velocity and prove that it is always greater than velocity of light. [4]
(c) Calculate the de Broglie wavelength of proton when it is accelerated by potential difference of 10 kV. [3]

7. (a) State and explain Meissner effect and hence show that superconductivity is influenced by perfect diamagnetism. [6]
- (b) Explain how colloids are synthesized by the chemical route. [4]
- (c) Discuss applications of nanotechnology in medical field. [3]

Or

8. (a) Explain any *two* properties of nanoparticle. [6]
- (b) Distinguish between type-I and type-II superconductors. [4]
- (c) State any *six* applications of superconductivity. [3]

Total No. of Questions—8]

[Total No. of Printed Pages—4+1

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[4756]-205

F.E. (First and Second Semester) EXAMINATION, 2015

BASIC ELECTRICAL ENGINEERING

(2012 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Attempt Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8.

(ii) Figures to the right indicate full marks.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Use of non-programmable pocket size scientific calculators is permitted.

(v) Assume suitable data, if necessary.

1. (a) If a coil of 150 turns is linked with a flux of 0.01 Wb when carrying a current of 10 A, then calculate the induced emf : [6]

(i) if this current is uniformly reversed in 0.1 second.

(ii) if this current is interrupted in 0.05 second.

(b) Define insulation resistance and obtain an expression for insulation resistance of a single core cable. [6]

P.T.O.

Or

2. (a) Explain what do you mean by statically induced EMF and dynamically induced EMF. [6]
- (b) A coil of insulated copper wire has a resistance of $150\ \Omega$ at 20°C . When the coil is connected across a $240\ \text{V}$ supply, the current after several hours is $1.25\ \text{A}$. Calculate the temperature of the coil, assuming the temp. co-efficient of resistance of copper at 20°C to be 0.0039 per $^\circ\text{C}$. [6]
3. (a) Derive an EMF equation of 1-ph transformer. [6]
- (b) Derive an expression for instantaneous current and power consumed when voltage of $V = V_m \sin(\omega t)$ is applied to pure inductance alone. Also draw the phasor diagram. [6]

Or

4. (a) A single phase $4\ \text{kVA}$ transformer has 400 turns on its primary and 1000 secondary turns. The net cross-sectional area of the core is $60\ \text{cm}^2$. When the primary winding is connected to $500\ \text{V}$, $50\ \text{Hz}$ supply, calculate : [6]
- (i) the max. value of flux density in the core
- (ii) the voltage induced in the secondary winding and
- (iii) the secondary full load current.

(b) The expression of the alternating current is given by

$$i = 5.48 \sin \omega t : \quad [6]$$

Calculate :

(i) the average value

(ii) rms value of the current

(iii) power consumed if the current is passed through a resistance of $10 \, \Omega$.

5. (a) What is admittance of an AC circuit ? What are its *two* components ? State units of these quantities. How the admittance is expressed in rectangular and polar form ? [6]

(b) An impedance $Z_1 = (100 + j0) \, \Omega$ is connected in series with another impedance $Z_2 = (50 + j80) \, \Omega$. The circuit is connected to a single phase 230 V, 50 Hz supply. Calculate : [7]

(i) current drawn by the circuit

(ii) power consumed by whole circuit

(iii) circuit power factor.

Or

6. (a) Draw and explain phasor diagram of an RLC series circuit, when : [7]
- (1) $X_C > X_L$
 - (2) $X_C < X_L$
 - (3) $X_C = X_L$
- (b) A delta connected balanced load across a 400 V 3-phase supply consist of three identical impedances, each equal to $(15 + j12) \Omega$. Find the line current, active power and reactive power. [6]
7. (a) State and explain superposition theorem. [6]
- (b) Using Kirchhoff's Law, determine the current flowing through 6Ω resistance. [7]

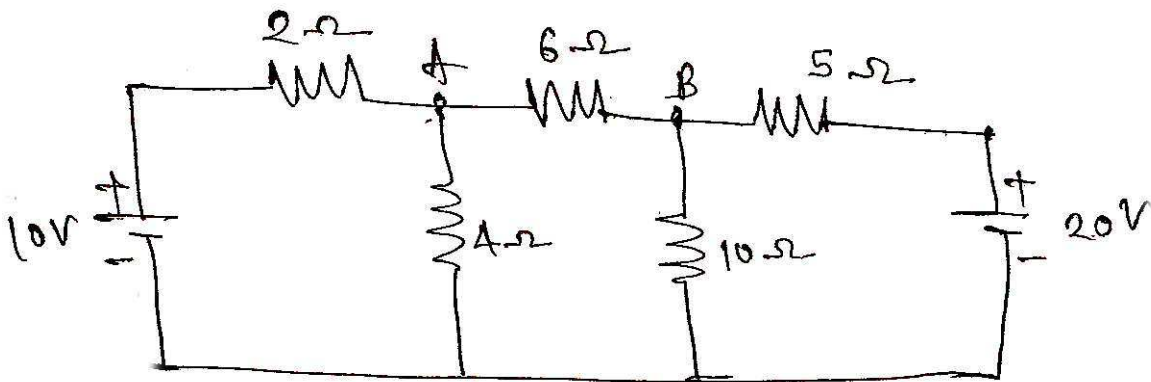


Fig. 1

Or

8. (a) Derive the expressions to convert delta connected resistances into equivalent star circuit. [6]
- (b) Using Thevenin's Theorem, determine the value of current flowing through $6\ \Omega$ resistance. [7]

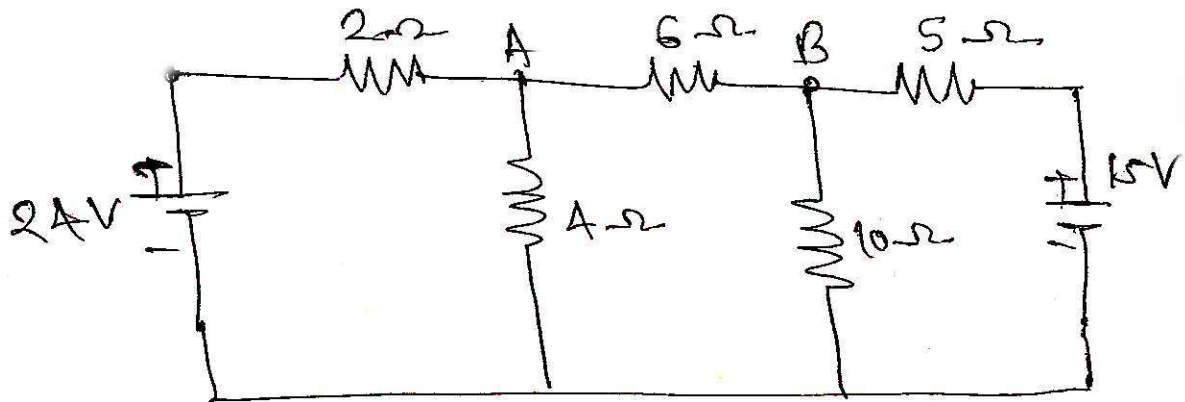


Fig. 2