

Total No. of Questions—12]

[Total No. of Printed Pages—7

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[4756]-11

**F.E. (First Semester) EXAMINATION, 2015**

**ENGINEERING MATHEMATICS-I**

**(2008 PATTERN)**

**Time : Three Hours**

**Maximum Marks : 100**

**N.B. :—** (i) Answer *three* questions from Section I and *three* questions from Section II.

(ii) Answers to the two Sections should be written in separate answer-books.

(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.

**SECTION I**

1. (A) Reduce the following matrix A to its normal form and hence find its rank, where [5]

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

P.T.O.

- (B) Is the following system of equations consistent ? If so solve it : [6]

$$x + y + z = 6$$

$$x - y + 2z = 5$$

$$3x + y + z = 8$$

$$2x - 2y + 3z = 7$$

- (C) Verify Cayley-Hamilton theorem for the matrix : [7]

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

*Or*

2. (A) Find Eigenvalues and corresponding Eigenvectors for the matrix : [7]

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

- (B) Examine whether the following vectors are linearly dependent.

If so find the relation between them : [5]

$$\bar{X}_1 = (3, 1, -4), \bar{X}_2 = (2, 2, -3), \bar{X}_3 = (0, -4, 1).$$

(C) Show that :

$$A = \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix}$$

is an orthogonal matrix. [6]

3. (A) If  $Z_1$  and  $Z_2$  are two complex numbers such that :

$$|Z_1 + Z_2| = |Z_1 - Z_2|, \text{ then show that } \text{amp} \left( \frac{Z_1}{Z_2} \right) = \frac{\pi}{2}. \quad [6]$$

(B) Find the continued product of the four values of  $\left( \frac{1}{2} + i \frac{\sqrt{3}}{2} \right)^{1/4}$ . [5]

(C) If  $p \log(a + ib) = (x + iy) \log m$ , prove that : [5]

$$\frac{y}{x} = \frac{2 \tan^{-1} \frac{b}{a}}{\log(a^2 + b^2)}.$$

*Or*

4. (A) If  $y = \log \tan \left( \frac{\pi}{4} + \frac{x}{2} \right)$ , prove that : [5]

$$(i) \quad \tanh \frac{y}{2} = \tan \frac{x}{2}$$

$$(ii) \cosh y \cos x = 1.$$

$$(B) \text{ If } \sin(\alpha + i\beta) = x + iy, \text{ prove that :} \quad [5]$$

$$(i) \frac{x^2}{\cosh^2 \beta} + \frac{y^2}{\sinh^2 \beta} = 1$$

$$(ii) \frac{x^2}{\sin^2 \alpha} - \frac{y^2}{\cos^2 \alpha} = 1.$$

$$(C) \text{ A square lies above the real axis in Argand diagram, and two of its adjacent vertices are origin and the point } 5 + 6i. \text{ Find the complex numbers representing other vertices.} \quad [6]$$

$$5. (A) \text{ Find } n\text{th derivative of } y = x^2 e^x \cos x. \quad [5]$$

$$(B) \text{ If } y = A \cos(\log x) + B \sin(\log x) \text{ then show that}$$

$$x^2 y_{n+2} + (2n + 1)x y_{n+1} + (n^2 + 1)y_n = 0. \quad [5]$$

$$(C) \text{ Test convergence of the series (any one) :} \quad [6]$$

$$(i) \sum_{n=1}^{\infty} \frac{2n+1}{n^3+1} x^n$$

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

*Or*

$$6. (A) \text{ If } y = \sin^{-1}(3x - 4x^3), \text{ prove that :} \quad [5]$$

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

(B) If

$$y = \frac{x}{(x-1)(x-2)(x-3)}$$

find  $n$ th order differential coefficient of  $y$  w.r.t.  $x$ . [5]

(C) Test convergence of the series (any one) : [6]

(i)  $\frac{2}{1} + \frac{3}{8} + \frac{4}{27} + \frac{5}{64} \dots + \frac{n+1}{n^3} \dots$

(ii)  $\frac{x}{1.2} + \frac{x^2}{3.4} + \frac{x^3}{5.6} + \frac{x^4}{7.8} + \dots$

## SECTION II

7. (A) Expand  $\sqrt{1 + \sin x}$  upto  $x^6$ . [5]

(B) Expand  $2x^3 + 7x^2 + x - 6$  in powers of  $(x - 2)$ . [5]

(C) Solve (any one) : [6]

(a) If  $\lim_{x \rightarrow 0} \frac{\sin 2x + p \sin x}{x^3}$  is finite, then find the value of

$p$  and hence the value of the limit.

(b) Evaluate :

$$\lim_{x \rightarrow 0} \left( \frac{1}{x} \right)^{2 \sin x}.$$

Or

8. (A) Expand  $\tan^{-1} x$  in ascending powers of  $x$ . [5]

(B) Using Taylor's theorem, express  $(x - 2)^4 - 3(x - 2)^3 + 4(x - 2)^2 + 5$  in powers of  $x$ . [5]

- (C) Solve (any *one*) : [6]  
 (a) Evaluate

$$\lim_{x \rightarrow 1} \left[ \frac{x}{x-1} - \frac{1}{\log x} \right].$$

- (b) Evaluate

$$\lim_{x \rightarrow 0} \frac{1 - x^x}{x \log x}.$$

9. Solve (any *two*) : [16]

- (A) If  $u = \log(x^3 + y^3 - x^2y - xy^2)$ , prove that :

$$\left( \frac{\partial}{\partial x} + \frac{\partial}{\partial y} \right)^2 u = \frac{-4}{(x+y)^2}.$$

- (B) If

$$x = \frac{x}{2}(e^\theta + e^{-\theta}), y = \frac{r}{2}(e^\theta - e^{-\theta}),$$

then show that :

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

- (C) Verify Euler's theorem for homogeneous function  
 $u = \sqrt{x} + \sqrt{y} + \sqrt{z}.$

*Or*

10. Solve (any *two*) : [16]

- (A) If

$$V = \frac{C}{\sqrt{t}} e^{-x^2/4a^2t}$$

then show that :

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

(B) If

$$u = \sin^{-1} \left( \frac{x+y}{\sqrt{x} + \sqrt{y}} \right),$$

show that :

$$2x \frac{\partial u}{\partial x} + 2y \frac{\partial u}{\partial y} = \tan u.$$

(C) If

$$u = f(x^2 - y^2, y^2 - z^2, z^2 - x^2),$$

prove that :

$$\frac{1}{x} \frac{\partial u}{\partial x} + \frac{1}{y} \frac{\partial u}{\partial y} + \frac{1}{z} \frac{\partial u}{\partial z} = 0.$$

11. (A) Find the percentage error in the area of an ellipse when an error of 1% is made in measuring its major and minor axis. [6]

- (B) If  $x + y + z = u$ ,  $y + z = uv$ ,  $z = uvw$ , find [6]

$$\frac{\partial(x, y, z)}{\partial(u, v, w)}.$$

- (C) Determine the points where the function  $x^3 + y^3 - 3axy$  has maximum or minimum values. [6]

Or

12. (A) Verify  $JJ' = 1$  for  $x = e^u \cos v$ ,  $y = e^u \sin v$ . [6]

- (B) Examine for functional dependence/independence. If dependent, find relation between them : [6]

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

- (C) Use Lagrange's method to find the minimum distance from origin to the plane  $3x + 2y + z = 12$ . [6]

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[4756]-12

F.E. (First Semester) EXAMINATION, 2015

APPLIED SCIENCE-I

(Chemistry)

(2008 PATTERN)

Time : Two Hours

Maximum Marks : 50

**N.B. :**— (i) Answer *three* questions in all.

(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 seven basic crystal systems ? Give the characteristics of each system with examples. [7]
- (b) Determine total number of elements of symmetry for a cubic crystal system giving suitable diagrams. [6]
- (c) What is radius ratio ? Determine radius ratio for CN = 4. [4]

P.T.O.



*Or*

2. (a) Define liquid crystals. Give different types and their applications. [7]
- (b) (i) Distinguish between Frenkel and Schottky defects. [3]
- (ii) Write a note on fullerenes. [3]
- (c) Explain applications of ZnS as luminescent. [4]
3. (a) Explain the titration curve for strong acid-strong base titration and mention suitable indicators for the same. [7]
- (b) What is Mohr's method for precipitation titration ? Give its procedure and formula for calculation of chloride content of given water sample. [6]
- (c) Calculate morality and normality of a solution of 0.5 g NaOH dissolved in 500 ml water. [4]

*Or*

4. (a) Explain complexometric titration with suitable example. [7]
- (b) Calculate the pH at different stages in titration of weak acid-strong base. [6]
- (c) Calculate equivalent weight of  $\text{KMnO}_4$  in acidic medium. [4]
- [At.wt K = 39, Mn = 55, O = 16]

5. (a) Explain Addition polymerization mechanism on the basis of free radical with example. [6]
- (b) Give polymerization reaction, properties and uses of the following polymers : [6]
- (i) S.B.R.
- (ii) Polystyrene.
- (c) Write a note on any *one* : [4]
- (i) Biodegradable polymers
- (ii) Conducting polymers.

*Or*

6. (a) State the drawbacks of Natural Rubber. Explain how they are overcome by vulcanization, with the help of chemical reaction involved in it. [6]
- (b) What are plastics ? Give an account on compounding of plastics. [6]
- (c) Compare LDPE and HDPE. [4]

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**[4756]-13**

**F.E. (First Semester) EXAMINATION, 2015**

**APPLIED SCIENCE—I (PHYSICS)**

**(2008 COURSE)**

**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.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of electronic calculator, Mollier chart, steam tables  
are allowed.

(v) Assume suitable data, if necessary.

**Constant :**

$$h = 6.63 \times 10^{-34} \text{ J-s}$$

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

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

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

1. (a) With the help of neat labeled diagram explain the principle,  
construction and working of Michelson Interferometer. [7]

P.T.O.

- (b) Obtain an expression for the displacement when a transverse magnetic field acts on an electron in a limited region. [6]
- (c) In Newton's ring experiment the diameter of 4th and 12th dark rings are 0.40 cm and 0.70 cm. Find the diameter of 12th dark ring. [4]

*Or*

2. (a) Explain with neat diagram how Bainbridge Mass Spectrograph is used to determine the mass of the isotopes. [7]
  - (b) Derive the condition of maxima and minima when light incident on thin parallel film of uniform thickness in reflected system. [6]
  - (c) An electron is accelerated through a potential difference of 5 KV and enter in a uniform magnetic field of 0.02 Wb/m<sup>2</sup> acting normal to the direction of electron motion. Determine the radius of the path. [4]
3. (a) Explain Fraunhofer diffraction at a single slit and derive the condition of maxima and minima. [7]
  - (b) Define magnetostriction effect. Explain with neat circuit diagram how magnetostriction oscillator is used to generate ultrasonic waves. [6]

- (c) What is the maximum wavelength that can be observed in the fourth order for a transmission grating having 5000 lines per cm ? [4]

*Or*

4. (a) What is Ultrasonics ? Explain Echo sounding and non-destructive testing using Ultrasonics. [7]
- (b) Explain Rayleigh's criteria of resolution and hence obtain the expression for the resolving power of grating. [6]
- (c) Calculate the nature frequency of ultrasonic waves using the following data : the thickness of quartz plate =  $5.5 \times 10^{-3}$  m,  $Y = 8.0 \times 10^{10}$  N/m<sup>2</sup>,  $\rho = 2.65 \times 10^3$  kg/m<sup>3</sup>. [4]
5. (a) Define double refracting crystal. Explain Huygen's theory of double refracting crystal. [6]
- (b) With the help of neat labeled diagram explain the construction and working of Betatron, also derive Betatron condition. [6]
- (c) Calculate the thickness of Quarter wave plate and half wave plate from the following data : [4]

$$\mu_e = 1.592, \mu_o = 1.586, \lambda = 5890 \text{ \AA}.$$

*Or*

6. (a) Define nuclear fusion. Describe carbon-nitrogen cycle in fusion reaction as a source of Stellar energy. [6]
- (b) Distinguish between polarized and unpolarized light. Describe the process of production and detection of circularly polarized light. [6]
- (c) The magnetic flux within a stable orbit of Betatron changes from  $1.384 \times 10^3$  wb to  $8.44 \times 10^2$  wb in half of a minute. What would be the energy of an electron which undergoes  $2 \times 10^6$  revolutions ? [4]

Total No. of Questions—12]

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**[4756]-14**

**F.E. (First Semester) EXAMINATION, 2015**

**BASIC ELECTRICAL ENGINEERING**

**(2008 PATTERN)**

**Time : Three Hours**

**Maximum Marks : 100**

**N.B. :—** (i) Answers to the two Sections should be written in separate answer-books.

(ii) 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, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12.

(iii) Figures to the right indicate full marks.

(iv) Neat diagrams must be drawn wherever necessary.

(v) Use of non-programmable pocket size scientific calculator is permitted.

(vi) Assume suitable additional data if necessary.

**Section I**

1. (a) What is insulation resistance ? State its unit and obtain an expression for insulation resistance of cable. [8]

(b) Explain lead-acid battery with respect of construction and maintenance. [8]

P.T.O.

*Or*

2. (a) A resistance element having cross-sectional area of  $10 \text{ mm}^2$  and length of 10 m takes a current of 4A from 200 V supply at temperature of  $25^\circ\text{C}$ . Find : [10]

(i) Resistivity of material

(ii) Current it will take when temp rises to  $75^\circ\text{C}$ .

Assume  $\alpha_{25} = 0.0003/^\circ\text{C}$

- (b) Explain the following terms with respect to electrical : [6]

(i) Energy

(ii) Power.

3. (a) Derive an expression to convert star-connected network into its equivalent delta connected network. [8]

- (b) State and explain the following laws : [8]

(i) KCL

(ii) KVL.

*Or*

4. (a) Explain the following terms with reference to D.C. resistive network : [8]

(i) Unilateral and bilateral network



- (ii) Linear and non-linear network
  - (iii) Lumped and distributed network
  - (iv) Active and passive network.
- (b) State and explain superposition theorem. [8]
5. (a) Compare electrical and magnetic circuits : [10]
- (b) Define the following terms and state its units : [8]
- (i) Magnetic flux
  - (ii) Flux density
  - (iii) Permeability of free space
  - (iv) Reluctance.

*Or*

6. (a) A coil of 2000 turns is wound uniformly over non-magnetic ring of mean circumference of 80 cm and cross-sectional area of  $0.6 \text{ cm}^2$ , if the current through the coil is 2A. Calculate : [8]
- (i) Magnetising force
  - (ii) Reluctance
  - (iii) Total flux
  - (iv) Flux density.

- (b) Derive an expression for the energy stored in magnetic field in terms of energy stored per unit volume. [10]

7. (a) Define with respect to alternating quantity : [8]

(i) Instantaneous value

(ii) Periodic time

(iii) Frequency

(iv) Time period.

- (b) Prove that average value of sinusoidal alternating current is 0.637 times its maximum value. [8]

*Or*

8. (a) Find the resultant of three voltages given by : [8]

$$V_1 = 10 \sin \omega t, V_2 = 20 \sin (\omega t / \pi / 4), V_3 = 30 \cos (\omega t + \pi / 6)$$

- (b) Derive an expression for energy stored in a capacitor. [8]

9. (a) Define and explain the following terms : [8]

(i) Active power

(ii) Reactive power

(iii) Impedance

(iv) Admittance.

(b) A circuit consisting of a resistance of  $20\ \Omega$  and inductance of  $0.1\ \text{H}$  is connected in series across single-phase  $200\ \text{V}$ ,  $50\ \text{Hz}$  supply. Calculate : [8]

(i) Current drawn

(ii) Power consumed.

*Or*

10. (a) A sinusoidal voltage  $v = V_m \sin \omega t$  is applied across a series R-C circuit. Derive an expression for current and average power consumed by a circuit. [8]

(b) A resistance of  $25\ \Omega$ , inductance of  $64\ \text{mH}$  and capacitor of  $80\ \mu\text{F}$  are connected in series across  $110\ \text{V}$ ,  $50\ \text{Hz}$  single-phase a.c. supply. Calculate the current, voltage across individual element and overall power factor of the circuit. [8]

11. (a) Write short notes on : [10]

(i) Losses taking place in a transformer;

(ii) Autotransformer.

(b) A 500 kVA transformer has iron losses 2 kW and full load copper losses of 5 kW. Calculate : [8]

(i) Efficiency at 75% of full load, unity power factors

(ii) Efficiency at full load, 0.8 power factor lag.

*Or*

**12.** (a) Differentiate between core type and shell type of transformer. [8]

(b) Define the following terms related to three-phase circuit : [10]

(i) Symmetrical system

(ii) Phase sequence

(iii) Balanced load

(iv) Unbalanced load.

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**[4756]-15**

**F.E. (First Semester) EXAMINATION, 2015**

**BASIC CIVIL AND ENVIRONMENTAL ENGINEERING**

**(2008 Pattern)**

**Time : Three Hours**

**Maximum Marks : 100**

- 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 from Section I, Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10 and Q. No. 11 or Q. No. 12 from Section II.
- (ii) Answers to the two sections should be written in separate answer-books.
- (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.
- (vi) Neat diagrams must be drawn wherever necessary.

**Section I**

1. (a) Explain in brief the role of civil engineer in construction of a Expressway. [6]

P.T.O.

(b) State comparison between Rigid and Flexible Pavement. [4]

(c) State any *six* Practical Applications of Quantity Surveying. [6×1]

*Or*

2. (a) Explain in brief the general role of civil engineer in any construction work. [6]

(b) Define fluid mechanics. State any *three* practical applications of Fluid Mechanics. [1+3]

(c) Explain in brief the following branches of Civil Engineering : [3+3]

(i) Surveying.

(ii) Structural Engineering.

3. (a) State comparison between Load Bearing Structure and Framed Structure. [6]

(b) Draw neat labelled sketches of the following : [2+2]

(i) Friction Pile

(ii) Wall Footing.

(c) Explain with a neat sketch the following : [3+3]

(i) Uniform Settlement

(ii) Differential Settlement.

*Or*

4. (a) State any *three* types of mortars. Also state their uses. [3+3]
- (b) State any *four* characteristics of First Class Bricks. [4×1]
- (c) Write a short note on automation in construction. [6]
5. (a) The following consecutive readings were taken with a level and 4 m leveling staff. The readings are 2.350, 1.915, 3.210, 2.650, 1.445, 3.955 and 0.345. The first reading was taken on Permanent Bench of RL 975.850 m and the level was shifted after third and fifth reading. Calculate the reduced levels of remaining staff stations by Height of Instrument method. Apply Usual Arithmetic Check. [6]
- (b) Define the following : [2+2+2]
- (i) Line of Collimation
- (ii) Reduced Level
- (iii) Change Point.
- (c) State with a neat sketch any *three* characteristics of contour lines. [3+3]

*Or*

6. (a) Write a short note on EDM. [6]
- (b) State any *three* practical applications of the GPS and GIS. [3+3]
- (c) The following consecutive readings were taken with a level and 4 m leveling staff. The readings are 2.350, 1.915, 3.210, 2.650, 1.445, 3.955 and 0.345. The first reading was taken on Permanent Bench of RL 975.850 m and the level was shifted after third and fifth readings. Calculate the reduced levels of remaining staff stations by Rise and Fall Method. Apply usual Arithmetic check. [6]

## **Section II**

7. (a) Explain in brief the components of Aquatic Ecosystem. [3+3]
- (b) State and explain the components of Forest Ecosystem. [6]
- (c) Write a short note on various Natural Resources. [4]

*Or*

8. (a) What do you understand by Sustainable Development ? State the importance of Sustainable Development. [2+4]
- (b) Write a short note on Environmental Impact Assessment. [6]
- (c) Explain with a neat sketch Hydrological Cycle. [4]



9. (a) Explain in brief the following principles of building planning : [3+3]
- (i) Roominess
- (ii) Circulation.
- (b) Write a short note on Sustainable Building. [6]
- (c) Explain in brief the following : [4]
- (i) Building Line
- (ii) Control Line.

*Or*

10. (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 m<sup>2</sup> 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 ? [6]
- (b) State the various points to be considered while selecting a site for Industrial Building. [6]
- (c) Explain in brief the “Privacy” as a principle of building planning. [4]

11. (a) Write a short note on Global Warming. [6]
- (b) State comparison between Conventional and Non-conventional sources of energy. [6]
- (c) Explain in brief the mechanism of production of Biogas energy. [6]

*Or*

12. (a) Write a short note on primary and secondary Air Pollutants. [6]
- (b) Explain in brief the various sources of Water Pollution. [6]
- (c) As a responsible member of the Civil Society, how will you contribute yourself to reduce the pollution due to Automobiles. [6]

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**[4756]-16**

**F.E. (First Semester) EXAMINATION, 2015**

**ENGINEERING GRAPHICS-I**

**(2008 PATTERN)**

**Time : Four Hours**

**Maximum Marks : 100**

**N.B. :—** (i) Answer any *one* question from each Unit.

(ii) Answer to the two Sections should be written in separate answer-sheet, use back side of sheet.

(iii) Figures to the right indicate full marks.

(iv) Assume suitable data, if necessary.

(v) Retain construction lines.

(vi) Marks are reserved for Dimensioning and good presentation.

**Section-I**

**Unit I**

1. (a) Draw a circle with diameter AB equal to 65 mm. Draw a line AC 135 mm long and tangent to the circle at point A. Trace the paths of point A when the line AC rolls on the circle without slipping in anticlockwise direction till the end C touches the circumference of the circle. Name the curve and also draw the normal and tangent to the curve at a point 100 mm from the centre of the circle.

[7]

P.T.O.

- (b) A right angled triangle of two adjacent sides 45 mm and 60 mm is rotating around side 60 mm. A point P is moving from the bottom most position to the highest position on hypotenuse while the triangle completes one revolution. Both the movements are uniform. Draw the path of point P in the elevation and plan. Name the curve. [8]

*Or*

2. (a) A circular disc of 40 mm diameter rolls on another fixed disc same radius with external contact, for one complete revolution of the rolling circle. Draw a curve traced by a point on the circumference of the rolling circle, which is in contact with base circle, in the starting position. Name the curve. [8]
- (b) The major axis of ellipse is 120 mm long and minor axis is 80 mm long. Find the foci and draw the ellipse by arc of circle method. Draw tangent to the ellipse at a point on it 30 mm above the major axis. [7]

## **Unit II**

3. Fig. 1 shows a pictorial view of an object. Draw the following views to full scale by using First Angle Method of projection.
- (1) Sectional elevations on a sectional plane X-X looking in the direction of arrow X.

[7+6+5+2=20]

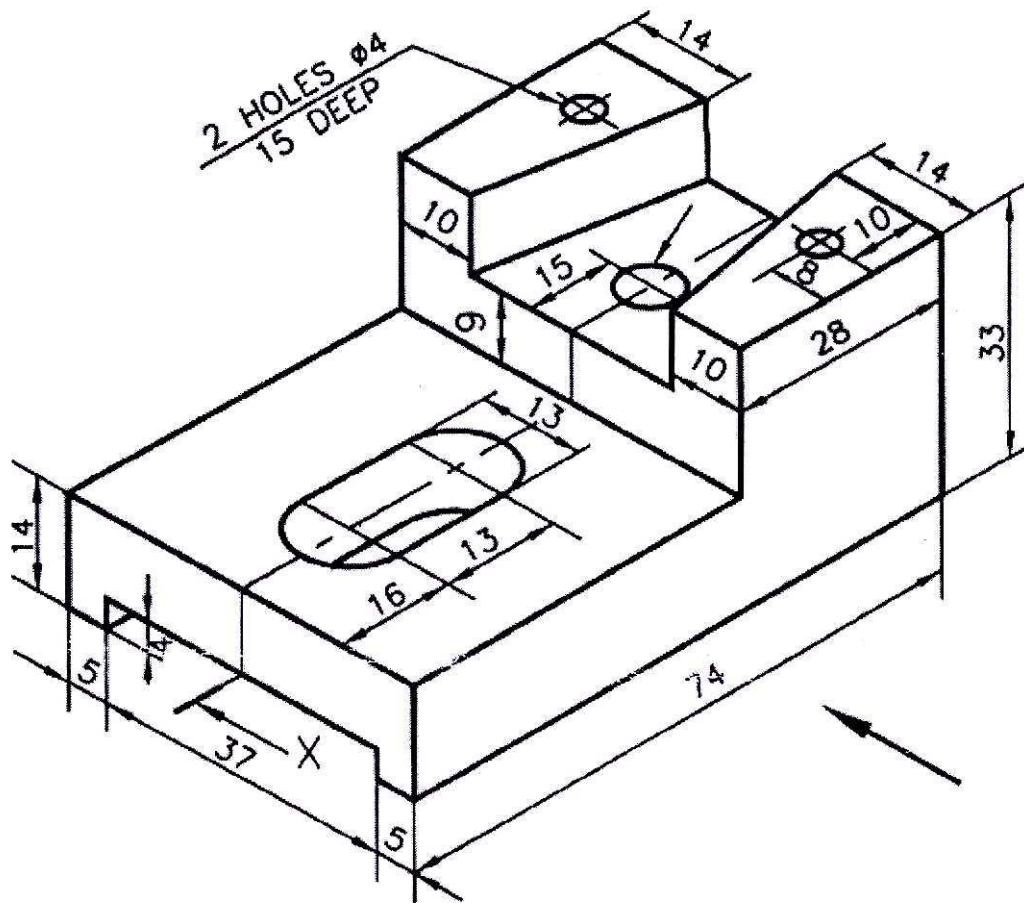


Fig. 1

Or

4. Fig. 2 shows a pictorial view of a C I-Bracket. Draw the following views to full scale by using First Angle Method of projection :
- (1) Sectional elevations looking in the direction of arrow X.
  - (2) Top View (Plan) (show all the necessary dotted lines).
  - (3) End view from Right Hand Side
  - (4) Give the entire Dimensions.
- [7+6+5+2=20]

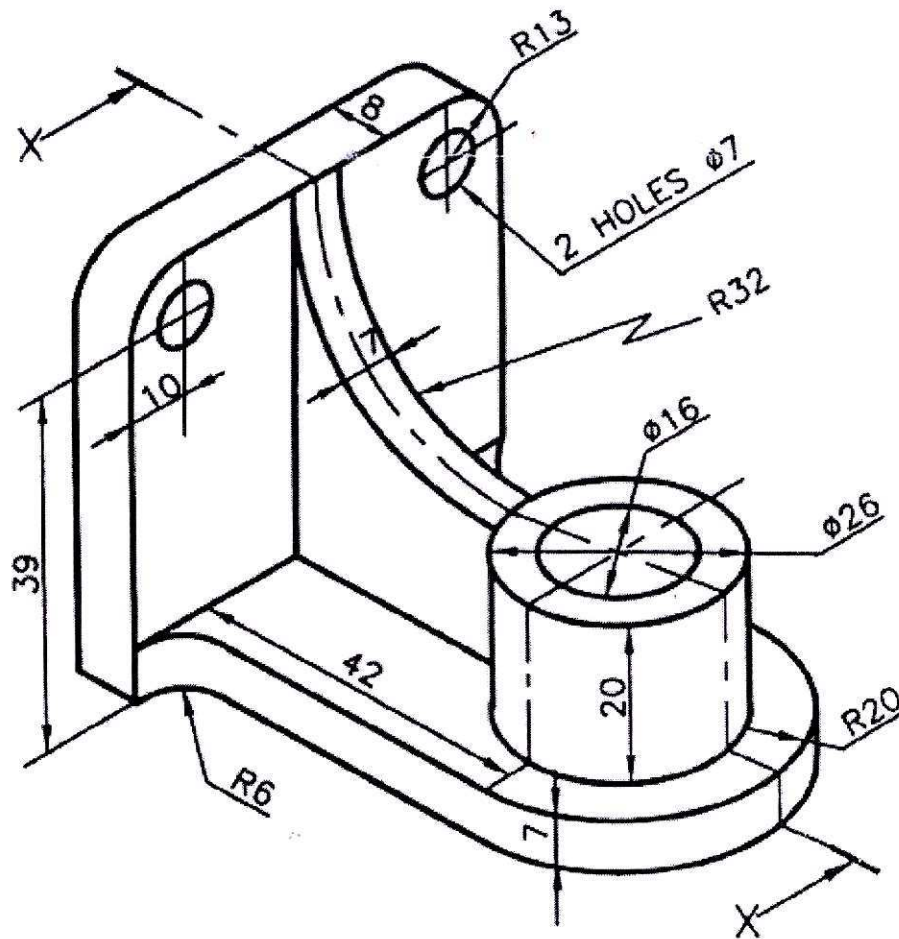


Fig. 2

### Unit III

5. Draw the Front View, Top View and an Auxiliary View which will show the true shape of the surface 'A' for the object shown in the following

Fig. 3.

[3+4+8=15]

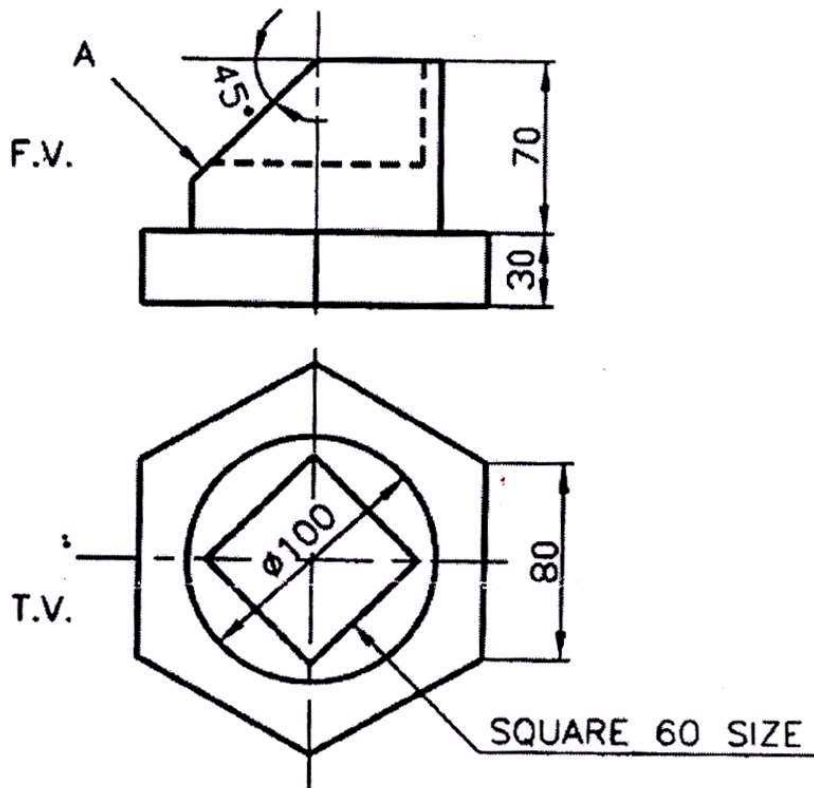


Fig. 3.

Or

6. Draw the given Front View and complete the Top View with the help of the given auxiliary views and give all the dimensions.

(refer fig.4)

[6+9=15]

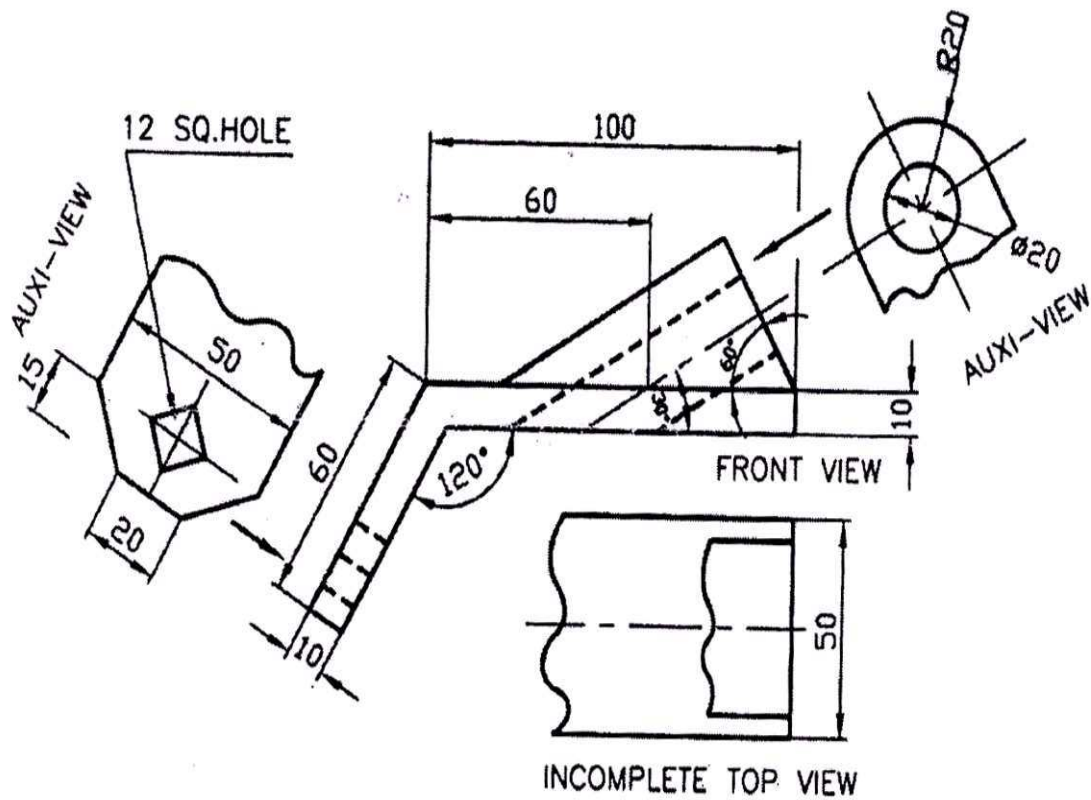


Fig. 4



**Section II**  
**Unit IV**

7. The following Fig. 5 shows LHSV and elevation of object according to first angle projections method draw its Isometric View. Retain all the construction lines and construction you have made. [17+3=20]

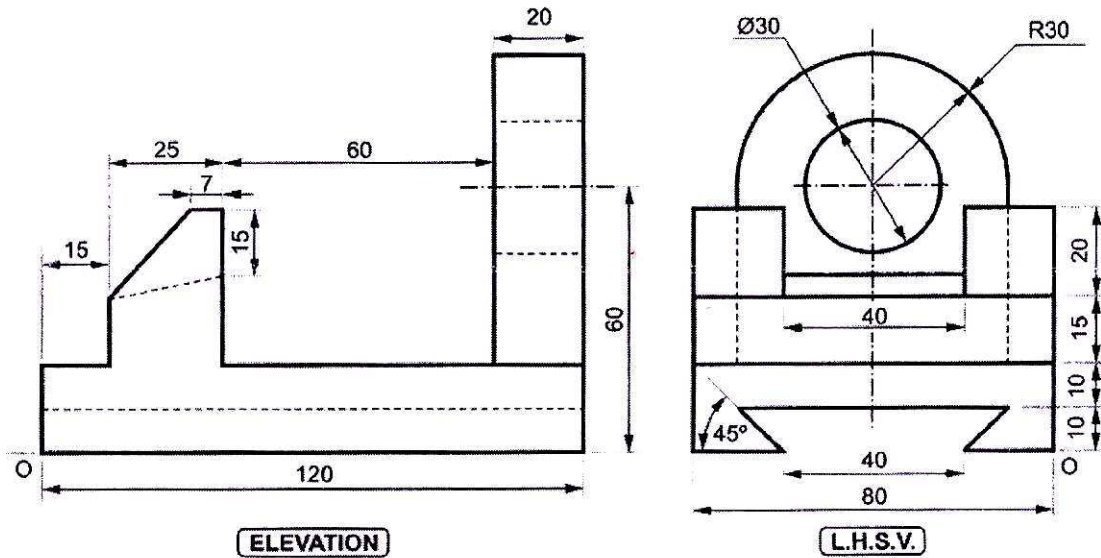


Fig. 5  
*Or*

8. The following Fig. 6 shows Elevation and Right hand side view of the object. Draw its Isometric View. Retain all the constuction lines and construction you have made. [17+3=20]

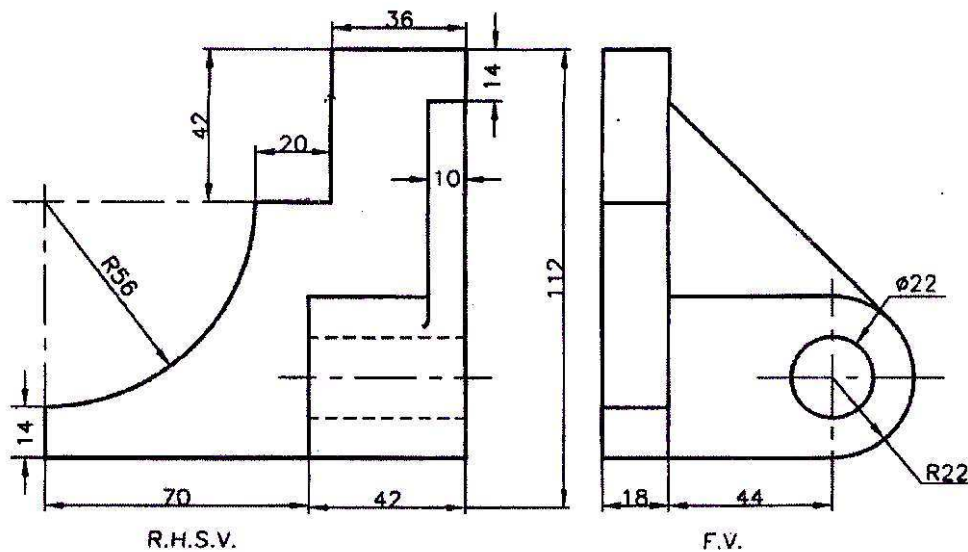


Fig. 6

## Unit V

9. The following Fig. 7 shows Elevation and plan of an object. Using same method of projection, draw the following views :
- Sectional Elevation, Section along A-A,
  - Plan
  - End view

Give all the dimensions.

[7+4+6+3=20]

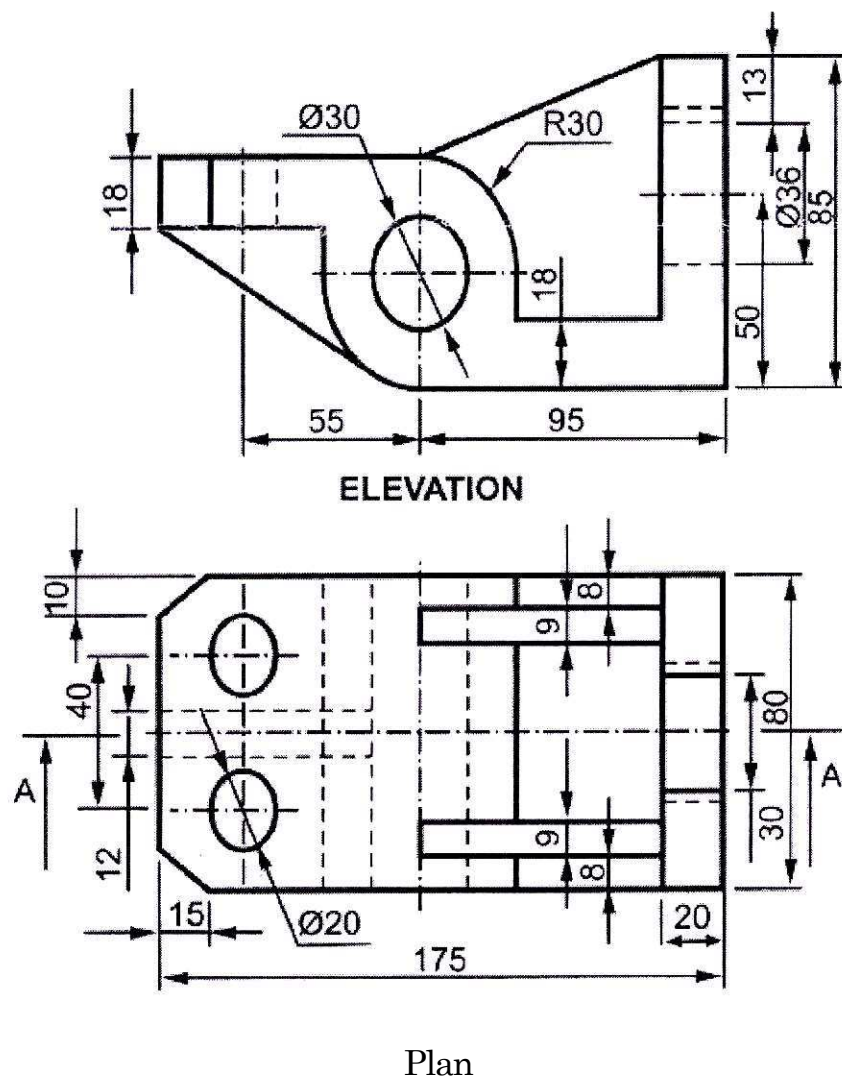


Fig. 7

Or

10. The following Fig. 8 shows elevation and End View of an object. Using same method of projection, draw the following views :

- (a) Sectional Elevation, section along A-A,
- (b) End view
- (c) Plan

Give all the dimensions.

[7+4+6+3=20]

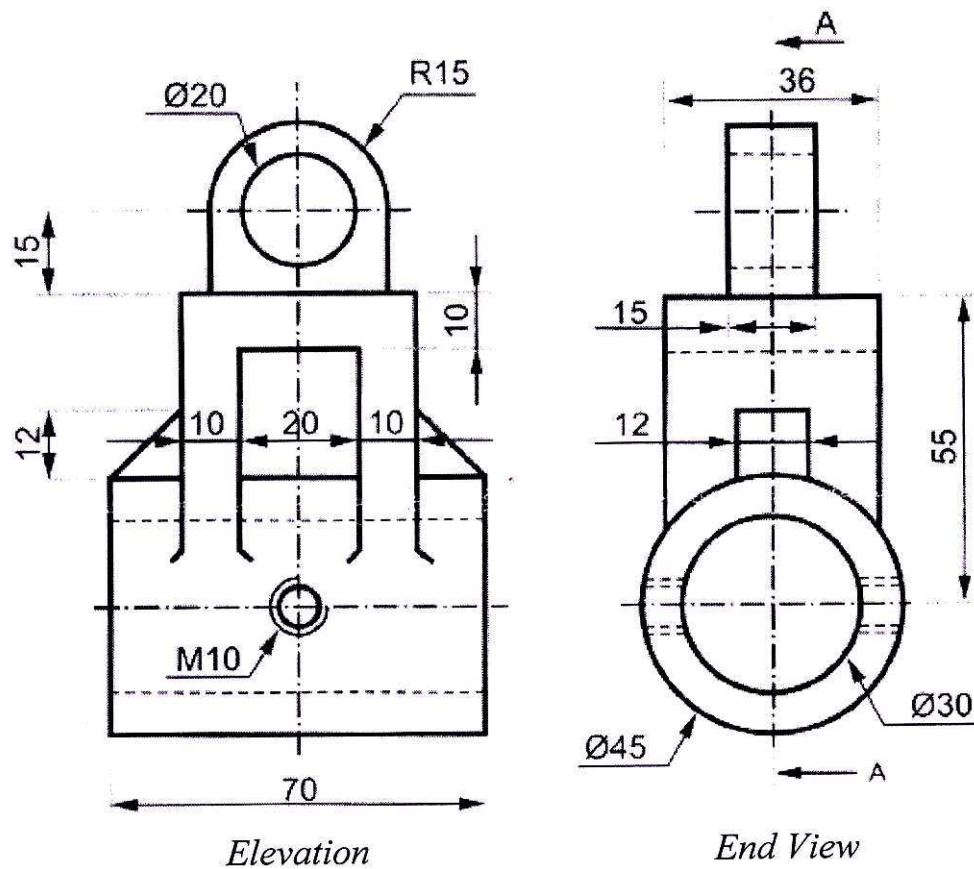


Fig. 8

**11.** Draw proportional free-hand sketches of any *two* from the following machine parts : [5+5=10]

- (1) Acme thread
- (2) Universal coupling
- (3) Capston Nut
- (4) Cylindrical helical compression and tension springs

*Or*

**12.** Draw proportional free-hand sketches of any *two* from the following machine parts : [5+5=10]

- (1) External and internal thread
- (2) Flexible coupling
- (3) Saddle key and Gib-headed sunk key
- (4) Triple riveted (zig-zag type) lap joint.

Total No. of Questions—12]

[Total No. of Printed Pages—8

Seat No.	
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[4756]-21

**F.E. (Second Semester) EXAMINATION, 2015**

**ENGINEERING MATHEMATICS-II**

**(2008 PATTERN)**

**Time : Three Hours**

**Maximum Marks : 100**

**N.B. :—** (i) **Section I** : Solve Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6.

**Section II** : Solve Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

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

(v) Assume suitable data, if necessary.

### **SECTION I**

1. (a) Form the differential equation whose general solution is :

$$y = e^x [c_1 \cos x + c_2 \sin x],$$

where  $c_1$  and  $c_2$  are arbitrary constants.

[6]

P.T.O.

(b) Solve any two : [10]

(i)  $\frac{dy}{dx} = (4x + y)^2$

(ii)  $(x^2 - 3xy + 2y^2) dx + (3x^2 - 2xy) dy = 0$

(iii)  $\frac{dy}{dx} + \frac{4x}{1+x^2} y = \frac{1}{(x^2+1)^3}$

Or

2. (a) Form the differential equation by eliminating arbitrary constants  $c_1$  and  $c_2$  from the general solution given by : [6]

$$y = c_1 \cos \log x + c_2 \sin \log x$$

(b) Solve any two : [10]

(i)  $\frac{dy}{dx} = \frac{6x - 4y + 3}{3x - 2y + 1}$

(ii)  $\frac{dy}{dx} - \frac{\tan y}{1+x} = (1+x) e^x \sec y$

(iii)  $(2x + e^x \log y) y dx + e^x dy = 0.$

3. Solve any three : [18]

(a) Find the orthogonal trajectories of the family :

$$xy = c^2$$

- (b) An e.m.f.  $200 e^{-5t}$  is applied to a series circuit consisting of  $20 \Omega$  resistor and  $0.01 \text{ F}$  capacitor. Find the charge and current at any time, assuming that there is no initial voltage on capacitor.
- (c) A body of mass  $m$  falling from a rest is subject to the force of gravity and an air resistance proportional to the square of velocity ( $kv^2$ ). If it falls through a distance  $x$  and possesses a velocity  $v$  at that instant. Prove that :

$$\frac{2 kx}{m} = \log \left( \frac{a^2}{a^2 - v^2} \right)$$

where  $mg = ka^2$ .

- (d) If 30% of radioactive substance disappeared in 10 days, how long will it take for 90% of it to disappeared ?

*Or*

4. Solve any *three* : [18]

- (a) A body of temperature  $100^\circ\text{C}$  is placed in a room whose temperature is  $20^\circ\text{C}$  and cools to  $60^\circ\text{C}$  in 5 minutes. What is time required to reach temperature of body at  $40^\circ\text{C}$ .

- (b) A voltage  $10 e^{-2t}$  is applied at  $t = 0$  to a circuit containing an inductance  $L$  and resistance  $R$  connected in a series. Find current  $I$  at any time  $t$  as a function of time  $t$ , given that when  $t = 0$ ,  $I = 0$ .
- (c) A long hollow pipe has an inner diameter of 10 cm and outer diameter of 20 cm, the inner surface is kept at  $200^{\circ}\text{C}$  and outer surface is at  $50^{\circ}\text{C}$ . The thermal conductivity  $k = 0.12$ . How much heat is lost per minute from the portion of the pipe 20 m long.
- (d) A metal ball is heated to a temperature of  $100^{\circ}\text{C}$  at time  $t = 0$ , it is placed in a water which is maintained at  $40^{\circ}\text{C}$ . If the temperature of the ball reduces to  $60^{\circ}\text{C}$  in 4 minutes, find the time at which the temperature of ball is  $50^{\circ}\text{C}$

5. (a) Find the Fourier series for :

$$f(x) = x^2, \quad -\pi < x < \pi$$

and hence deduce that :

[9]

$$\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \dots = \frac{\pi^2}{12}.$$



(b) If :

$$U_n = \int_0^{\pi/4} \tan^n \theta \, d\theta$$

show that :

$$n (U_{n+1} + U_{n-1}) = 1$$

hence find  $U_4$ . [7]

*Or*

6. (a) The following table gives variation of periodic current over a period : [4]

<b><math>t</math> (sec)</b>	:	0	T/6	T/3	T/2	2T/3	$\frac{5T}{6}$	T
<b>A (amp)</b>	:	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is a direct current part of 0.75 amp in variable current and obtain the amplitude of first harmonic. [8]

(b) Evaluate : [4]

$$\int_0^{\infty} e^{-2x^2} x^9 \, dx$$

(c) Prove that : [4]

$$\beta(m, n) = \int_0^1 \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}} \, dx.$$

## SECTION II

7. (a) Trace the following curves (any *two*) : [8]

(i)  $xy^2 = a^2 (2a - x)$

(ii)  $r = a(1 - \sin \theta)$

(iii)  $x^{2/3} + y^{2/3} = a^{2/3}$

- (b) Show that :

$$\phi(a) = \int_{\pi/6a}^{\pi/2a} \frac{\sin ax}{x} dx$$

is independent of  $a$ . [4]

- (c) Find the perimeter of the cardioid : [5]

$$r = a (1 - \cos \theta)$$

*Or*

8. (a) Trace the following curves (any *two*) : [8]

(i)  $y^2 (3a - x) = x^3$

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

(iii)  $x = t^2, y = t - \frac{t^3}{3}$

- (b) Show that : [4]

$$\int_0^\infty e^{-x^2 - 2ax} dx = \frac{\sqrt{\pi}}{2} e^{a^2} [1 - \operatorname{erf}(a)]$$

- (c) Find the whole length of the loop of the curve : [5]

$$3y^2 = x(x - 1)^2$$

9. (a) Prove that the sphere :

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

touches the plane :

$$2x - 2y - z + 16 = 0$$

and find the point of contact.

- (b) Find the equation of the right circular cone whose vertex is at the origin, axis is the line :

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

and semi-vertical angle is  $30^\circ$ . [5]

- (c) Find the equation of the right circular cylinder with radius 2 and axis is the line : [6]

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

Or

10. (a) Find the equation of the sphere which has its centre at (2, 3, -1) and which touches the line : [6]

$$\frac{x+1}{-5} = \frac{y-8}{3} = \frac{z-4}{4}$$

- (b) Find the equation of the right circular cone with vertex (1, 2, 3) axis has direction ratios 2, -1, 4 and semi-vertical angle is  $60^\circ$ . [5]

- (c) Find the equation of the right circular cylinder with axis :

$$\frac{x-1}{2} = \frac{y-3}{2} = \frac{z-5}{-1}$$

and radius = 3. [6]

11. Solve any two :

- (a) Evaluate : [8]

$$\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{dy dx}{(1+x^2+y^2)}$$

- (b) Find the area of the upper half of the cardioid : [8]

$$r = a(1 + \cos \theta)$$

- (c) Find the C.G of an arc of the catenary : [8]

$$y = a \cosh\left(\frac{x}{a}\right) \text{ from } x = -a \text{ to } x = a.$$

Or

12. Solve any two :

- (a) Evaluate : [8]

$$\int_0^1 \int_0^{\sqrt{1-x^2}} \frac{y dy dx}{(1+y^2) \sqrt{1-x^2-y^2}}$$

- (b) Evaluate : [8]

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

- (c) Find the moment of inertia of a sphere about a diameter. [8]

Total No. of Questions—6]

[Total No. of Printed Pages—3

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**[4756]-22**

**F.E. (Second Semester) EXAMINATION, 2015**

**APPLIED SCIENCE-II**

**(Chemistry)**

**(2008 Pattern)**

**Time : Two Hours**

**Maximum Marks : 50**

**N.B. :—** (i) Solve Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Assume suitable data, if necessary.

1. (a) Define Gross Calorific Value (GCV) and explain Boy's Calorimeter method for determination of GCV. [7]

(b) Explain refining of crude petroleum by fractional distillation method and give composition, boiling range, CV and uses of any *three* fractions obtained. [6]

(c) 1.96 gm coal was analysed by Kjeldahl's method and liberated ammonia was passed in 50 ml 0.1 N  $\text{H}_2\text{SO}_4$ . Unreacted acid required 8.4 ml 0.1 N NaOH for neutralisation, calculate percentage of Nitrogen.

2.8 gm of coal sample when analysed by Eschka method gave 0.190 gm  $\text{BaSO}_4$  precipitate. Calculate percentage of sulphur. [4]

P.T.O.

*Or*

2. (a) What is Biodiesel ? Give its synthesis, merits and demerits. [7]
- (b) Define carbonisation of coal and differentiate between low temperature and high temperature carbonisation. [6]
- (c) A gaseous fuel has the following composition by volume :
- $H_2 = 20\%$ ,  $CH_4 = 8\%$ ,  $CO = 24\%$ ,  $CO_2 = 4.5\%$ ,  $O_2 = 4\%$  and  $N_2 = 39.5\%$ .
- Calculate volume of air required for combustion of  $1\text{ m}^3$  of gaseous fuel. [4]
3. (a) Define atmospheric corrosion and explain mechanism of atmospheric corrosion due to oxygen. [6]
- (b) Define electroplating and explain its process and applications. [6]
- (c) Differentiate between e.m.f. series and galvanic series. [4]

*Or*

4. (a) Give Pilling-Bedworth rule and explain nature of oxide films. [6]
- (b) Explain cathodic protection method with sacrificial anode and impressed current method. [6]
- (c) Explain any *one* method of hot dipping of metallic coating. [4]

5. (a) Define priming and foaming. Explain their causes, prevention and disadvantages. [7]
- (b) Explain curves, points and regions of water system with the help of phase diagram. [6]
- (c) Give the types of alkalinities in water and explain method for alkalinity determination. [4]

*Or*

6. (a) State Gibbs' phase rule and its equation. Explain terms involved in it with suitable example. [7]
- (b) Define hardness of water and explain phosphate conditioning and calgon conditioning for water softening. [6]
- (c) An exhausted zeolite softener was regenerated by passing 64 lit of 14% NaCl solution. How many litres of hard water having hardness 350 ppm can be soften by this softener ? [4]

Total No. of Questions—6]

[Total No. of Printed Pages—3

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**[4756]-23**

**F.E. (Second Semester) EXAMINATION, 2015**

**APPLIED SCIENCE—II**

**PHYSICS**

**(2008 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.

(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.

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

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

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

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

1. (a) State and explain properties of matter wave. Show that the wavelength associated, with an electron, accelerated by a potential difference of V volts, is given by  $\frac{h}{\sqrt{2meV}}$ . [7]

P.T.O.



- (b) State and explain Heisenberg's uncertainty principle. Illustrate it by an experiment on electron diffraction at a single slit. [6]
- (c) De Broglie wavelength of electrons in a monoenergetic beam is  $7.2 \times 10^{-11}$  m. Calculate the momentum and energy of electrons in the beam in eV. [4]

*Or*

2. (a) Derive the Schrödinger's time independent wave equation. [7]
- (b) What is a wave group ? Show that the group velocity of a matter wave is equal to the particle velocity. [6]
- (c) Compute energy difference between the ground state and first excited state for an electron in 1-dimensional rigid box of length  $10^{-8}$  cm. [6]
3. (a) Explain the construction and working of Ruby laser with neat labelled diagram. [7]
- (b) What is superconductivity ? Explain Meissner's effect. [6]
- (c) Explain any *two* applications of the superconductors. [4]

*Or*

4. (a) Explain with neat diagram principle, construction and working of He-Ne laser. [7]

- (b) Explain type-I and type-II superconductor. [6]
  - (c) Explain : [4]
    - (i) Population Inversion
    - (ii) Pumping Mechanism.
5. (a) Explain with neat diagram any *one* method of synthesis of nano-particles. [6]
- (b) State and explain Hall effect. Obtain an expression for Hall voltage. [6]
- (c) Calculate the mobility of charge carriers in doped silicon whose conductivity is 100 per  $\Omega\text{-m}$  and the Hall coefficient is  $3.6 \times 10^{-4} \text{ m}^3/\text{C}$ . [4]

*Or*

6. (a) Explain any *two* properties of nano-materials. [6]
- (b) Using the Fermi-Dirac probability distribution function, derive the position of Fermi level in the intrinsic semiconductor. [6]
- (c) Discuss applications of Nanotechnology in the field of Medical and Electronics. [4]

Total No. of Questions—12]

[Total No. of Printed Pages—4

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**[4756]-24**

**F.E. (Second Semester) EXAMINATION, 2015**

**BASIC MECHANICAL ENGINEERING**

**(2008 PATTERN)**

**Time : Three Hours**

**Maximum Marks : 100**

**N.B. :—** (i) Attempt *six* questions. Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12.

(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) Answers of the two sections should be written in separate answer-books.

(vi) Assume suitable data, if necessary.

### **SECTION I**

1. (a) Define thermodynamic system. Explain its types with example. [8]

(b) Explain Joules experiment with neat sketch and state the various statements of first law of thermodynamics. [8]

P.T.O.

*Or*

2. (a) Define and explain :  $C_P$ ,  $C_V$ , Enthalpy, Internal Energy. [8]
- (b) State and explain Kelvin-Plancks statement of second law of thermodynamics. A heat engine with efficiency of 30% develops 30 kW of work output. Find the heat supplied to the engine and heat rejected to atmosphere. Draw the schematic sketch of the heat engine. [8]
3. (a) Explain working of four stroke petrol engine with neat sketch. [8]
- (b) Draw block diagram of : [8]
- (1) Open Cycle Gas Turbine
- (2) Household Refrigerator.

*Or*

4. (a) Draw block diagram of : [8]
- (1) Reciprocating air compressor
- (2) Reciprocating pump.
- (b) State classification of boilers. Explain any *two* mountings and any *two* accessories. [8]
5. (a) State and explain Newton's law of cooling. [2]
- (b) Explain concept of thermal resistance in series and parallel. [8]
- (c) Explain hydro-electric power plant with neat sketch. [8]

*Or*

6. (a) Explain nuclear power plant with neat sketch. State its any *two* advantages and disadvantages. [10]

- (b) State Stefan-Boltzmann's law of radiation. Define emissivity and write the formula for heat radiation by a grey body. [8]

A black body of temperature 1000 degree C is kept in the surrounding of 200 degree C. Find the heat loss per unit area by radiation from black body.

*Given* : Stefan-Boltzmann's Constant,  $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$ .

## SECTION II

7. (a) How bearings are classified ? Explain ball bearing with neat sketch. [8]

- (b) Draw neat sketches of spur gear, helical gear, bevel gear, rack and pinion gear. [8]

*Or*

8. (a) How couplings are classified ? Explain any *one* coupling with neat sketch. [8]

- (b) Draw neat sketches of : [8]

(1) Single plate clutch

(2) Open and Cross belt drive.

9. (a) Explain general steps in design process. [8]  
(b) Explain any *four* sheet metal working process. [8]

*Or*

10. (a) Explain sand casting process with neat sketch. [8]  
(b) State applications of any *four* engineering material. [8]

11. (a) Describe any *two* operations on lathe machines. [6]  
(b) Explain cylindrical grinding process with neat sketch. [6]  
(c) Draw neat sketches of any *three* operations performed on milling machines. [6]

*Or*

12. (a) Draw a block diagram of lathe machine. [6]  
(b) Explain centreless grinding process with sketch. [6]  
(c) Describe any *two* operations performed on drilling machines. [6]

Total No. of Questions—6]

[Total No. of Printed Pages—4+1

Seat No.	
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**[4756]-25**

**F.E. (Second Semester) EXAMINATION, 2015**

**BASIC ELECTRONICS ENGINEERING**

**(2008 Pattern)**

**Time : Two Hours**

**Maximum Marks : 50**

**N.B. :—** (i) Solve Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6.

(ii) Figures to the right indicate full marks.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Assume suitable data, if necessary.

1. (a) Explain the regulating mechanism in case of Zener regulator with variation in supply voltage and load is constant. [7]

(b) Discuss the effect of the following capacitors on frequency response of amplifier : [6]

(i) Coupling capacitor

(ii) Bypass capacitor

(iii) Diffusion and Transition capacitor.

P.T.O.

- (c) Give and explain any *four* specifications of SCR. [4]

*Or*

2. (a) What is d.c. load line ? Derive its equation for C.E. amplifier and explain the factors affecting the stability of d.c. load line. [7]

- (b) For the transistor circuit shown, in Fig. 1. :

(i) What is  $V_{CE}$  when  $V_{in} = 0$

(ii) What minimum values of  $I_B$  is required to saturate this transistor if  $\beta_{dc} = 200$ , neglect  $V_{CE}(\text{sat})$ . [6]

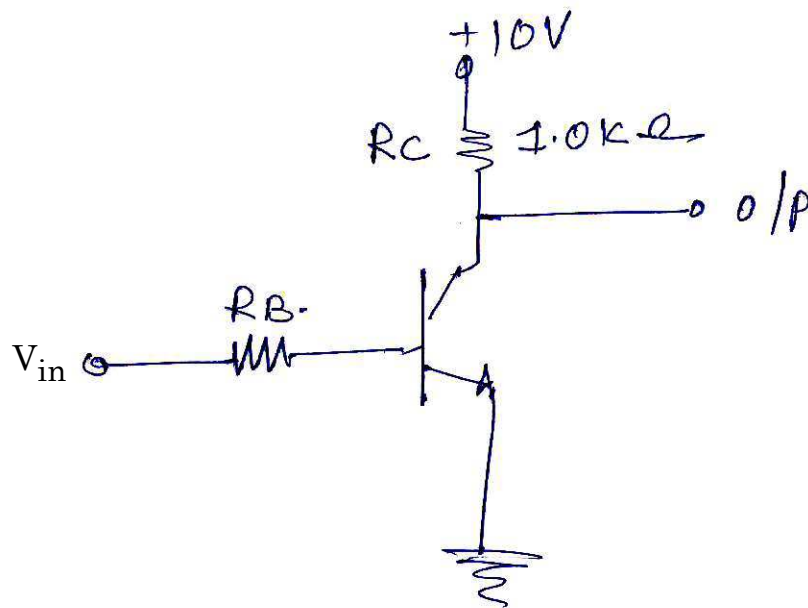


Fig. 1



(c) Write the peak inverse voltage of the diode in the following circuits : [4]

(i) Half wave rectifier without filter

(ii) Half wave rectifier with capacitor filter

(iii) Full wave rectifier

(iv) Bridge rectifier.

3. (a) Explain the following terms : [6]

(i) Input offset voltage

(ii) Slew rate

(iii) CMRR

(iv) Bandwidth.

(b) Draw and explain 8 : 1 mux using 4 : 1 mux. [7]

(c) What is shift register ? Give its operating modes. [4]

*Or*

4. (a) Draw and explain practical differentiator using Op-Amp. [7]

- (b) Determine the gain of the amplifier shown in Fig. 2, if the open loop voltage gain is 1,00,000. [6]

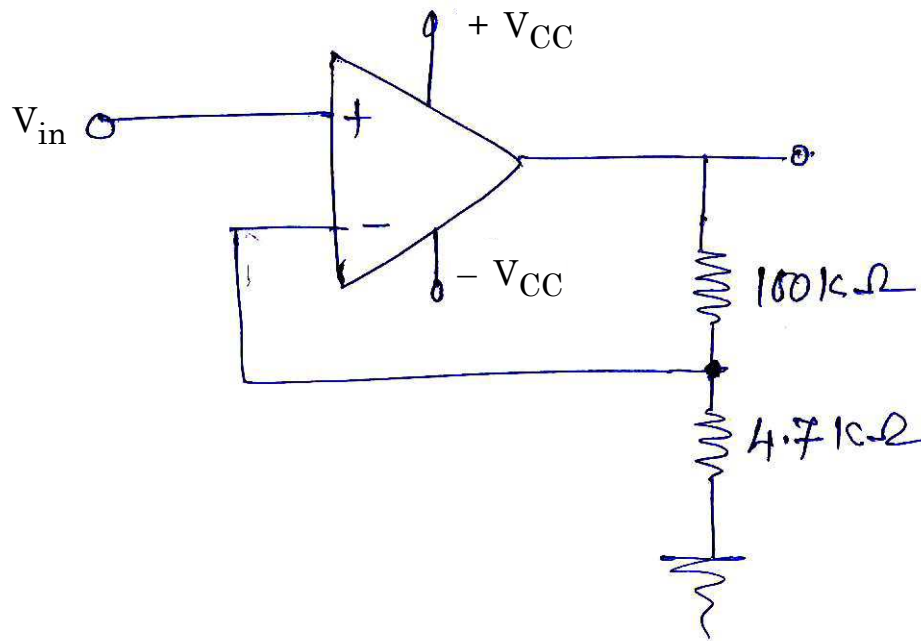


Fig. 2

- (c) State and prove DeMorgan's theorem. [4]
5. (a) With neat diagram explain construction and working of LVDT. [8]
- (b) Modulation reduces the antenna height, justify with suitable example. [4]

(c) Write a short note on any *one* :

(i) Thermocouple

(ii) Electronic weighing machine. [4]

*Or*

**6.** (a) Draw and explain the block diagram of FM transmitter. [8]

(b) Discuss the cell splitting technique in cellular network. [4]

(c) Write a short note on any *one* :

(i) PLC

(ii) Alarm Annunciator. [4]

Total No. of Questions—6]

[Total No. of Printed Pages—8

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**[4756]-26**

**F.E. (Second Semester) EXAMINATION, 2015**

**ENGINEERING MECHANICS**

**(2008 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 diagrams 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) The angle between the two concurrent forces is  $90^\circ$  and their resultant is 2500 N. The resultant makes an angle of  $45^\circ$  with one of the force. Determine the magnitude each force. [6]

(b) The velocity of a particle is given by

$$v = 20t^2 - 100t + 50,$$

where  $v$  is in m/s and  $t$  is in seconds. Determine the velocity of particle, when acceleration is zero. [6]

P.T.O.

Or

2. (a) Determine the  $y$  coordinate of the centroid of a trapezoidal area in terms of dimension shown in Fig. 2a with respect to origin  $O$ . [6]

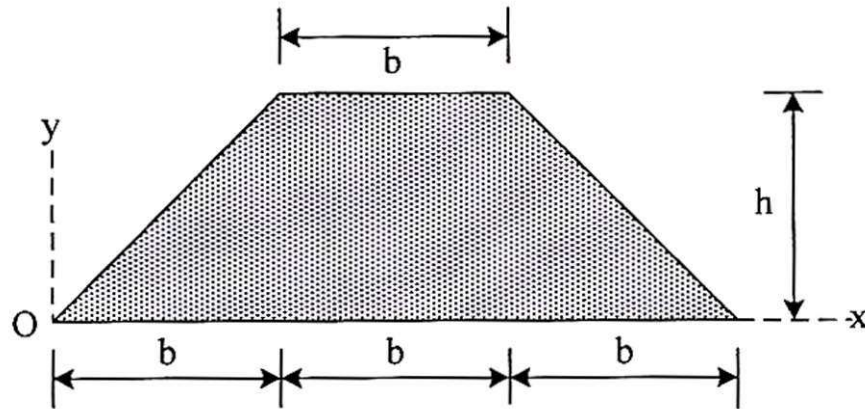


Fig. 2a

- (b) The system shown in Fig. 2b is initially at rest. Neglecting friction and the mass of pulley, determine the acceleration of block A and the velocity of block A after it has moved through 3 m. [6]

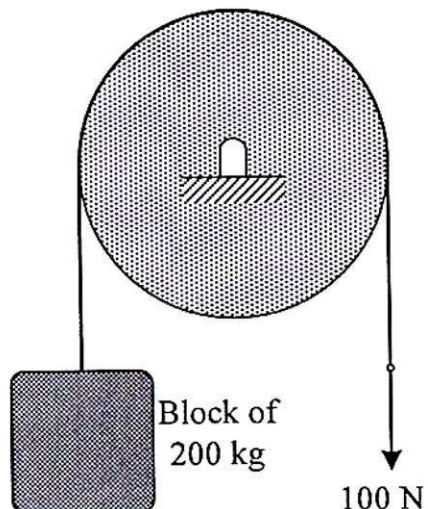


Fig. 2b

3. (a) A square foundation supports four loads as shown in Fig. 3a. Determine magnitude, direction and point of application of resultant of four forces. [6]

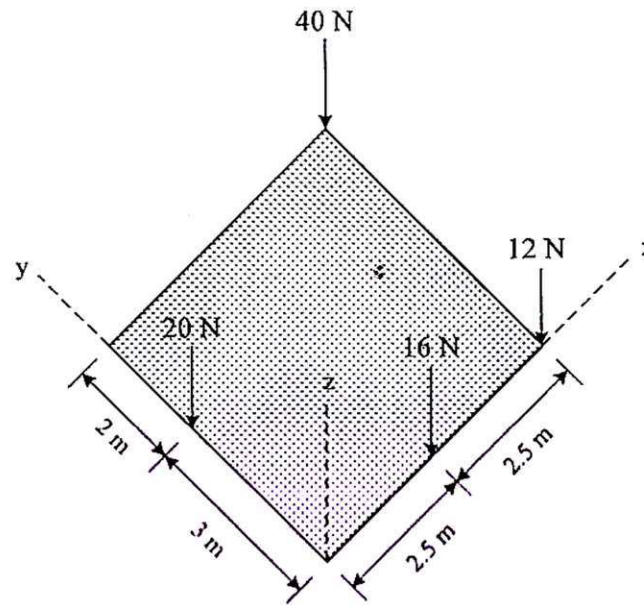


Fig. 3a

- (b) A sphere of weight 100 N and a radius of 200 mm as shown in Fig. 3b. Determine the reaction at the points of contact. [6]

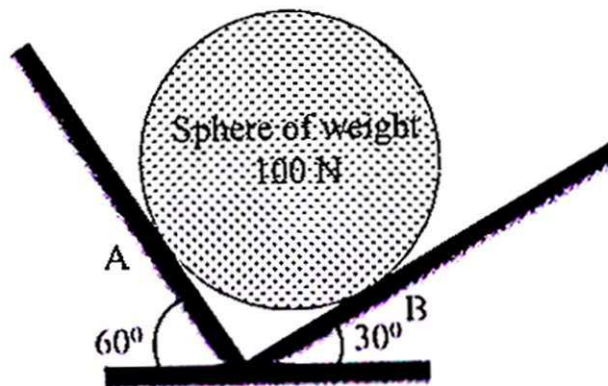


Fig. 3b

- (c) A cricket ball shot by a batsman from a height of 1.8 m at an angle of  $30^\circ$  with the horizontal with a velocity of 18 m/s is caught by a fielder at a height of 0.6 m from the ground. Determine the horizontal distance between the batsman and fielder. [7]

Or

4. (a) For the given loading of the beam AB, determine the range of values of the mass ' $m$ ' of the crate for which the system will be in equilibrium, knowing that the maximum allowable value of the reactions at each support is 2.5 kN and the reaction at E must be directed downward. (Refer Fig. 4a). [6]

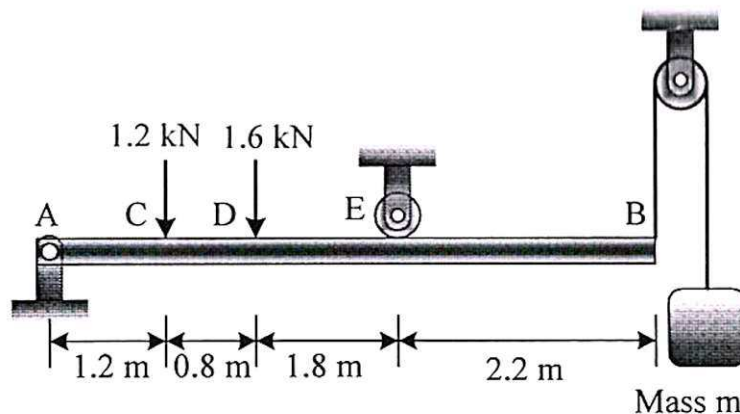


Fig. 4a

- (b) A vertical load of 50 kg is supported by three rods DA, DB and DC as shown in Fig. 4b. Determine the force in each

rod for the coordinates of points as shown.  $A(-4, -1, 0)$ ,  $B(3, 3, 0)$ ,  $C(3, -2, 0)$  and  $D(0, 0, 6)$ . [7]

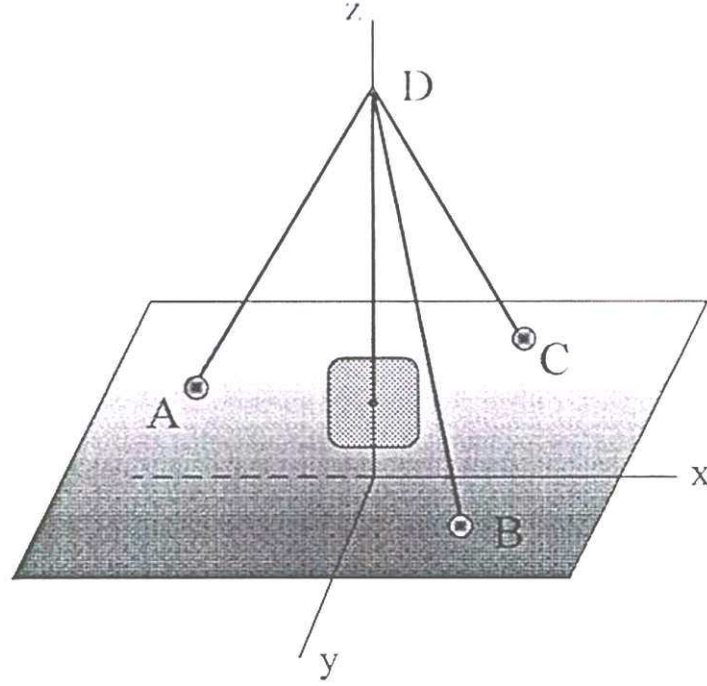


Fig. 4b

- (c) The small ball of mass  $m$  is attached to a light cord of length  $L$  and moves as a conical pendulum in a horizontal circle with a tangential velocity  $v$  as shown in Fig. 4c. Used the relation  $v = r\omega$ . Determine  $h$  and tension  $T$  in the cord. [6]

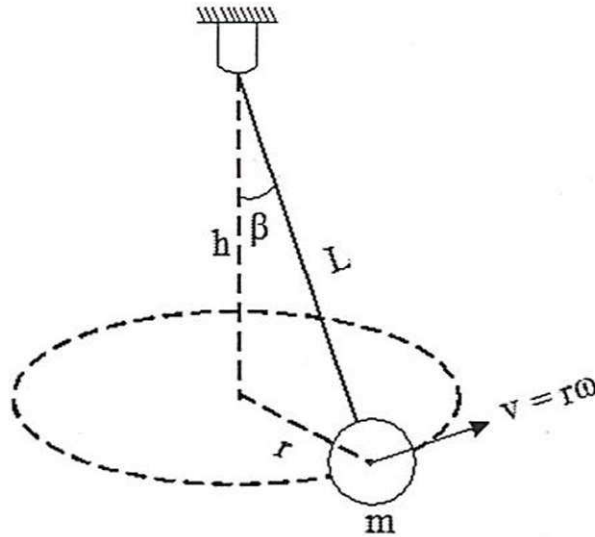


Fig. 4c



5. (a) A block weighing 200 N is pulled up a  $30^\circ$  plane by a force  $P$  producing a velocity of 5 m/s in 5 s. If the coefficient of friction is 0.2, determine the magnitude of force  $P$  using impulse momentum principle. Refer Fig. 5a. [6]

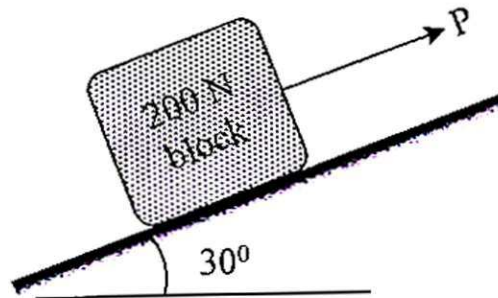


Fig. 5a

- (b) Determine the magnitude and nature of force in the members BC, BG and HG of the pin jointed truss loaded and supported as shown in Fig. 5b by method of section. [7]

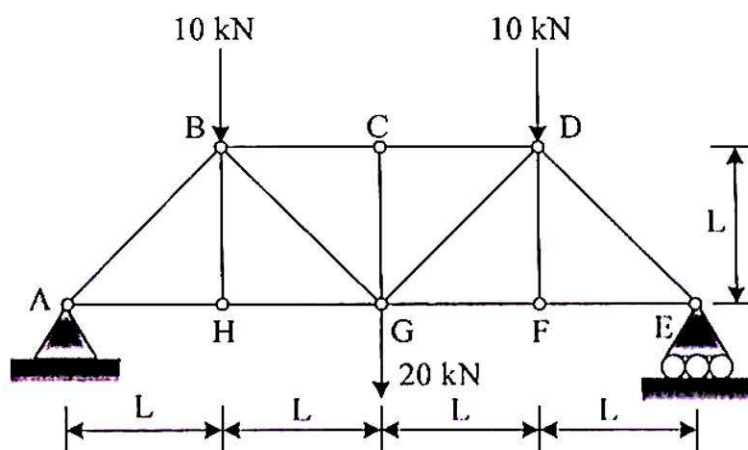


Fig. 5b

- (c) A 200 N block is rest on a plane which makes an angle  $30^\circ$  with the horizontal as shown in Fig. 5a. If the coefficient of static friction between the block and plane is 0.3, determine the range of force P to maintain the equilibrium. [6]

Or

6. (a) A cable passes around three 0.05 m radius pulleys and supports two blocks as shown in Fig. 6a. Pulleys C and E are locked to prevent rotation and the coefficient of friction between the cable and pulleys are  $\mu_s = 0.2$ . Determine the range of values of the weight of block A for which equilibrium is maintained, if the pulley D is free to rotate. [6]

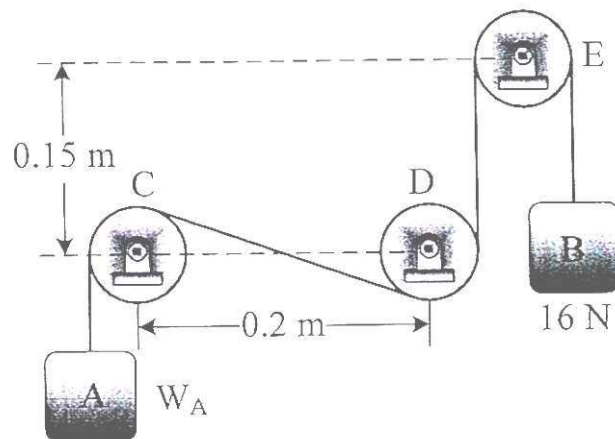


Fig. 6a

- (b) One of the requirement for tennis balls to be used in official competition is that, when dropped onto a rigid surface from a height of 2540 mm, the height of the first bounce of the ball must be in the range of  $1346 \text{ mm} \leq h \leq 1473 \text{ mm}$ . Determine the range of the coefficient of restitution of the tennis balls satisfying this requirement. [6]
- (c) Determine the magnitude and nature of force in all the members of the truss loaded and supported as shown in Fig. 5b by method of joint. [7]