Total No. of Questions—8]　　　　　[Total No. of Printed Pages—4+2

Seat
No.

[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]

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

(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]

$$z_1^2 + z_3^2 + 2z_2^2 = 2z_2\left(z_1 + z_3\right).$$

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) $\sinh ny = \dfrac{1}{2}\left(\tan^n x - \cot^n x\right),$

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

(C) Examine for linear dependance or independance for the given vectors and if dependance, 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) $\displaystyle\sum_{n=1}^{\infty} \left(\frac{2n+1}{3n+4}\right)5^n$

(ii) $\dfrac{1}{1+\sqrt{2}} + \dfrac{2}{1+2\sqrt{3}} + \dfrac{3}{1+3\sqrt{4}} + \ \text{............}$

(B) Prove that : [4]

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

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

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

Or

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

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

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

(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]

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

5.   Solve any *two* :

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

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

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]

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

show that :

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

[4756]-101   4

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 :

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

(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]

$$\left(x^2 + y^2 + 6x + 12\right).$$

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]

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

Total No. of Questions—8]　　　　　[Total No. of Printed Pages—4

Seat No.

[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.

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.

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]

Total No. of Questions—8]   [Total No. of Printed Pages—3

Seat
No.

[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]

3. *(a)* In shown in the following Fig. let R1 = R2 = 1 kΩ, R3 = 5 kΩ, Rf = 10 kΩ, V1 = –1V, V2 = 2V and V3 = 4V. Calculate Vo. [6]
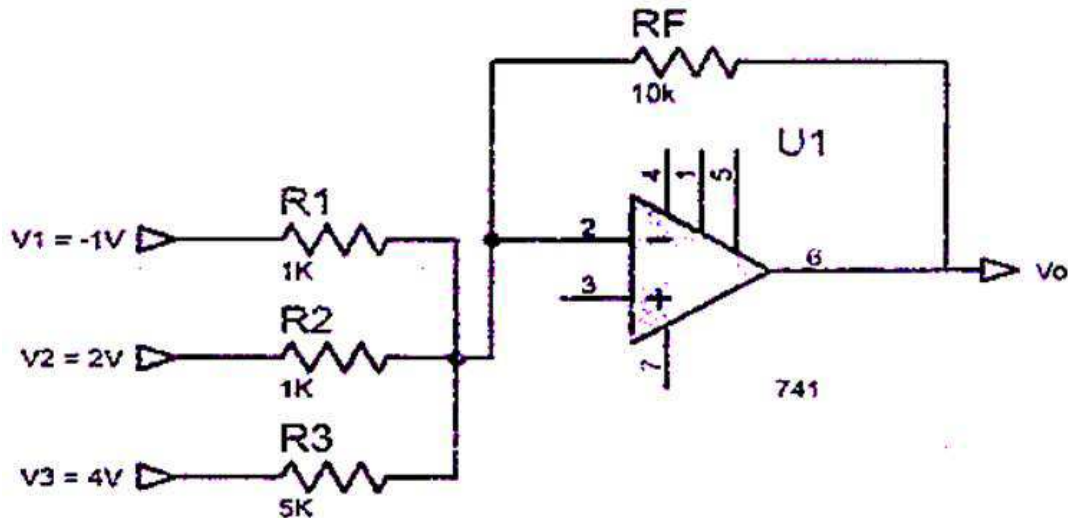
(b) State the IC number for the following two input logic gate : [6]

(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.

[4756]-103   2

(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]   [Total No. of Printed Pages—4

Seat
No.   **[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]

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 market 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 complemen-

tary 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 m^2 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]

<div align="center">*Or*</div>

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]　　　　[Total No. of Printed Pages—4+1

Seat
No.

[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]

2. A thin rectangular plate of size 70 mm × 40 mm appears as a square of side 40 mm in TV with one of its side inclined at 30º 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 45º to the HP and vertical plane containing that edge and axis inclined at 30º 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]
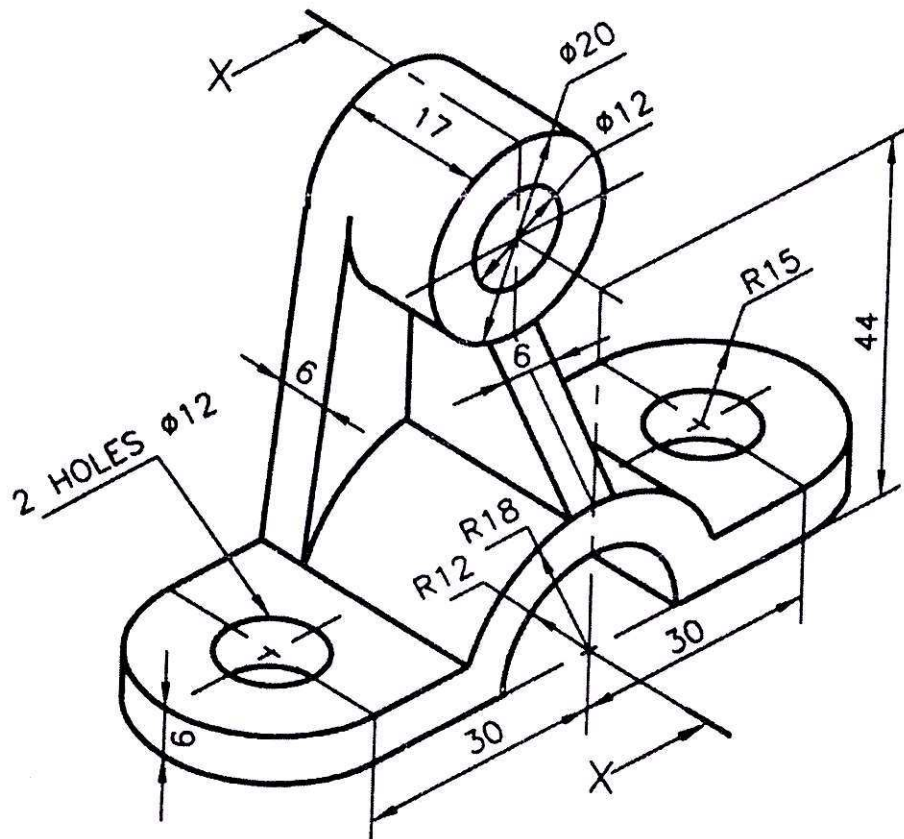
Fig. 1 C.I. Bracket

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
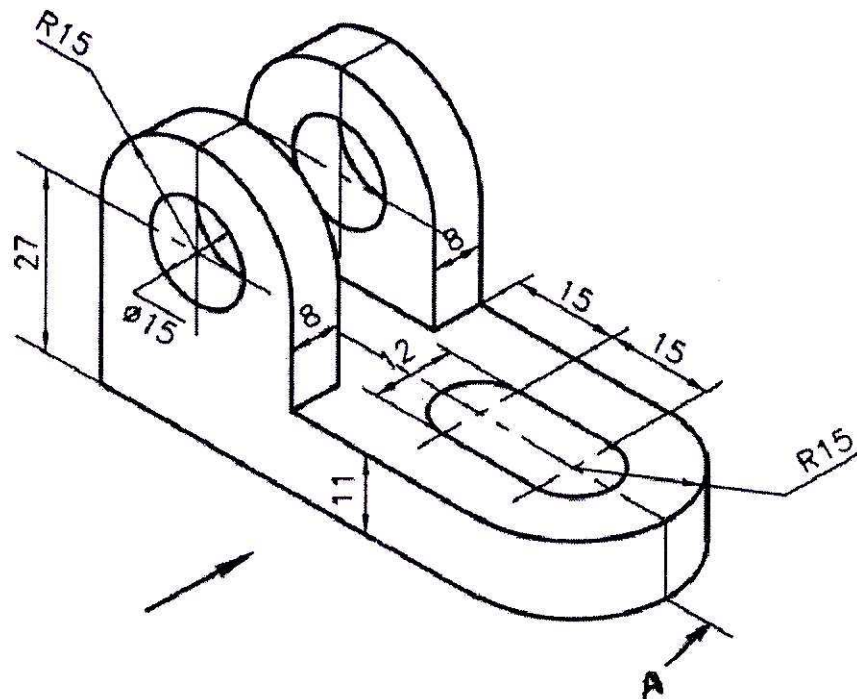
(*iii*) RHSV

Give all the dimensions

Fig. 2 C.I. Bracket

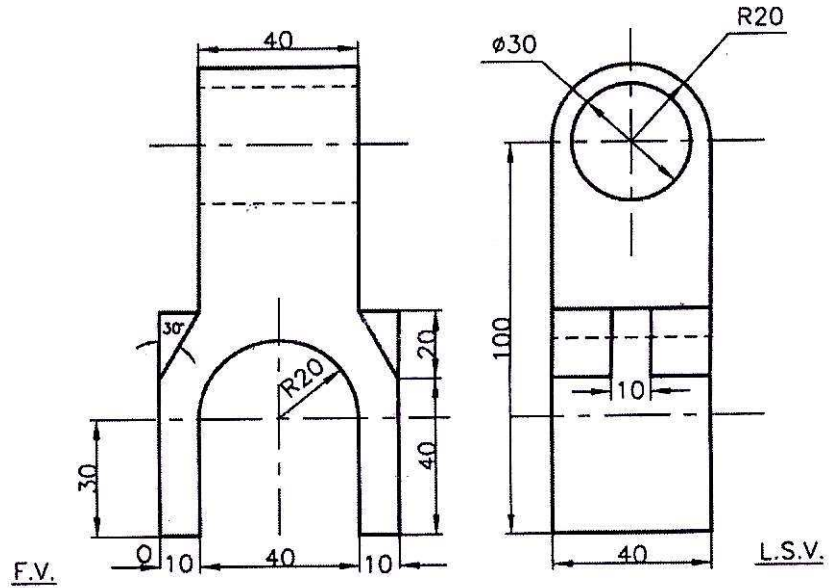**7.** Fig. 3 shows the FV and LHSV of an object. Draw the isometric views using natural scale. [12]

Fig. 3

Or

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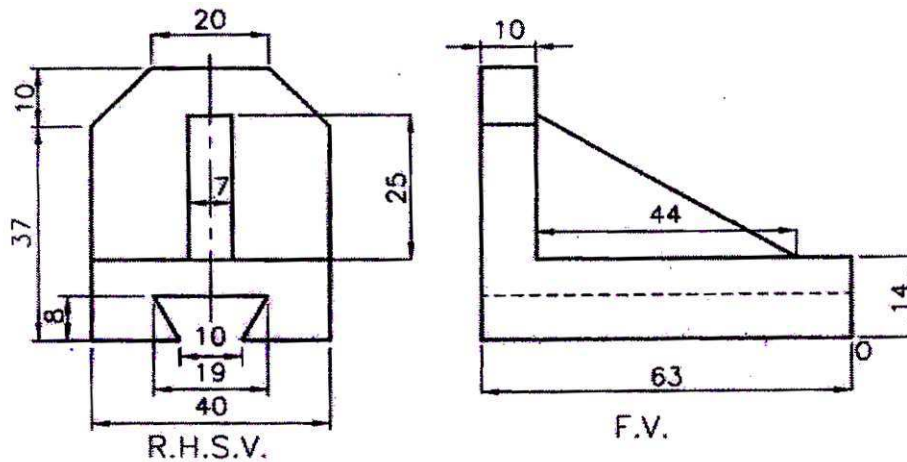
Fig. 4

Total No. of Questions—12]   [Total No. of Printed Pages—7

[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]

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

(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 :

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

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

[5]

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

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

Or

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

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

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

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

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

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

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

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

(B) If $y = A \cos(\log x) + B \sin(\log x)$ then show that $x^2 y_{n+2} + (2n + 1)x\, y_{n+1} + (n^2 + 1)y_n = 0$. [5]

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

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

(*ii*) $1 - \dfrac{1}{\sqrt{2}} + \dfrac{1}{\sqrt{3}} - \dfrac{1}{\sqrt{4}} \ldots\ldots$

Or

6. (A) If $y = \sin^{-1}(3x - 4x^3)$, prove that : [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 nth order differential coefficient of y w.r.t. x. [5]

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

(*i*) $\dfrac{2}{1} + \dfrac{3}{8} + \dfrac{4}{27} + \dfrac{5}{64} \ldots + \dfrac{n+1}{n^3} \ldots$

(*ii*) $\dfrac{x}{1.2} + \dfrac{x^2}{3.4} + \dfrac{x^3}{5.6} + \dfrac{x^4}{7.8} + \ldots$

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 $\lim\limits_{x \to 0} \dfrac{\sin 2x + p \sin x}{x^3}$ is finite, then find the value of

p and hence the value of the limit.

(*b*) Evaluate :

$$\lim\limits_{x \to 0} \left(\frac{1}{x}\right)^{2\sin x}.$$

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

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

(*b*) Evaluate

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

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

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

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

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

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]

Total No. of Questions—**6**]　　　　[Total No. of Printed Pages—**3**

Seat
No.

[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]

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 $KMnO_4$ in acidic medium.

[At.wt K = 39, Mn = 55, O = 16] [4]

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]

Total No. of Questions—6]   [Total No. of Printed Pages—4

Seat
No.

[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 :

$h = 6.63 \times 10^{-34}$ J–s

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

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

$m_e = 9.1 \times 10^{-31}$ 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^2 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 = 5.5×10^{-3} m, Y = 8.0×10^{10} N/m^2, ρ = 2.65×10^3 kg/m^3. [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]

$$\mu_e = 1.592, \ \mu_0 = 1.586, \ \lambda = 5890 \ \text{Å}.$$

Or

6. (*a*)   Define unclear 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 1.384×10^3 wb to 8.44×10^2 wb in half of a minute. What would be the energy of an electron which undergoes 2×10^6 revolutions ? [4]

Total No. of Questions—12]   [Total No. of Printed Pages—4+2

Seat
No.

[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 mm^2 and length of 10 m takes a current of 4A from 200 V supply at temperature of 25ºC. Find :   [10]

         (*i*)   Resistivity of material

         (*ii*)   Current it will take when temp rises to 75ºC.

         Assume α_{25} = 0.0003/ºC

    (*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 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 Ω and inductane of 0.1 H is connected in series across single-phase 200 V, 50 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 Ω, inductance of 64 mH and capacitor of 80 μF are connected in series across 110 V, 50 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 is a transforms;

(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.

Total No. of Questions—12]   [Total No. of Printed Pages—4+2

Seat
No.

[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]

(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^2 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]

Total No. of Questions—12]   [Total No. of Printed Pages—8+2

Seat
No.

[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.

(2)   Top View (Plan) (show all the necessary dotted lines).

(3)   LHSV

(4)   Give the entire dimensions.   [7+6+5+2=20]
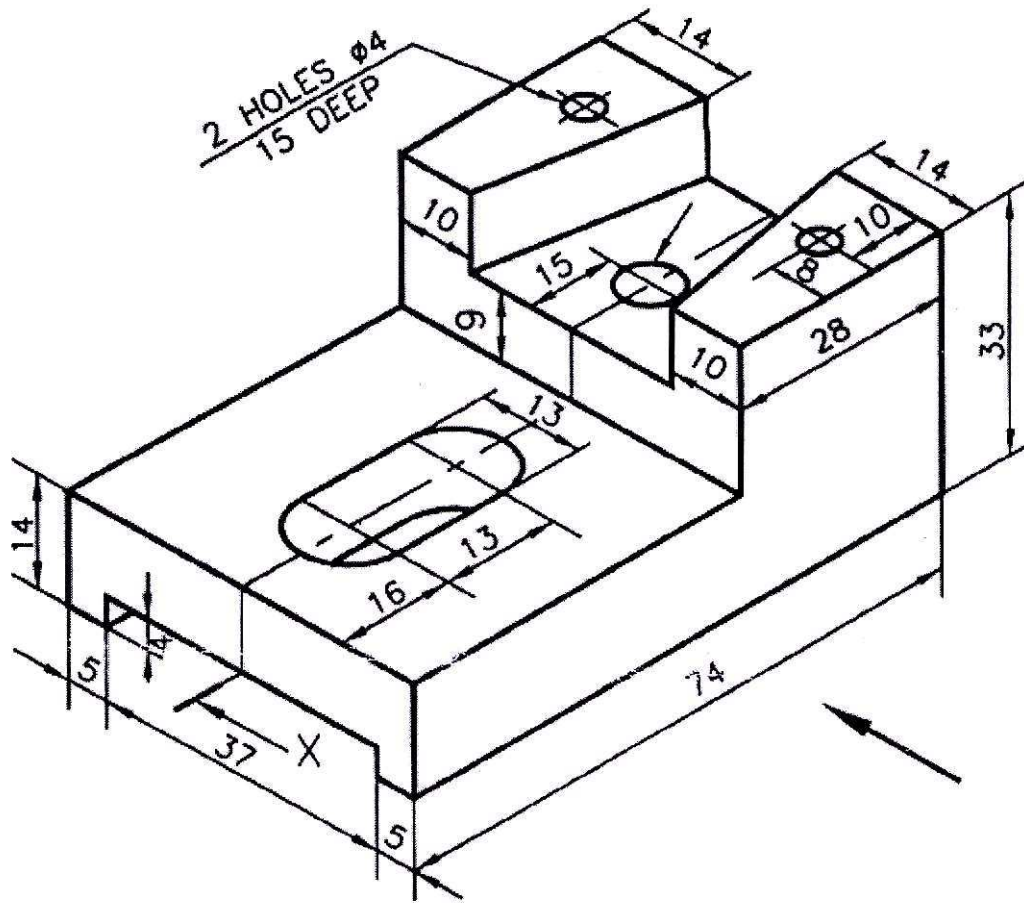
Fig. 1

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]
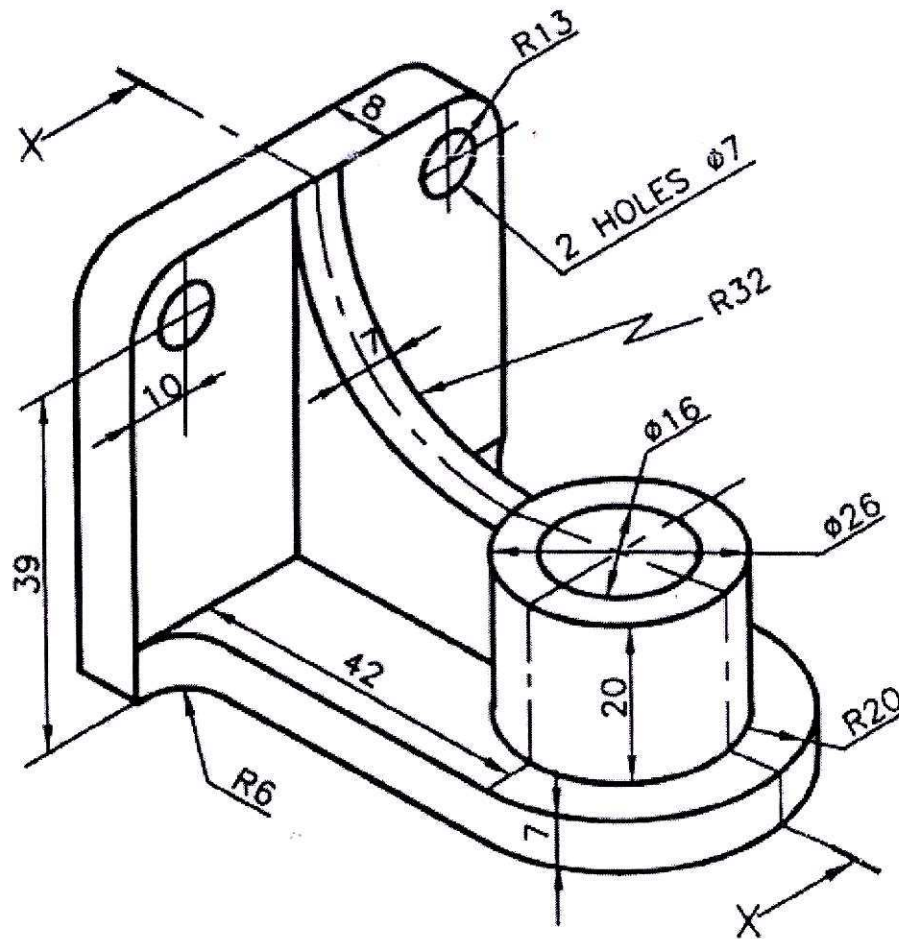
Fig. 2

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]
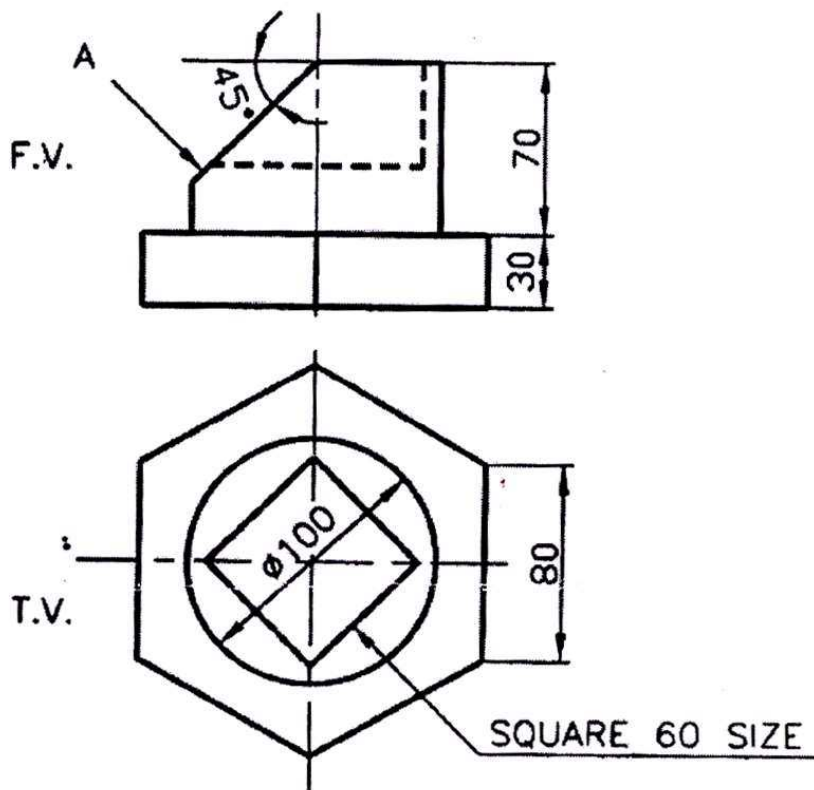
Fig. 3.

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]
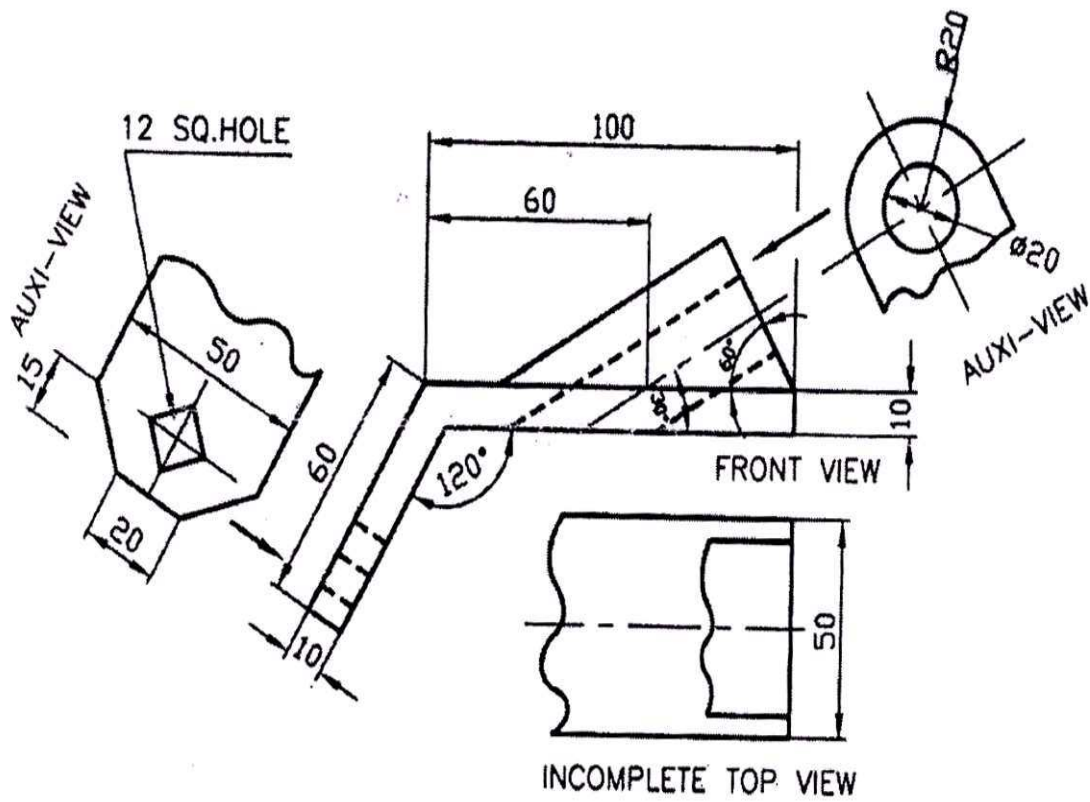
Fig. 4

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 vou 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]
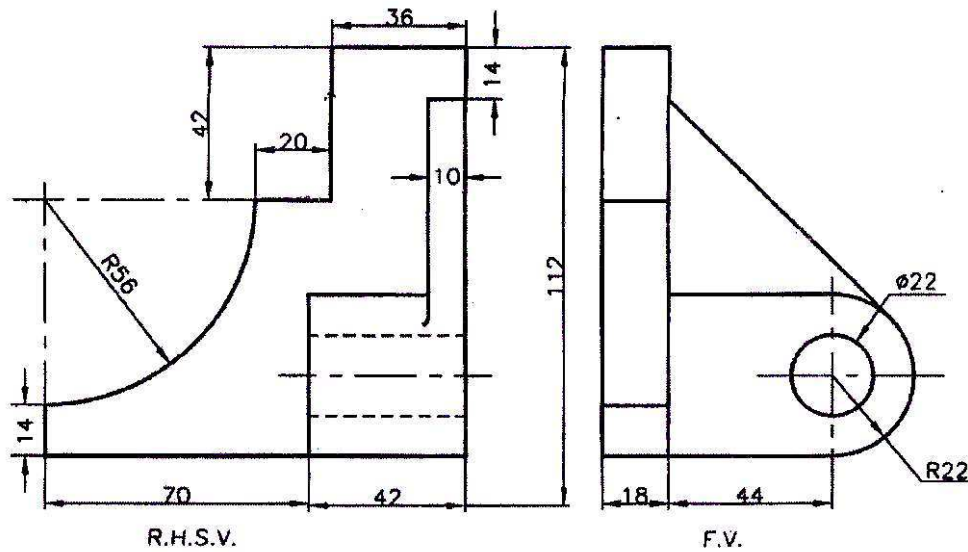
Fig. 6

Unit V

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

     Give all the dimensions.   [7+4+6+3=20]
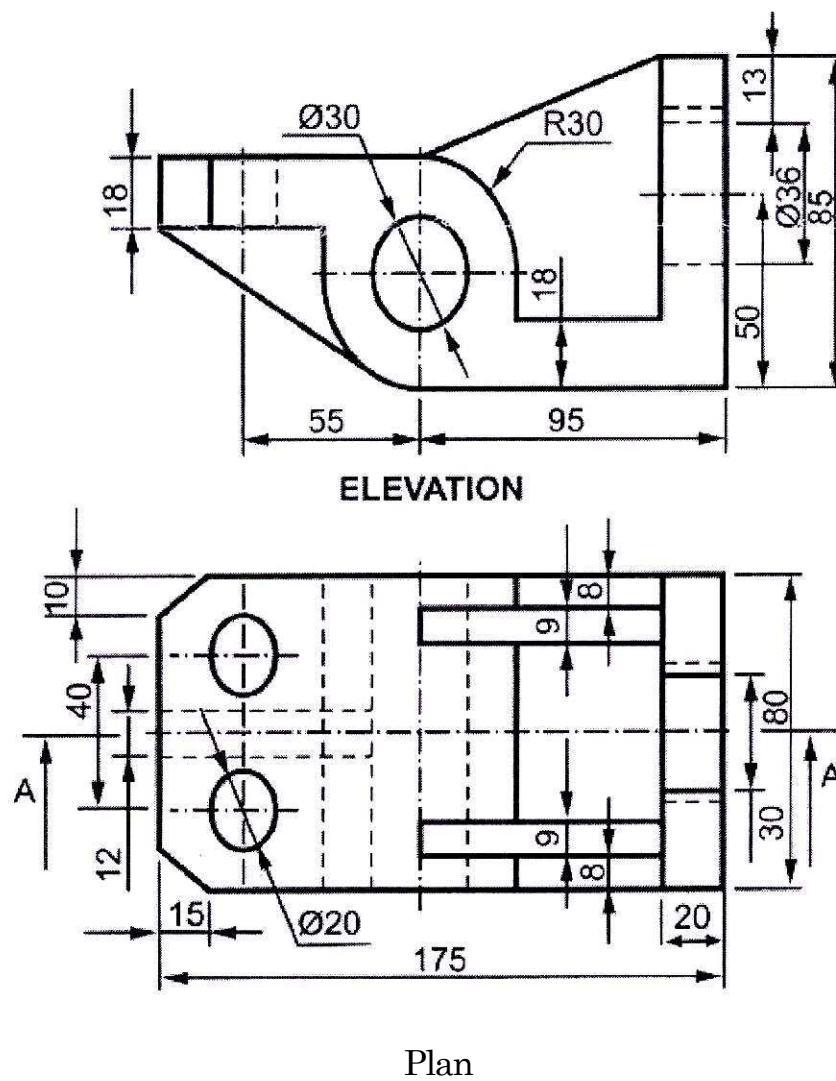
ELEVATION

Plan

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]
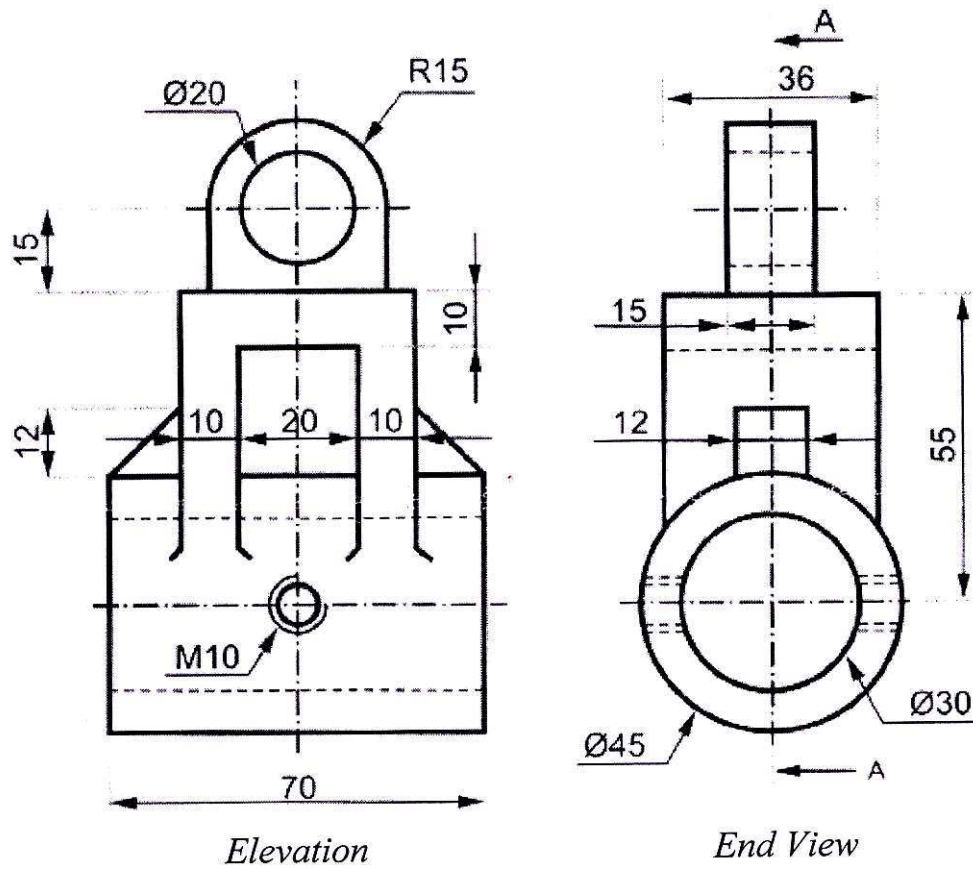
Fig. 8

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—8]　　　　[Total No. of Printed Pages—4+2

Seat
No.

[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*) $\dfrac{dy}{dx} = \cos x \cos y + \sin x \sin y$

(*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 :

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

P.T.O.

Given :

L = 640 H, R = 250 Ω, E = 500 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 100ºC is placed in a room whose
temperature is 20ºC and cools to 60ºC in 5 minutes. Find
its temperature after a further inrerval 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 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 200ºC and outer surface of the covering
is at 30ºC.

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 $I_n = \dfrac{1}{n - 1} - I_{n-2}$. 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 $\dfrac{x - 1}{2} = \dfrac{y + 1}{1} = \dfrac{z - 2}{-2}$ and semi-vertical angle is 45º. [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 at 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]

[4756]-201   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 $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} + \dfrac{z^2}{c^2} = 1$.

(*c*)   Prove that the moment of inertia of the area included between

the curves $y^2 = 4\,ax$ and $x^2 = 4ay$ about x-axis is $\dfrac{144}{35} Ma^2$,

where M is the mass of the area included between the

curves.   [7]

Total No. of Questions—6]　　　　[Total No. of Printed Pages—8+2

Seat
No.

[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°. Refer Fig. 1(*a*) : [4]
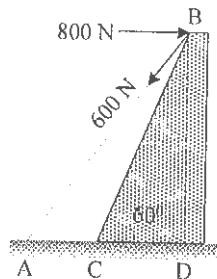
Fig. 1(*a*)

(*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]
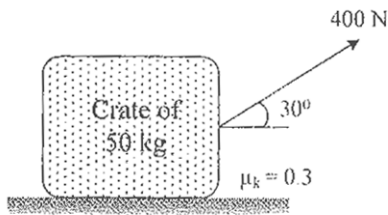
Fig. 1(*b*)

(*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]
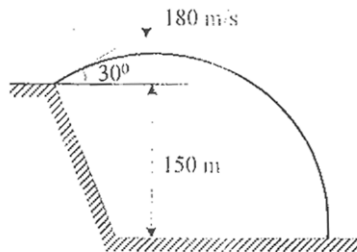
Fig. 1(*c*)

(*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]
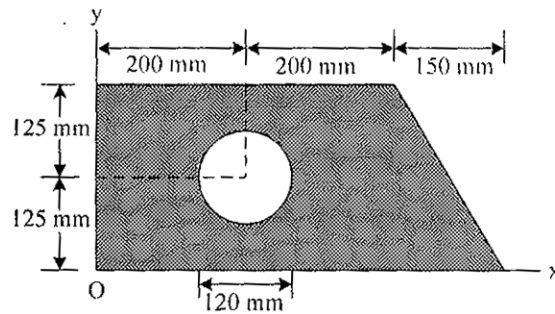
Fig. 2(*a*)

(*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 ρ = 60 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 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]
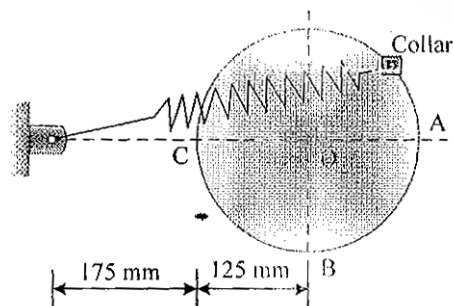
Fig. 2(*d*)

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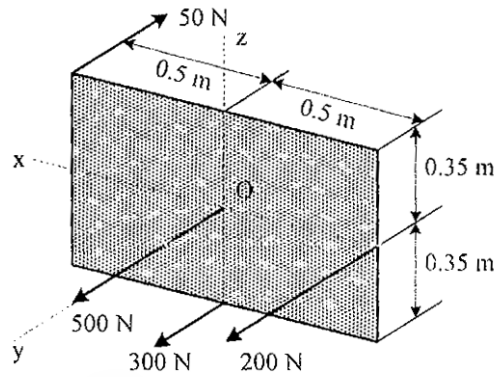
Fig. 3 (*a*)

(*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]
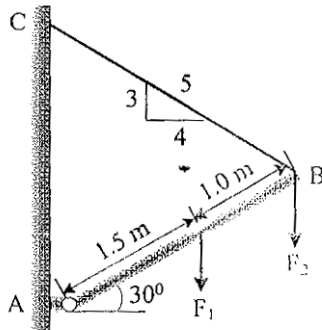
Fig. 3(*b*)

(*c*)   Determine the support reaction of the beam loaded and supported

as shown in Fig. 3(*c*) :   [5]
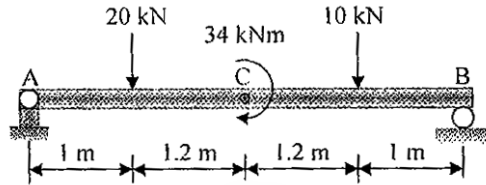
Fig. 3(*c*)

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]
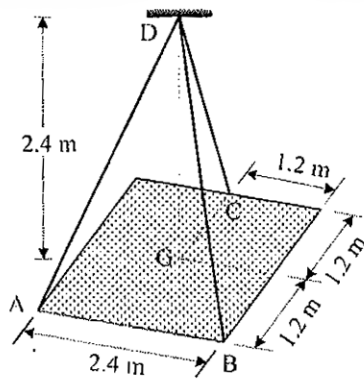
Fig. 4(*a*)

(*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]
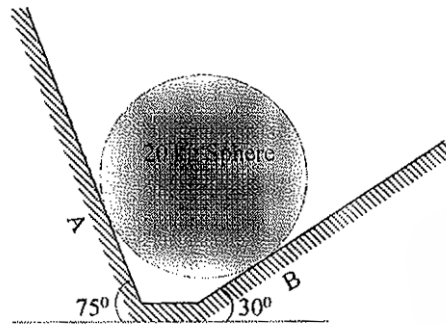
Fig. 4(*b*)

(*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]
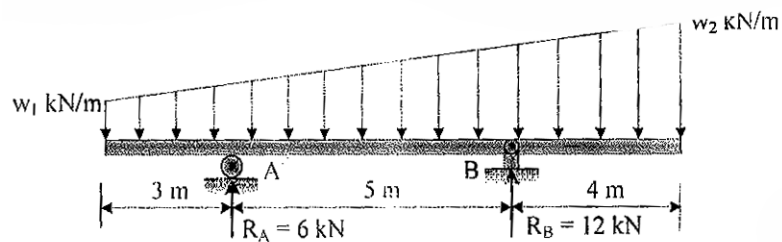

Fig. 4(*c*)

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]
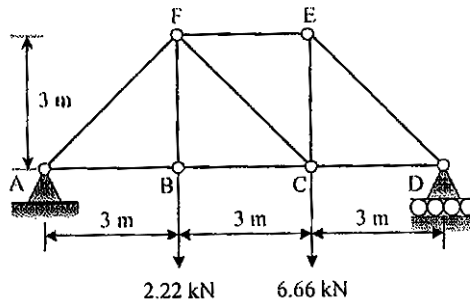

Fig. 5 (*a*)

(*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]
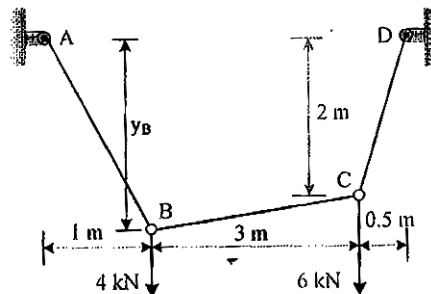

Fig. 5 (*b*)

(*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 μ_s = 0.25. The mass centre of the man is directly above his feet. [6]
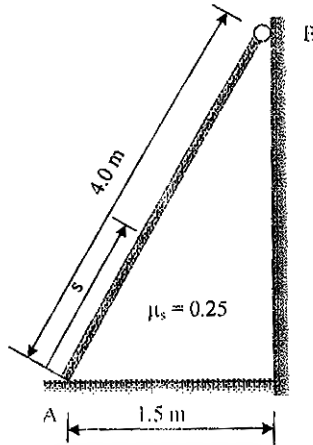

Fig. 5 (*c*)

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 μ_s = 0.1. [6]
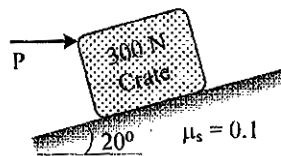

Fig. 6 (*a*)

(*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]
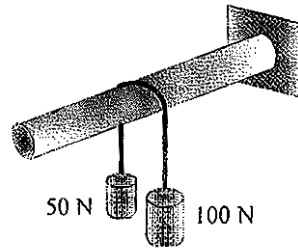

50 N   100 N

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]

D → 100 N   E
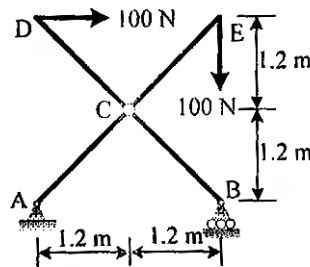
1.2 m

C   100 N

1.2 m

A   B

1.2 m   1.2 m

Fig. 6 (*c*)

Total No. of Questions—8]   [Total No. of Printed Pages—4+1

Seat
No.

[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]

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

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

Seat
No.

[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

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

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

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

$m_p = 1.67 \times 10^{-27}$ 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 A.U. 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 K and T > 0 K.   [3]

(*c*)   Calculate the number of acceptors to be added to a germanium sample to obtain the resistivity of 10 Ω cm.   [3]
(μ = 1700 cm^2/V.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, $\mu_0 = 1.586$ $\mu_e = 1.592$. [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

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]

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 Ω at 20°C. When the coil is connected across a 240 V supply, the current after several hours is 1.25 A. Calculate the temperature of the coil, assuming the temp. co-efficient of resistance of copper at 20°C to be 0.0039 per °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 kVA transformer has 400 turns on its primary and 1000 secondary turns. The net cross-sectional area of the core is 60 cm². When the primary winding is connected to 500 V, 50 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

$i = 5.48 \sin \omega t$:   [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 Ω.

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 $Z_1 = (100 + j0)$ Ω is connected in series with another impedance $Z_2 = (50 + j80)$ Ω. 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 $(15 + j12)$ Ω. 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 6 Ω resistance.   [7]
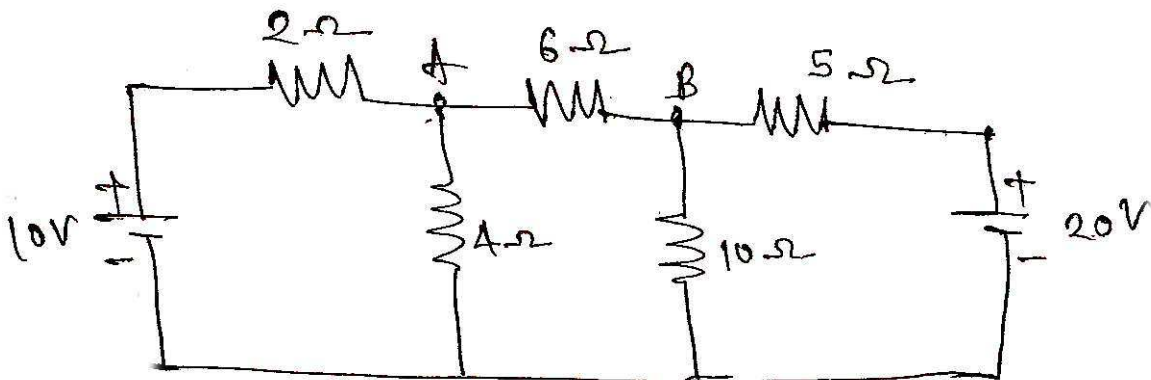

Fig. 1

Or

8. (*a*) Derive the expressions to convert delta connected resistances into equivalent star circuit. [6]

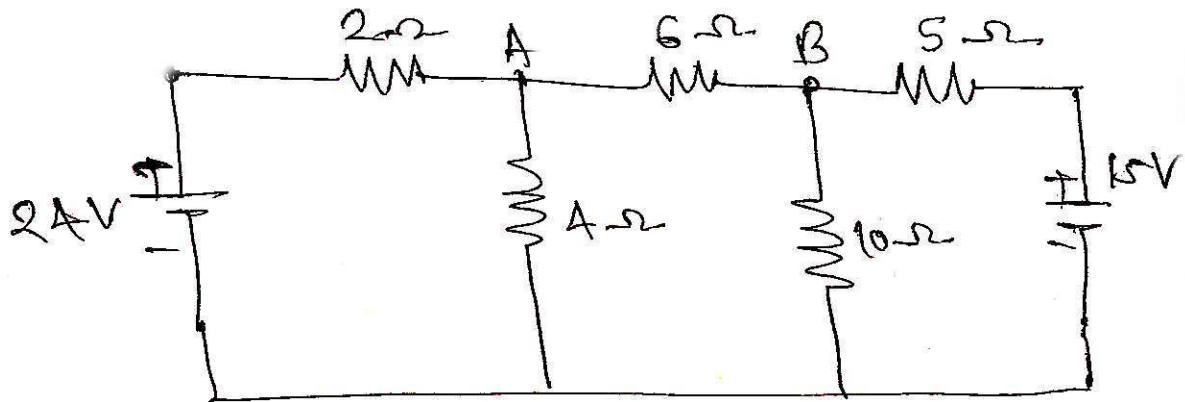(*b*) Using Thevenin's Theorem, determine the value of current flowing through 6 Ω resistance. [7]

Fig. 2

Total No. of Questions—12]   [Total No. of Printed Pages—8

Seat
No.

[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) $\dfrac{dy}{dx} = (4x + y)^2$

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

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

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

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

(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 Ω resistor and 0.01 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°C is placed in a room whose temperature is 20°C and cools to 60°C in 5 minutes. What is time required to reach temperature of body at 40°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°C and outer surface is at 50°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°C at time $t = 0$, it is placed in a water which is maintained at 40°C. If the temperature of the ball reduces to 60°C in 4 minutes, find the time at which the temperature of ball is 50°C

5.   (a)   Find the Fourier series for :

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

and hence deduce that :   [9]

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

(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]

t (sec) :	0	T/6	T/3	T/2	2T/3	$\dfrac{5T}{6}$	T
A (amp) :	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 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*) $x = t^2, \ y = t - \dfrac{t^3}{3}$

(*b*) Show that : [4]

$$\int_{0}^{\infty} e^{-x^2 - 2ax} \, dx = \frac{\sqrt{\pi}}{2} \, e^{a^2} [1 - erf(a)]$$

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

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

[4756]-21   6

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°. [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°. [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**

Seat
No.

[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 H_2SO_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 $BaSO_4$ precipitate. Calculate percentage of sulphur. [4]

  P.T.O.

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 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

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

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

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

$m_e = 9.1 \times 10^{-31}$ 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 $h/\sqrt{2meV}$.   [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 7.2×10^{-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 Ω-m and the Hall coefficient is 3.6×10^{-4} m^3/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

Seat
No.

[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.

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, $\sigma = 5.67 \times 10^{-8}$ W/m^{2}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.

[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.

(*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 B_{dc} = 200, neglect V_{CE} (sat). [6]
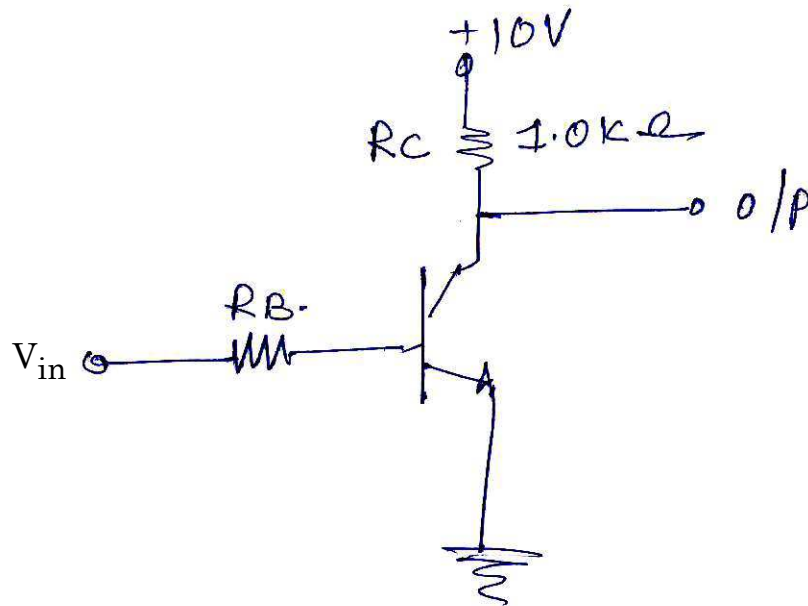
Fig. 1

(*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]
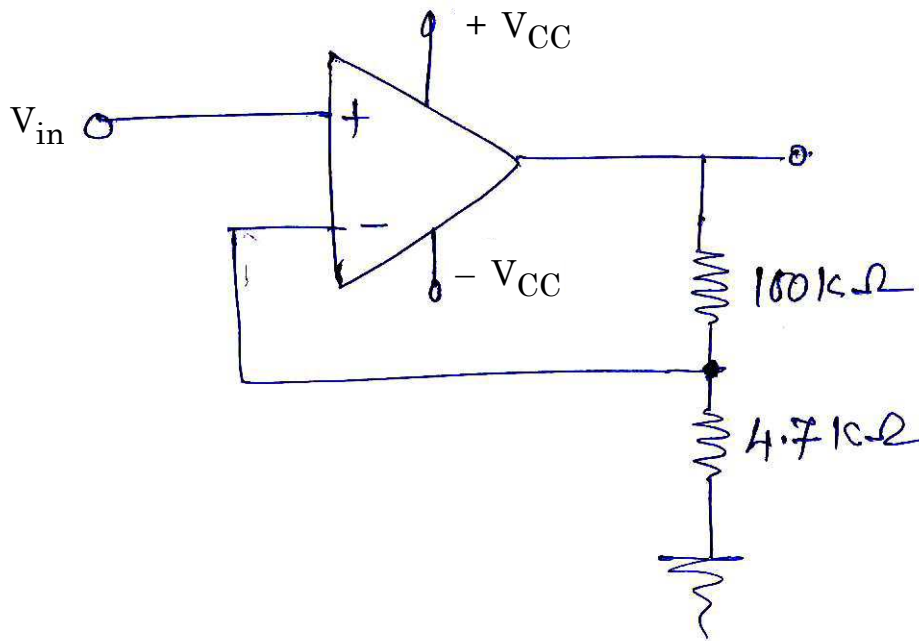
Fig. 2

(*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

Seat
No.

[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° and their

resultant is 2500 N. The resultant makes an angle of 45° 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]
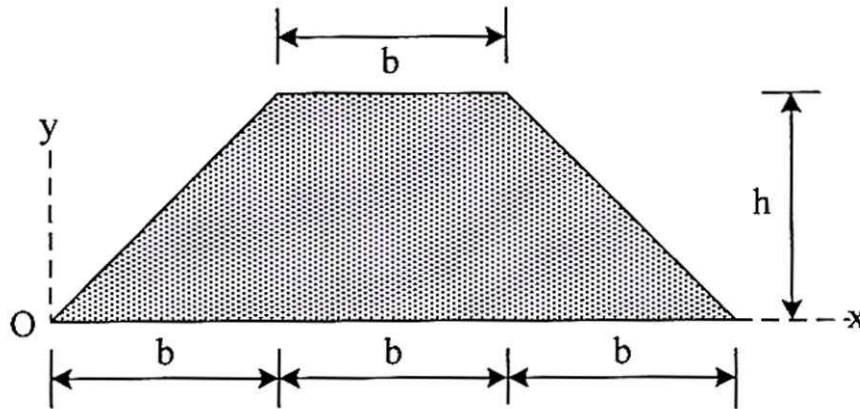
Fig. 2a

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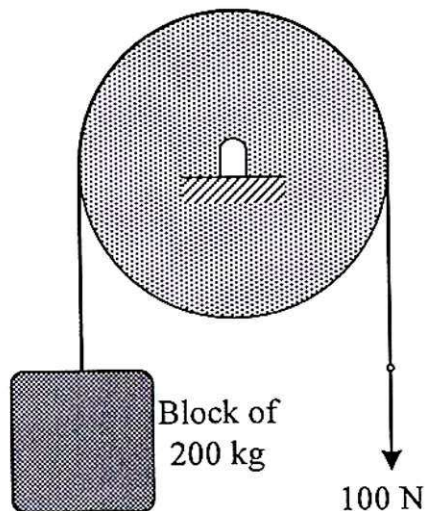
Fig. 2b

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]
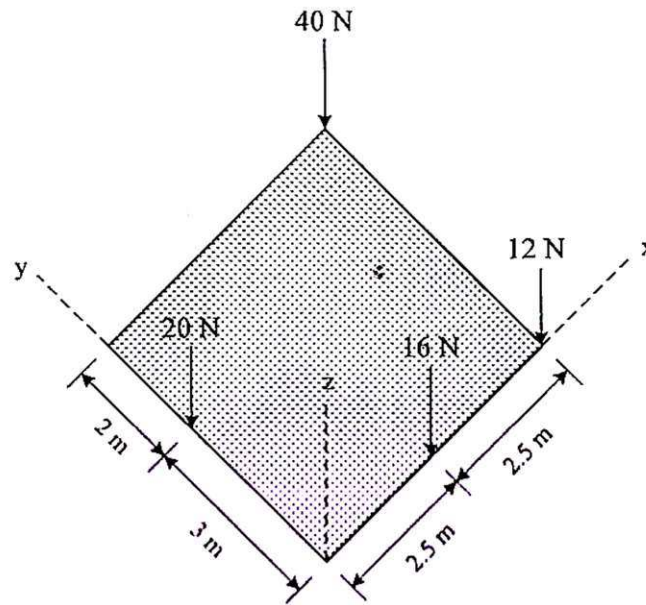
Fig. 3a

(*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]
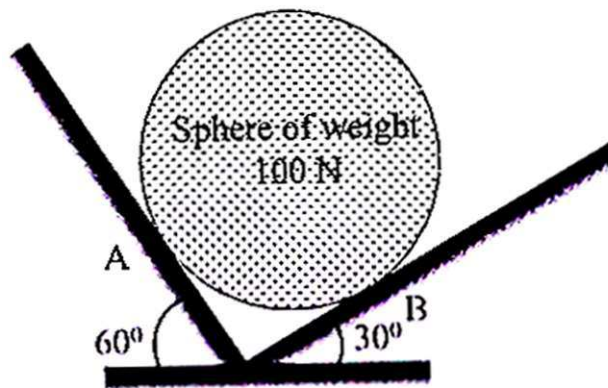
Fig. 3b

(*c*)   A cricket ball shot by a batsman from a height of 1.8 m at an angle of 30° 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]
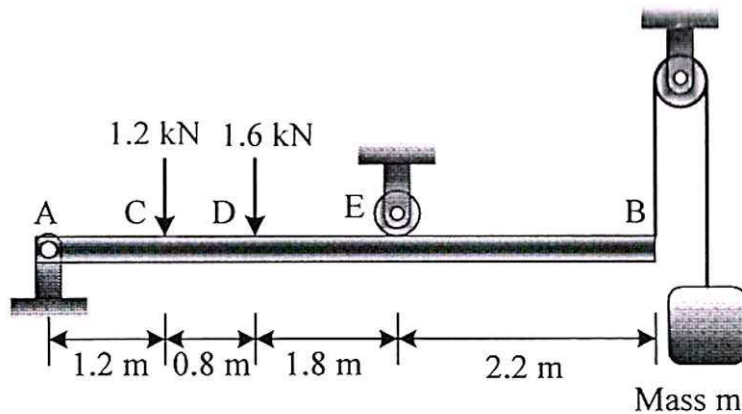
Fig. 4a

(*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]
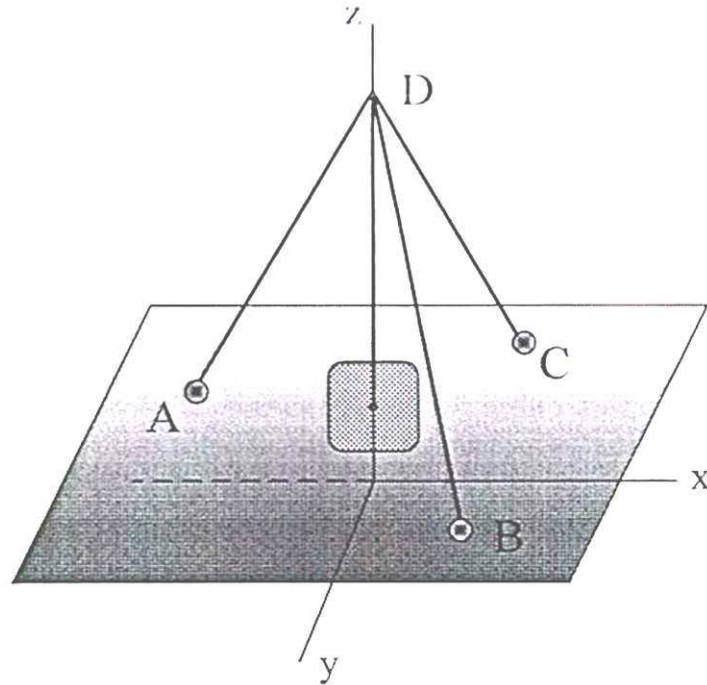

Fig. 4b

(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]
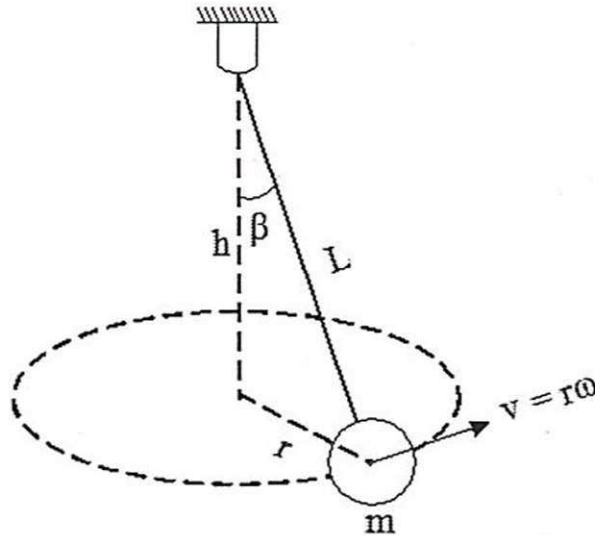

Fig. 4c

5. (*a*) A block weighing 200 N is pulled up a 30° 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]
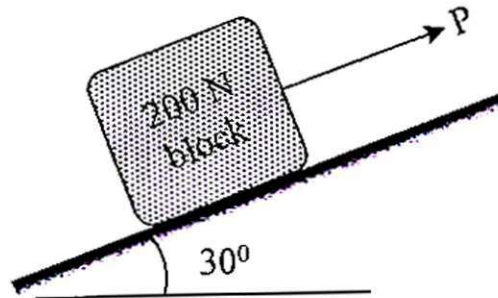

Fig. 5a

(*b*) Determine the mganitude 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]
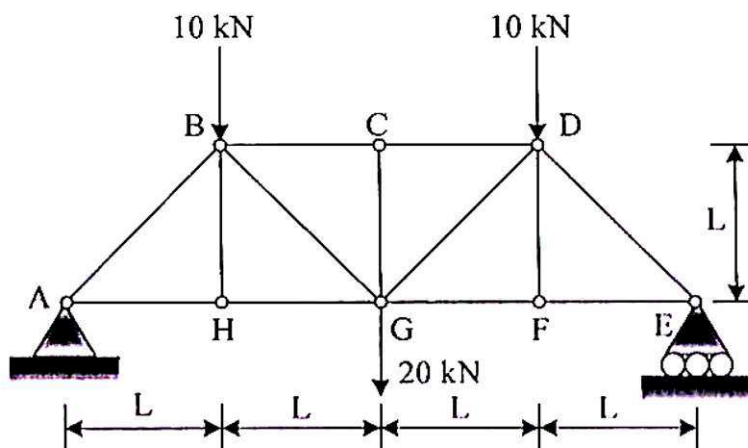

Fig. 5b

(c)   A 200 N block is rest on a plane which makes an angle 30°
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 μ_s = 0.2. Determine the range of values
of the weight of block A for which equilibrium is maintained,
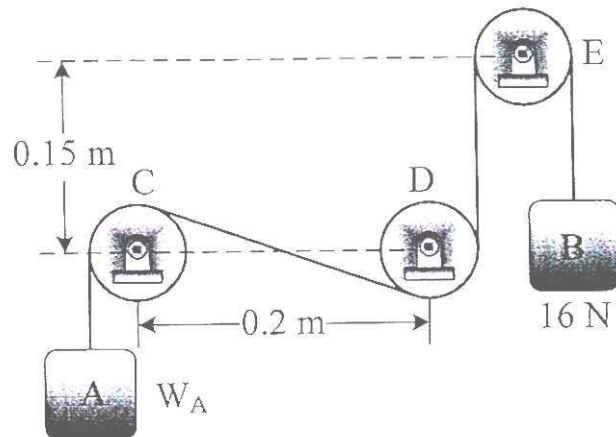if the pulley D is free to rotate.   [6]

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 mm $\leq h \leq$ 1473 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]