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

Seat No.	

[4956]-1

F.E. EXAMINATION, 2016
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*) Answer to the two Sections should be written in separate asnswer-book.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Reduce the matrix :

$$A = \begin{bmatrix} 5 & 3 & 14 & 4 \\ 0 & 1 & 2 & 1 \\ 1 & -1 & 2 & 0 \end{bmatrix}$$

to echelon form and determine its rank. [5]

(*b*) Discuss consistency and solve if consistent : [6]

$$\begin{aligned} x + y + z &= 6 \\ x - y + 2z &= 5 \\ 3x + y + z &= 8 \\ 2x - 2y + 3z &= 7 \end{aligned}$$

P.T.O.

(*c*) Verify Cayley-Hamilton theorem for the matrix : [6]

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Or

2. (*a*) Find eigen values and eigen vectors for the matrix : [6]

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

(*b*) Examine for linear dependence or linear independence of vectors :

$x_1 = (1, 1, -1)$, $x_2 = (2, 3, -5)$, $x_3 = (2, -1, 4)$

If dependent, find the relation between them. [6]

(*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. Find A^{-1}. [5]

3. (*a*) Find z if $\arg(z + 2i) = \frac{\pi}{4}$ and $\arg(z - 2i) = \frac{3\pi}{4}$. [5]

(*b*) Find all values of $(1 + i)^{1/5}$, show that their product is $1 + i$. [5]

(*c*) If $\log(\tan x) = y$ prove that : [6]

(*i*) $\cosh ny = \frac{1}{2}(\tan^n x + \cot^n x)$

(*ii*) $\sinh ny = \frac{1}{2}(\tan^n x - \cot^n x)$

Or

4. (*a*) If

$$2\cos\phi = x + \frac{1}{x} \text{ and } 2\cos\theta = y + \frac{1}{y}$$

then prove that : [5]

$$x^m y^n + \frac{1}{x^m y^n} = 2\cos(m\phi + n\theta)$$

(*b*) Prove that i^i is wholly real and find its principal value. Also show that the values of i^i form a G.P. [5]

(*c*) If $\tan(\alpha + i\beta) = x + iy$ prove that :

(*i*) $x^2 + y^2 + 2x \cot 2\alpha = 1$

(*ii*) $x^2 + y^2 - 2y \coth 2\beta + 1 = 0$ [6]

5. (*a*) Find *n*th derivative of : [5]

$$\frac{1}{x^2 - 4x + 3}$$

(*b*) If

$$y = A\cos\log x + B\sin\log x$$

then prove that :

$$x^2 y_{n+2} + (2n + 1)\, xy_{n+1} + (n^2 + 1)\, y_n = 0$$ [6]

(*c*) Discuss convergence or divergence (any *one*) : [6]

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

(*ii*) $\frac{1}{1.3} + \frac{2}{3.5} + \frac{3}{5.7} + \frac{4}{7.9} + \ldots\ldots + \ldots$

Or

6. (*a*) Find *n*th derivative of : [5]

$$y = \tan^{-1}\left(\frac{2x}{1 - x^2}\right)$$

(*b*) If

$$y = (x + \sqrt{x^2 - 1})^m$$

then prove that : [6]

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

(*c*) Attempt (any *one*) : [6]

(*i*) Test absolute or conditional convergence of :

$$1 - \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + \frac{1}{16} - \ldots\ldots$$

(*ii*) Determine the interval of convergence for the series :

$$\sum_{n=0}^{\infty} \frac{2^n x^n}{n!}$$

SECTION II

7. (*a*) Expand $(1 + x)^x$ in a series upto a term in x^4. [6]

(*b*) Expand :

$$x^4 - 3x^3 + 2x^2 - x + 1$$

in power of $(x - 3)$. [5]

(*c*) Attempt the following (any *one*) : [6]

(*i*) Evaluate :

$$\lim_{x \to 0} \frac{e^{2x} - (1 + x)^2}{x \log (1 + x)}$$

(*ii*) If

$$\lim_{x \to 0} \frac{\sin 2x + p \sin x}{x^3}$$

is finite then find the value of p and hence the value of the limit.

Or

8. (*a*) Expand :

$$\log \cos \left(x + \frac{\pi}{4} \right)$$

using Taylor's theorem in ascending powers of x. [6]

(*b*) Expand $\sqrt{1 + \sin x}$ up to x^6. [5]

(*c*) Attempt the following (any *one*) : [6]

(*i*) Evaluate :

$$\lim_{x \to \infty} \left\{ x - x^2 \log \left(1 + \frac{1}{x} \right) \right\}$$

(*ii*) Find a, b, c if :

$$\lim_{x \to \infty} \frac{ae^x - b \cos x + ce^{-x}}{x \sin x} = 2$$

9. (*a*) If $u = x^y$, then show that : [5]

$$\frac{\partial^3 u}{\partial x^2 \partial y} = \frac{\partial^3 u}{\partial x \partial y \partial z}$$

(*b*) If $x^2 = au + bv$, $y = au - bv$, then prove that : [6]

$$\left(\frac{\partial u}{\partial x} \right)_y \left(\frac{\partial x}{\partial u} \right)_v = \left(\frac{\partial v}{\partial y} \right)_x \left(\frac{\partial y}{\partial v} \right)_u$$

(*c*) If [6]

$$u = \frac{x^2 y^2 z^2}{x^2 + y^2 + z^2} + \cos\left(\frac{xy + yz}{x^2 + y^2 + z^2}\right)$$

show that :

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

Or

10. (*a*) If $u = f(r)$ where $r = \sqrt{x^2 + y^2 + z^2}$, then prove that : [6]

$$u_{xx} + u_{yy} + u_{zz} = f''(r) + \frac{2}{r} F'(r)$$

(*b*) If

$$v = f(e^{x-y}, e^{y-z}, e^{z-x})$$

then show that : [5]

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

(*c*) If

$$u = \operatorname{cosec}^{-1}\sqrt{\frac{x^{1/2} + y^{1/2}}{x^{1/3} + y^{1/3}}}$$

show that : [6]

$$x^2\frac{2\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \frac{\tan u}{12}\left(\frac{13}{12} + \frac{\tan^2 u}{12}\right)$$

11. (*a*) For the transformation : [5]

$$x = e^u \cos v,\ y = e^u \sin v$$

prove that JJ' = 1.

(*b*) If [5]

$$u^2 + xv^2 - uxy = 0,\ v^2 - xy^2 + 2uv + u^2 = 0$$

find $\frac{\partial u}{\partial x}$ by proper choice of dependent and independent variable. [5]

(*c*) Find maximum value of : [6]

$$x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$$

Or

12. (*a*) If

$$u = x + y + z,\ v = x^2 + y^2 + z^2,\ w = xy + yz + zx$$

examine whether u, v, w are functionally dependent. If so, find the relation between them. [5]

(*b*) Find the possible percentage error in computing the parallel resistance '*r*' of three resistance r_1, r_2, r_3 from the formula :

$$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$$

if r_1, r_2, r_3 are each in error by 1.2 %. [5]

(*c*) Divide 24 into three parts such that the continued product of the first, square of the second and cube of the third may be maximum. [6]

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

Seat No.	

[4956]-2

F.E. (First Sem.) EXAMINATION, 2016

APPLIED SCIENCE—I (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*) 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*) Define Atomic Packing Factor (APF). Calculate APF for SC, BCC and FCC unit cells of cubic crystal. [7]

(*b*) (*i*) Draw the following planes in a cubic system : [2]

(*a*) 100

(*b*) 111.

(*ii*) Show that radius ratio for ionic crystals with co-ordination No. 3 is 0.155. [4]

P.T.O.

(*c*) At what glancing angle would the first order diffraction from (110) plane of NaCl be observed using X-ray of wavelength 150 pm. The dimension of unit cell is 300 pm. [4]

Or

2. (*a*) What are the types of symmetries for crystals ? Explain them for a cubic crystal. [7]

(*b*) Explain structural features, properties and applications of fullerence. [6]

(*c*) Define : [4]

(*i*) Unit cell

(*ii*) Co-ordination Number

(*iii*) Anisotropy

(*iv*) Crystallography.

3. (*a*) Explain the strong acid-strong base titration curve with suitable indicator. Also give the formulae for calculation of pH before and after equivalence point. [7]

(*b*) (*i*) Calculate equivalent weight of $KMnO_4$ oxidising reagent in acidic medium.

(Atomic weights : K = 39, Mn = 55, O = 16) [3]

(*ii*) Define : [3]

(*a*) Equivalence Point

(*b*) Normality

(*c*) Molarity.

(*c*) 50 ml of NaCl solution requires 38.6 ml of M/50 $AgNO_3$ in Mohr's method. Calculate amount of chloride ion per litre of NaCl solution. [4]

Or

4. (*a*) What is complexometric titration ? Explain direct titration with EDTA. [7]

(*b*) What is Precipitation titration ? Explain Mohr's method for determination of Cl^- ions. [6]

(*c*) What are the characteristics of primary standard substances ? [4]

5. (*a*) What is glass transition temperature ? Explain the factors affecting Tg. [6]

(*b*) Give preparation reaction, properties and uses of any *two* of the following : [6]

(*i*) Polypropylene

(*ii*) HDPE

(*iii*) SBR.

(*c*) Explain free-radical chain reaction mechanism with suitable example. [4]

Or

6. (*a*) What is Vulcanisation of rubber ? Give the structural changes and effect on properties of natural rubber on vulcanisation by sulphur. [6]

(*b*) Explain compounding of Plastics. [6]

(*c*) Distinguish between thermosoftening and thermosetting resins. [4]

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

Seat No.	

[4956]-3

F.E. (First Semester) EXAMINATION, 2016

APPLIED SCIENCE—I (PHYSICS)

(2008 PATTERN)

Time : Two Hours **Maximum Marks : 50**

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

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

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

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

1. (A) Draw a neat labelled diagram of Michelson's Interferometer and explain how it is used to determine the wavelength of unknown source of light ? [7]

(B) Derive the expression of displacement produced by an electron when it passes through perpendicular electric field. [6]

(C) In Newton's ring experiment the diameter of 12th dark ring is 0.700 cm. Find the radius of curvature of planoconvex lens. Given $\lambda = 6000$ A.U. [4]

P.T.O.

Or

2. (A) Explain with neat diagram the principle, construction and working of Bain bridge Mass Spectrograph. [7]

(B) Derive the expression for condition of maxima and minima for reflected light in case of thin transparent film of uniform thickness. [6]

(C) Electrons accelerated by potential of 150 V enter in an electric field at an angle of 50° with normal to the interface of higher potential to get refracted at an angle of 35° with the normal. Find the potential difference between the two regions. [4]

3. (A) Explain the Fraunhofer diffraction at a single slit and obtain the condition for principal maximum and minimum. Draw intensity distribution curve. [7]

(B) What is magnetostriction effect ? Draw a neat diagram and explain how magnetostriction oscillator is used for the production of ultrasonic waves. [6]

(C) Calculate the natural frequency of cast iron rod of 2.6 cm in length.

Data given : $P = 7.23 \times 10^3$ kg/m^3, $Y = 1.16 \times 10^{11}$ N/m^2 [4]

Or

4. (A) What are ultrasonic waves ? Explain how they are used for flaw detection and liquid emulsification. [7]

(B) What is grating ? Derive the expression for resolving power of grating. [6]

(C) What is the highest order spectrum that is visible with light of wavelength 6000 Å by means of a grating having 5000 lines per cm. [4]

5. (A) Define the term double refraction and hence explain the same on the basis of Hnygen's wave theory. [6]

(B) With the help of neat labelled diagram explain the construction and working of cyclotron. Obtain the expression for frequency and maximum energy of the particle. [6]

(C) A.Q.W.P. of thickness 2.275×10^{-3} cm is cut with its faces parallel to optic axis. The emergent beam of light is elliptically polarized. Find the wavelength of monochromatic light made incident normally on the plate. Given : $\mu_0 = 1.586$, $\mu_e = 1.592$. [4]

Or

6. (A) Explain the principle, construction and working of Betatron. [6]

(B) Distinguish between polarized and unpolarized light. Describe the process of production and detection of elliptically polarized light. [6]

(C) If the frequency of the A.C. potential applied to the Dees of a cyclotron is 9 MHz, calculate the magnetic flux density to accelerate α particles.

(Given : $M_\alpha = 6.643 \times 10^{-27}$ kg) [4]

Total No. of Questions—**12**] [Total No. of Printed Pages—**4+1**

Seat No.	

[4956]-4

F.E. (First Semester) EXAMINATION, 2016

BASIC ELECTRICAL ENGINEERING

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. **:—** (*i*) Answers to the two sections must 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 diagram 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) With usual notation, prove that : [8]

$$(\alpha_1 - \alpha_2) = \alpha_1 \alpha_2 \ (t_2 - t_1)$$

(B) With neat diagram explain construction and working of Lead acid cell. [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 4 amp from 200 V supply at temperture of 20ºC. Find : [10]

(*i*) Resistivity of material and current it will take when temp. rises to 60ºC. Assume α_{20} = 0.0003/ºC.

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

(*i*) Energy

(*ii*) Power.

3. (A) State and explain Thevenin's theorem with example. [8]

(B) Derive formula to convert star connected network into delta connected network. [10]

Or

4. (A) State and explain Kirchhoff's Laws. [8]

(B) State and explain Superposition theorem with example. [10]

5. (A) Compare Electric and Magnetic circuits. [8]

(B) Derive the expression for energy stored in a magnetic field in terms of energy stored per unit volume. [8]

Or

6. (A) Explain what do you mean by statistically induced emf and dynamically induced emf. [8]

(B) A coil of 2000 turns is wound uniformly over a non-magnetic ring of mean circumference of 80 cm and cross-sectional area of 0.6 sq. cm. If the current through the coil is 2 A, calculate : [8]

(*i*) Magnetizing force

(*ii*) Reluctance

(*iii*) Total flux

(*iv*) Flux density.

SECTION II

7. (A) Define with respect to alternating quantities with units : [8]

(*i*) Amplitude

(*ii*) Frequency

(*iii*) Time period

(*iv*) Cycle.

(B) The equation of an alternating current is given by $i = 42.42 \sin (628t)$. Calculate its : [8]

(*i*) Maximum value

(*ii*) Frequency

(*iii*) RMS value

(*iv*) Average value.

Or

8. (A) Derive an expression for average value of alternating current. [8]

(B) Derive an expression for capacitance of parallel plate capacitor. [8]

9. (A) Derive an expression for instantaneous current and power consumed when voltage $V = V_m \sin \omega t$ is applied to pure inductance alone. Also draw waveform for the power. [9]

(B) A circuit consisting of resistance of 20 Ω and inductance of 0.1 H is connected in series across single phase, 200 V, 50 Hz supply. Calculate : [9]

(*i*) Impedance

(*ii*) Current drawn

(*iii*) Power consumed

(*iv*) Draw phasor diagram.

Or

10. (A) If a sinusoidal voltage $V = V_m \sin \omega t$ is applied across R-C series circuit. Derive expression for current and average power consumed by a circuit. Draw waveform of power. [9]

(B) Two impedances $Z_1 = 6 + j8$ Ω and $Z_2 = 5 + j15$ Ω are connected in series across the voltage of 100 V, 50 Hz supply. Calculate : [9]

(*i*) Power factor of the circuit

(*ii*) Total active reactive and apparent power consumed in the circuit.

11. (A) Write a short note on losses taking place in transformer. [6]

(B) 25 kVA, 50 Hz single phase transformer has an iron loss and full load copper loss of 350 W and 400 W respectively. Find percentage efficiency at : [10]

(*i*) 50% of full load at unity power factor.

(*ii*) 50% of full load at 0.8 lagging power factor.

(*iii*) 75% of full load at unity power factor.

(*iv*) 75% of full load at 0.8 lagging power factor.

Or

12. (A) Compare core type and shell type transformer. [6]

(B) A balanced star connected load is supplied by 3-phase, 415 V, 50 Hz supply. Current in phase is 20 A and lags 30º behind phase voltage. Find : [10]

(*i*) Power consumed by load.

(*ii*) Calculate value of load impedance and value of R and X.

(*iii*) Load power factor.

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

Seat No.	

[4956]-5

F.E. (Common) (First Semester) EXAMINATION, 2016

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**, Q. No. **5** *or* Q. No. **6** from Section I and Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, 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*) What are the various duties to be performed by civil engineer in any construction project. [6]

(*b*) Enlist the various modes of transportation. [4]

P.T.O.

(*c*) Briefly explain the scope of the following branches of civil engineering : [3+3]

(*i*) Irrigation Engineering

(*ii*) Project Management.

Or

2. (*a*) Give the classification of roads on the basis of the following : [3+3]

(*i*) Location and function (Nagpur Road plan)

(*ii*) Materials of construction.

(*b*) Define valuation. State any three practical applications of valuation. [1+3]

(*c*) Explain in brief the following branches of Civil Engineering :

(*i*) Earthquake Engineering

(*ii*) Surveying. [3+3]

3. (*a*) With the help of neat sketch differentiate between End bearing pile and Friction Pile. [3+3]

(*b*) What do you understand by Grade of cement ? State the various grades of cement commonly used in any construction work. [1+3]

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

(*i*) Wall footing

(*ii*) Rectangular combined footing.

Or

4. (*a*) State the uses of the following in construction work : [2+2]

(*i*) Stone

(*ii*) Sand.

(*b*) State comparison between load bearing structure and framed structures. [3+3]

(*c*) State the causes of Uniform settlement and differential settlement. [3+3]

5. (*a*) The following staff readings were observed by a dumpy level and 4 m leveling staff, at an interval of 20 m. The readings are 2.650, 1.650, 4.000, 3.250 and 1.555. Level was shifted after third reading. The first reading was taken on a BM of RL 1000.00 m. Calculate the reduced levels of staff stations by Rise and Fall Method. [6]

(*b*) Define the following : [2+2+2]

(*i*) Leveling

(*ii*) Bench Mark

(*iii*) Change point.

(*c*) Define contour line. State any four uses of contours. [2+4]

Or

6. (*a*) Explain with a neat sketch the procedure of determining area of an irregular figure by Digital Planimeter. [6]

(*b*) State various axes of dumpy level. Also state the desired relationship between them. [3+3]

(*c*) The following staff readings were observed by a dumpy level and 4 m leveling staff. The readings are 1.555, 1.950, 2.400, 0.850, 1.250, 1.200 and 0.650. Level was shifted after third and fifth reading. The first reading was taken on a BM of RL 260.350 m. Calculate the reduced levels of staff stations by collimation plane Method. [6]

SECTION II

7. (*a*) Discuss in brief the components of Grass land Ecosystem. [6]

(*b*) State the various sources of Urban and Industrial waste. Explain in brief three R's of management of solid waste. [6]

(*c*) Write a short note on Carbon cycle. [4]

Or

8. (*a*) State various natural resources. What measures should we take to conserve water-a precious resource. [2+4]

(*b*) Write a short note on Environment Impact Assessment. [6]

(*c*) Explain with a neat sketch Hydrological cycle. [4]

9. (*a*) Enlist all the principles of building planning. Explain any one in brief. [6]

(*b*) A plot owner wants to construct a bungalow with G+1 floor, on a plot who's length of Breadth ratio is 2.0 and perimeter is 66 m. Find the ground coverage and area on first floor, if the side margin is 2 m for all the sides. As per the rules FSI allowed is 1.0. [6]

(*c*) Differentiate between building line and control line. [3+3]

Or

10. (*a*) A rectangular plot measures 25 × 36 m. The front and side set backs are 2.5 m. Permissible FSI is 1.33. G+1 storeyed building is to be constructed to consume full FSI. Determine the built up area on each storey. [6]

(*b*) State the various points to be considered while selecting a site for industrial building. [6]

(*c*) Explain in brief the following principles of building planning : [2+2+2]

(*i*) Aspect

(*ii*) Roominess

(*iii*) Elegance.

11. (*a*) Explain in brief the following : [6]

(*i*) Geothermal energy

(*ii*) Solar energy.

(*b*) Discuss in brief sources and effects of air pollution. [6]

(*c*) Explain in brief the Mechanism of production of Hydropower. [4]

Or

12. (*a*) Define Noise. Also write remedial measures to control Noise pollution. [6]

(*b*) Discuss in brief effects and control of land pollution. [6]

(*c*) Write a short note on water pollution. [4]

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

[4956]-6

Seat No.	

F.E. (Common) (First Semester) EXAMINATION, 2016

ENGINEERING GRAPHICS–I

(2008 PATTERN)

Time : Four Hours **Maximum Marks : 100**

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

(*ii*) Answers to the two sections should be drawn on separate drawing 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 an ellipse with major axis equal to 100 mm and minor axis is equal to 70 mm by using concentric circle method. [7]

(B) Draw an Archimedean spiral of one convolution with the shortest and longest radius vector of 10 mm and 50 mm lengths respectively. Draw normal and tangent to the curve at a point 25 mm from the pole. [8]

P.T.O.

Or

2. (A) A point P moves around the cone of 60 mm diameter and 70 mm height. Initially the point P is on periphery of base of cone and travels a vertical distance of 45 mm in one revolution around the cone. Draw the path traced by point if its axial movement is uniform with its angular motion. [8]

(B) Draw a cycloid generated by a point P on the circumference of the circle of diameter 56 mm when the circle rolls along a straight line and completes one rotation. Initially the position of point P is extreme top end. [7]

Unit II

3. Fig. No. 1 shows a pictorial view of an object. Draw the following views to full scale by using First Angle method of projection. : [8]

(1) Sectional elevations on a sectional plane A-A looking in the direction of arrow X.

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

(3) RHSV

(4) Give the entire Dimensions. 7+6+5+2=20

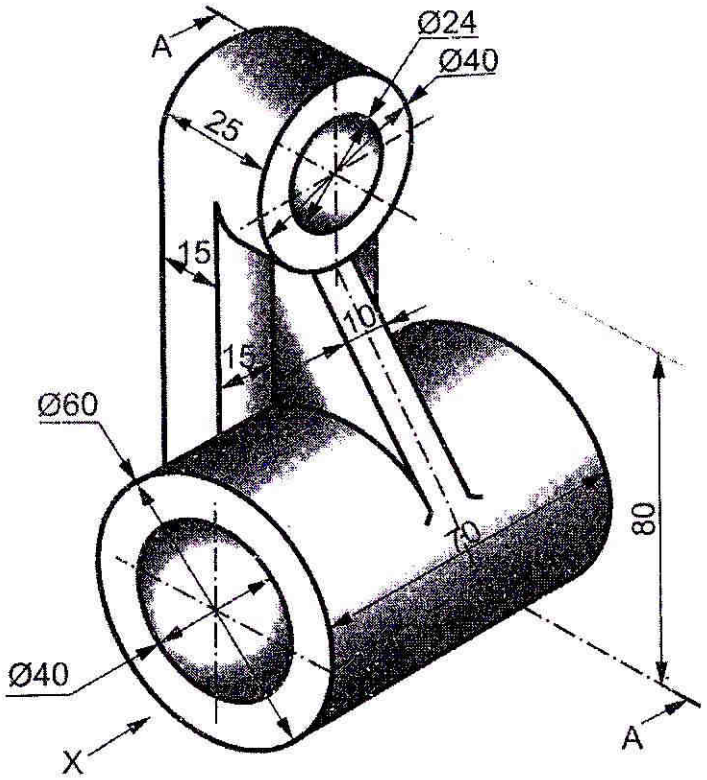

Fig. No. 1

Or

4. Fig. No. 2 shows a pictorial view of a SLIT GUIE. Draw the following views to full scale by using First Angle method of projection :

(1) Sectional Elevations along A-A looking in the direction of arrow X.

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

(3) End view from Left Hand Side.

Give the entire Dimensions. 7+6+5+2=20

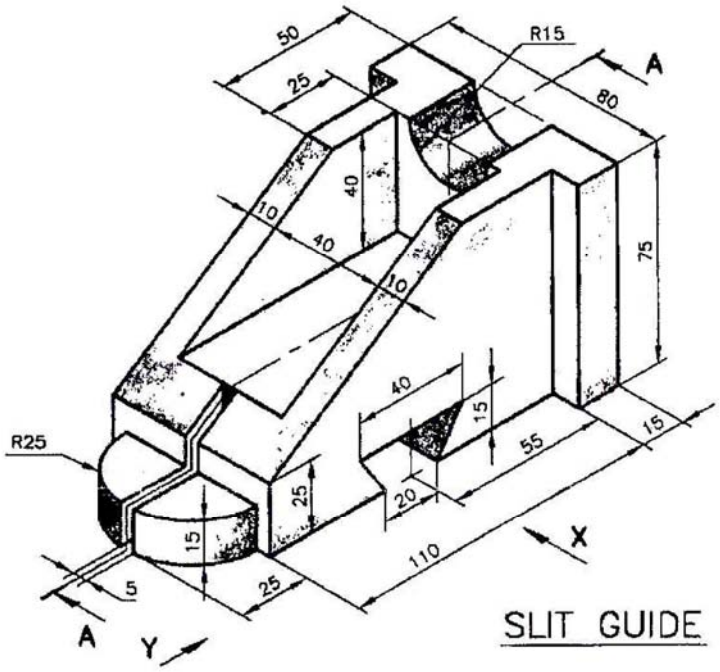

Fig. No. 2

UNIT III

5. Draw the given Front View and auxiliary views and add top view for the object shown in the following Fig No.3. Give all the dimensions.

[3+4+8=15]

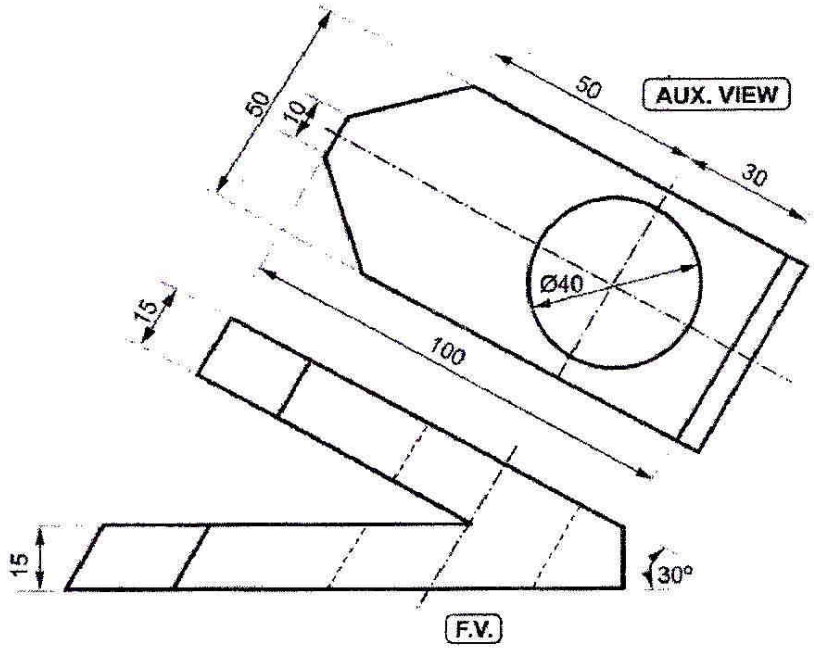

Fig. No. 3

Or

6. Machine Component is shown in the Fig. No. 4. Draw to full scale the following views :

(1) Given views,

(2) Add top view, and

(3) An auxiliary view in the direction of arrow X. Give all the dimensions. [5+4+6=15]

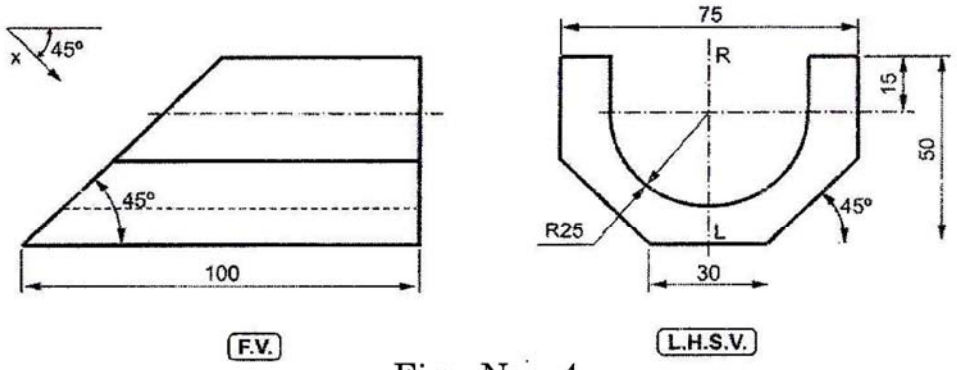

Fig. No. 4

SECTION II
UNIT IV

7. The following Fig. No. 5 shows plan and elevation of object according to First Angle Projections Method. Draw its Isometric View. Retain all the Construction lines and Construction you have made.

[17+3=20]

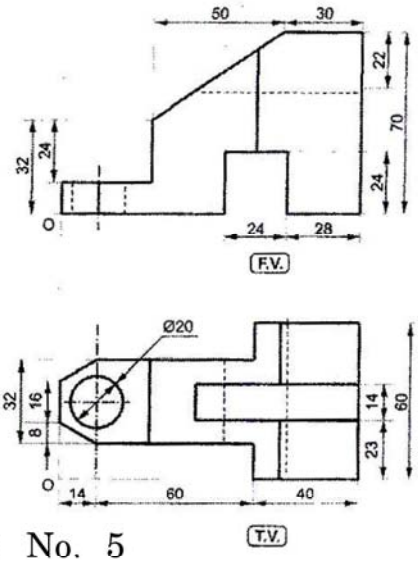

Fig. No. 5

Or

8. The following Fig. No. 6 shows Elevation and Right hand side view of the object draw its Isometric View. Retain all the Construction lines and Construction you have made. [17+3=20]

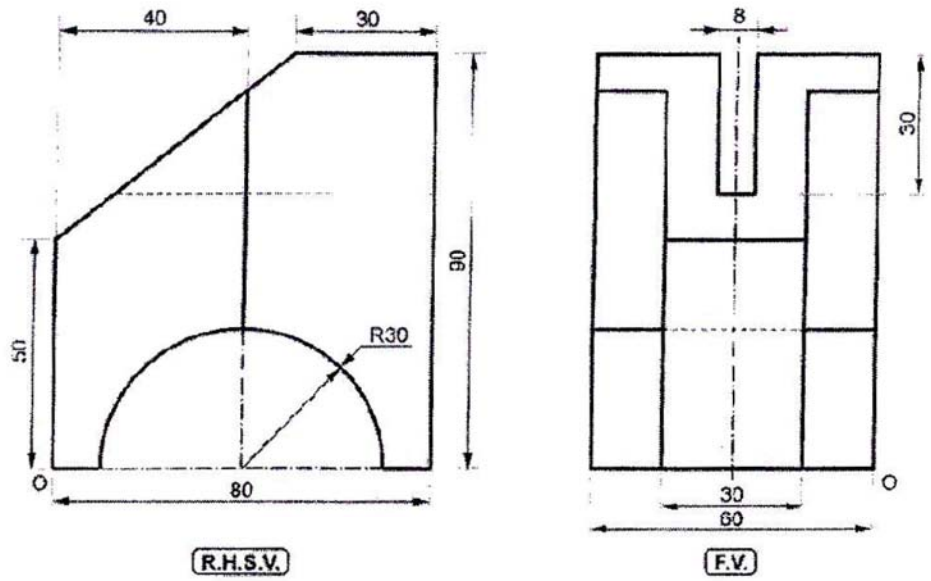

Fig. No. 6

UNIT V

9. The following Fig. No. 7 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 dimension. [7+5+6+2=20]

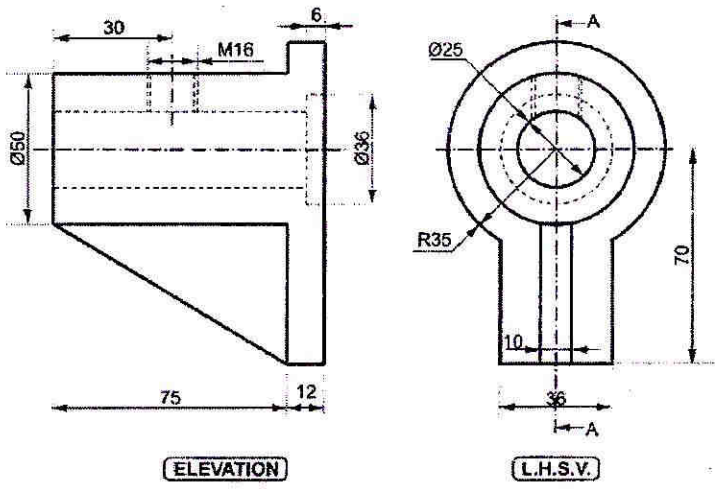

Fig. No. 7

Or

10. The following Fig. No. **8** shows Elevation and Plan of an object. Using same method of projection, draw the following views :

(*a*) Sectional Elevation, section along A-A,

(*b*) Left Hand Side view,

(*c*) Plan.

Give all the dimension. [7+6+5+2=20]

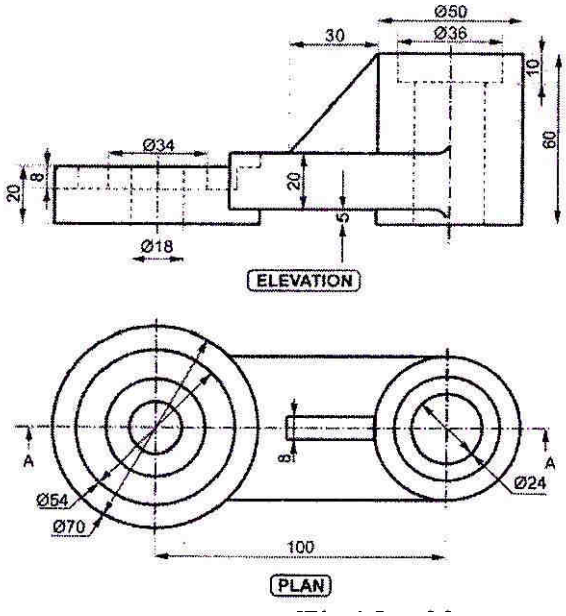

Fig. No. 8

UNIT VI

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

(*i*) Lifting Eye Bolt

(*ii*) Studs

(*iii*) Woodruff Key and Gib headed Key

(*iv*) Cotter Joint with Sleeve.

Or

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

(*i*) Double Riveted Lap Joint

(*ii*) Knuckle Joint

(*iii*) Flanged Coupling

(*iv*) Wing Nut.

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

Seat No.	

[4956]-7

F.E. (Second Semester) EXAMINATION, 2016

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 calculator is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

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

$$Y = Ax^2 + Bx^3,$$

where A and B are arbitrary constant. [6]

(*b*) Solve any *two* : [10]

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

(*ii*) $\frac{dy}{dx} = -\frac{(y\cos x + \sin y + y)}{\sin x + x\cos y + x}$

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

P.T.O.

Or

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

$$(x-h)^2 + (y-k)^2 = 1,$$

where h and k are arbitrary conotant. [6]

(*b*) Solve any *two* : [10]

(*i*) $3y^2 \frac{dy}{dx} + 2xy^3 = 4xe^{-x^2}$

(*ii*) $(x^2 + y^2 + x)\, dx + 2y\, dy = 0$

(*iii*) $x \frac{dy}{dx} + \frac{y^2}{x} = y$.

3. Solve any *three* : [18]

(*i*) A body originally at 80ºC cools down to 60ºC in 20 minutes the temperature of the air being 40ºC. What will be the temperature of the body after 40 minutes from the original ?

(*ii*) In a circuit containing inductance L, resistance R and voltage E1 the current I is given by $\mathrm{E} = \mathrm{RI} + \mathrm{L}\frac{d\mathrm{I}}{dt}$ Given L = 640 H, R = 200 W and E = 500 V. I being zero when t = 0, find the time that elapses before it reaches 90% of its maximum value.

(*iii*) The distance x descended by a parachuter satisfies differential equation :

$$\frac{dv}{dx} = 9\left(1 - \frac{v^2}{k^2}\right),$$

where v is the velocity, k and g are constant. If $v = 0$ and $x = 0$ at $t = 0$ show that :

$$x = \frac{k^2}{g} \log \cosh \left(\frac{gt}{k} \right)$$

(*iv*) Find the orthogonal trajecties of the family of curve $y^2 = 4ax$.

Or

4. Solve any *three* : [18]

(*i*) If 5% of radioactive substance disappeared in 50 years, how much will remain after 100 years.

(*ii*) The temp of air is 30ºC and the substance cools from 100ºC to 70°C in 15 minutes. Find the time when the temp will be 40°C.

(*iii*) An electric circuit contains an inductance of 5 henries and a resistance of 12 Ω in series with an emf 120 sin 20t volts. Find the current at $t = 0.01$, if it is zero when $t = 0$.

(*iv*) A particle is moving in a straight line with an acceleration

$$k\left[x + \frac{a^4}{x^3} \right]$$

directed towards origin, prove that it will arive at origin at the end of time $\frac{\pi}{4\sqrt{k}}$.

5. (*a*) Obtain the Fourier series for the period function $f(x) = x \sin x$ defined in the interval $0 \le x \le 2\pi$. [9]

(*b*) Establish the reduction formula connecting : [7]

$$I_n = \int_0^{\pi/2} x \cos^n x \, dx$$

with I_{n-2}, hence find I_4.

Or

6. (*a*) Obtain the constant term and the coefficient of the first cosine and sine terms in the expansion of y from the table : [8]

x	y
0	9
1	18
2	24
3	28
4	26
5	20

(*b*) Evaluate : [4]

$$\int_0^1 \frac{x\,dx}{\sqrt{\log\left(\frac{1}{x}\right)}}.$$

(*c*) Prove that : [4]

$$\int_0^\infty \frac{x^{m-1}}{(a+bx)^{m+n}} dx = \frac{1}{a^n b^m} B(m, n).$$

SECTION II

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

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

(*ii*) $r = a \cos 2\theta$

(*iii*) $x = at, \quad y = \frac{a}{t}$.

(*b*) Prove that : [4]

$$\int_0^1 \left(\frac{x^a - 1}{\log x} \right) dx = \log (1 + a)$$

$$a \geq 0$$

(*c*) Find the length of the arc of the curve $r = a\, e^{m\theta}$ intercepted between radii vectors r_1 and r_2. [5]

Or

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

(*i*) $y^2 (x^2 - 1) = x$

(*ii*) $r = a \sin 3\theta$

(*iii*) $r = \left(\frac{x}{a} \right)^{2/3} + \left(\frac{y}{b} \right)^{2/3} = 1$.

(*b*) Prove that : [4]

$$\int_0^\infty e^{-st} erf\left(\sqrt{t}\right) dt = \frac{1}{s\sqrt{s+1}}$$

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

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

from $\theta = 0$ to $\theta = \pi$.

9. (*a*) Prove that the plane $x + y + z = 1$ touches the sphere :

$$3(x^2 + y^2 + z^2) - 30x + 12y - 18z + 89 = 0$$

and find the coordinates of the point of contact. [6]

(*b*) Find the equation of the right circular cone whose vertex is (1, 0, 1) which passes through the point (1, 1, 1) and axis of the cone is equally inclined with the coordinate axes. [5]

(*c*) Find the equation of the right circular cylinder with radius 2, whose axis passes through (1, 2, 3) and has direction cosines proportional to 2, –3, 6. [6]

Or

10. (*a*) Find the equation of the sphere which passes through the point (–1, 0, 0) and touches the plane $2x - y - 2z - 4 = 0$ at the point (1, 2, –2). [6]

(*b*) Find the equation of the right circular cone with vertex at origin, axis is the y-axis and semi-vertical angle is 30°. [5]

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

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

11. Solve any *two* :

(*a*) Evaluate : [8]

$$\int_0^1 \int_0^{1-x} xt\sqrt{1-x-y}\, dydx$$

(*b*) Find the area bounded by : [8]

$$y^2 = 4ax \quad \text{and} \quad x^2 = 4ay .$$

(*c*) Find the C-G of the loop of the curve : [8]

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

Or

12. Solve any *two* :

(*a*) Evaluate : [8]

$$\int_0^1 \int_0^{\sqrt{1-y^2}} \frac{\cos^{-1} x \; dxdy}{\sqrt{(1-x^2-y^2)\,(1-x^2)}}$$

(*b*) Evaluate : [8]

$$\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-y^2}} y dxdydz$$

(*c*) Find the M.I. of the area in XOY plane bounded by :

$$y^2 = 2x \text{ and } y = x,$$

assuming constant density ? [8]

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

Seat No.	

[4956]-8

F.E. (Common to All Branches) (Second Semester)

EXAMINATION, 2016

APPLIED SCIENCE—II

(Chemistry)

(2008 PATTERN)

Time : Two Hours **Maximum Marks : 50**

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

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

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

(*v*) Assume suitable data, if necessary.

1. (*a*) Give the principle of Bomb calorimeter. How gross calorific value of solid fuel is determined by Bomb calorimeter ? [7]

(*b*) Give preparation reaction of biodiesel. State merits and demerits of biodiesel. [6]

(*c*) 0.25 gm of a coal sample on burning in combustion apparatus in the current of pure oxygen was found to increase weight of U-tube with anhydrous $CaCl_2$ by 0.075 gm and of KOH U-tube by 0.52 gm. Calculate percentage of C and H in coal sample. [4]

P.T.O.

Or

2. (*a*) Explain in brief the process of distillation of crude petroleum. Give composition, boiling range and uses of any *three* fractions obtained. [7]

(*b*) What is rocket propallent ? Explain different types of propallent used in rocket. [6]

(*c*) Calculate the weight of air required for complete combustion of 100 kg of coal if it contains C = 82%, H_2 = 6%, O_2 = 2%, S = 4%, remaining ash. [4]

3. (*a*) What is principle of cathodic protection ? Discuss the various types of cathodic protection. [7]

(*b*) Explain different factors affecting rate of corrosion. [6]

(*c*) Give the names of oxide films in Mg, Cr, Ag and Mo metals. [4]

Or

4. (*a*) Define corrosion. Explain the mechanism of wet corrosion by H_2 evolution and O_2 absorption. [7]

(*b*) Explain galvanising and tinning methods for applying metallic coatings. [6]

(*c*) Write a note on electroplating of metal. [4]

5. (*a*) What is priming and foaming ? What are the disadvantages of priming and foaming ? How can they be prevented ? [6]

(*b*) How chloride quantity in water is determined by Mohr's method ? [6]

(*c*) 50 ml of an alkaline water sample requires 9.2 ml of N/50 HCl upto phenolphthalein end point and total 13.1 ml of the acid for complete neutralization. Find the types and amount of alkalinities in water. [4]

Or

6. (*a*) Draw and explain phase diagram for water system. [6]

(*b*) Explain zeolite process for water softening. [6]

(*c*) Give the differences in sludge and scale in boiler. [4]

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

Seat No.	

[4956]-9

F.E. (Semester II) EXAMINATION, 2016
APPLIED SCIENCE-II (Physics)
(2008 COURSE)

Time : Two Hours **Maximum Marks : 50**

N.B. **:—** (*i*) Answer any *three* questions (Q. Nos. 1 *or* 2, Q. Nos. 3, *or* 4, Q. Nos. 5 *or* 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.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*) Explain group velocity and phase velocity. Derive an expression for group velocity with which a wave group travels. [7]

(*b*) Derive Schrodinger's time independent wave equation. [6]

(*c*) An electron is accelerated through potential difference of 10 kV. Calculate the de-Broglie wavelength and momentum of the electron. [4]

Or

2. (*a*) Starting from Schrodinger's time independent equation, find energy and wave function of the particle in a rigid box. Show necesssary waveforms. [7]

P.T.O.

(*b*) State Heisenberg's uncertainty principle and illustrate it by electron diffraction at a single slit. [6]

(*c*) Calculate first two energy eigen values of an electron trapped in an infinite potential well of length 1 Å. [4]

3. (*a*) Draw a neat diagram and explain the construction and working of He-Ne laser. [7]

(*b*) Distinguish between Type I and Type II superconductors. [6]

(*c*) Explain the preocess of spontaneous emission and stimulated emission. [4]

Or

4. (*a*) What is Superconductivity ? State and explain the following : [7]

(*i*) Meissner effect

(*ii*) Critical magnetic effect

(*iii*) Persistent current.

(*b*) Explain the operation of Ruby laser with a neat labelled diagram. [6]

(*c*) Explain any *two* applications of superconductivity. [4]

5. (*a*) Explain classification of solids into conductors, semiconductors and insulators on the basis of energy band theory. [6]

(*b*) Explain synthesis of metal nanoparticles by colloidal route. [6]

(*c*) Calculate the number of acceptors to be added to a Germanium sample to obtain resistivity of 10 Ω cm. [4]
(Given : μ = 1700 cm^2 / Volt-sec)

Or

6. (*a*) Explain any *two* properties of Nanoparticles. [6]

(*b*) What is Hall effect ? Derive relation for Hall voltage and Hall coefficient. [6]

(*c*) Discuss any *two* applications of Nanotechnology. [4]

Total No. of Questions—**12**] [Total No. of Printed Pages—**3**

Seat No.	

[4956]-10

F.E. (Semester II) EXAMINATION, 2016
BASIC MECHANICAL ENGINEERING
(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. **:—**
- (*i*) Assume suitable data, if necessary.
- (*ii*) Figures to the right indicate full marks.
- (*iii*) Neat diagrams must be drawn whenever necessary.
- (*iv*) Use of non-programmable electronic Calculator is permitted.
- (*v*) Answer of two sections should be written in separate answer-book.
- (*vi*) Attempt *six* question. 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

SECTION-I

1. (*a*) Draw P-V diagram and explain the work done in : [6]
- (*i*) Constant Temperature Process
- (*ii*) Constant Entropy Process.

(*b*) Explain various types of thermodynamic systems with example. [6]

(*c*) Explain the following devices :
Heat Engine and Heat Pump. [6]

Or

2. (*a*) Define and explain : Cp, Cv Pure Substance. [6]

(*b*) State different statements of first law of thermodynamics. Discuss its limitations. [6]

P.T.O.

(*c*) A household refrigerator with a COP of 1.5 removes heat from the refrigerated space at a rate of 90 kJ/min. Find electric power consumed by the refrigerator and rate of heat transfer to the kitchen air. Draw the sketch of the Regrigerator. [6]

3. (*a*) Explain the working of four-stroke petrol engine with neat sketch. [8]

(*b*) Draw block diagram of : [8]

(*i*) Open Cycle Gas Turbine

(*ii*) Centrifugal Pump.

Or

4. (*a*) State classification of boilers. Explain any *two* mountings and any *two* accessories. [8]

(*b*) Draw block diagram of : [8]

(*i*) Reciprocating air compressor

(*ii*) Reciprocating pump.

5. (*a*) Draw a layout for : [8]

(*i*) Wind power plant

(*ii*) Solar power plant.

(*b*) State and explain Newton's law of cooling and derive an expression for "Overall Heat Transfer coefficient for composite slab." [8]

Or

6. (*a*) Explain hydro-electric power plant with neat sketch. [8]

(*b*) State and explain Fourier's law of heat conduction. [4]

(*c*) Write a short note on thermal insulation. [4]

SECTION-II

7. State the function of following machine elements with neat sketch : [16]

(*i*) Transmission Shaft

(*ii*) Parallel key

(*iii*) Flywheel

(*iv*) Cross belt drive.

Or

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

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

9. (*a*) Explain general steps in design process. [8]

(*b*) Explain any *four* sheet metal working process. [8]

Or

10. (*a*) State properties and engineering applications of any *four* materials. [8]

(*b*) Explain sand casting process with neat sketch. [8]

11. (*a*) Describe any *two* operations on drilling machines. [6]

(*b*) Draw a neat sketch of power saw and state its application. [6]

(*c*) Draw neat sketches of any *three* operations performed on milling machines. [6]

Or

12. (*a*) Draw a block diagram of any drilling machine. [6]

(*b*) Explain surface grinding process with a neat sketch. [6]

(*c*) Describe any *two* operations performed on lathe machines. [6]

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

Seat No.	

[4956]-11

F.E. (Common) (Second Semester) EXAMINATION, 2016

BASIC ELECTRONICS ENGINEERING

(2008 Pattern)

Time : Two Hours **Maximum Marks : 50**

N.B. **:—** (*i*) Answer Q. **1** or Q. **2**, Q. **3** or Q. **4**, Q. **5** or Q. **6**.

(*ii*) Answer *all* questions in same answer-book.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right side indicate full marks.

(*v*) Use of calculator is allowed.

(*vi*) Assume suitable data if necessary.

1. (*a*) A bridge rectifier is applied with input from a step down transformer having turns ratio 8 : 1 and input 230V, 50Hz. If diode forward resistance is 1Ω, secondary resistance is 10Ω, load resistance is 2KΩ, [8]

find :

(*i*) DC power output

(*ii*) PIV across each diode

(*iii*) Percentage efficiency

(*iv*) Percentage regulation.

(*b*) Explain the operation of BJT as a switch with neat diagram. [4]

(*c*) With a neat construction diagram explain the working of TRIAC. Also draw its characteristic. [6]

P.T.O.

Or

2. (*a*) Explain the operation of a bridge rectifier. Also state its advantages. [8]

(*b*) Write a short note on : Seven segment display. [4]

(*c*) Compare SCR and TRIAC. [6]

3. (*a*) Draw a neat diagram of three input inverting summing amplifier using op-amp and obtain the expression of its output voltage. [8]

(*b*) What is full adder ? Explain the working of full adder with the help of truth table and give equation for sum and carry. [8]

Or

4. (*a*) Draw diagram of 8 : 1 MUX. What is the relation between number of select lines and inputs ? Give applications of multiplexers. [6]

(*b*) Draw a neat circuit diagram of Ideal integrator and explain its operation with input and output waveform. Also state drawbacks of this circuit. [6]

(*c*) State and prove the DeMorgan's theorems. [4]

5. (*a*) Differentiate AM and FM. [6]

(*b*) Write expression of AM. Also draw its frequency spectrum. [2]

(*c*) Draw constructional details of LVDT (displacement transducer). Explain its operation. State its advantages and disadvantages. [8]

Or

6. (*a*) What is the need of modulation ? Explain. [6]

(*b*) Explain wired communication and wireless communication. [4]

(*c*) Draw block diagram of electronic weighing machine and explain its operation. [6]

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

Seat No.	

[4956]-12

F.E. (Common) (II Semester) EXAMINATION, 2016

ENGINEERING MECHANICS

(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 sketches must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Assume suitable data, if necessary.

(*v*) Use of electronic pocket calculator is allowed in the examination.

(*vi*) Use of cell phone is prohibited in the examination hall.

1. (*a*) Determine the resultant of three forces as shown in Fig. 1(*a*), if $\alpha = 50°$. [6]

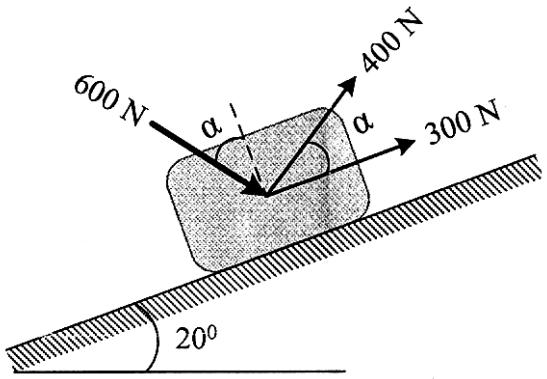

Fig. 1(*a*)

P.T.O.

(*b*) A base ball is thrown down from a 15 m tower with an initial velocity of 5 m/s. Determine the velocity with which it hits the ground and also determine the time of travel. [6]

Or

2. (*a*) A thin homogeneous wire ABC is bent as shown in Fig. 2(*a*). Determine the location of its centroid with respect to A. [6]

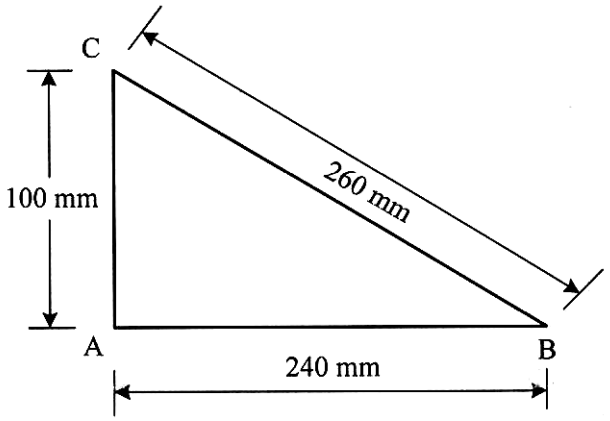

Fig. 2(*a*)

(*b*) A 90.7 kg block rests on a horizontal plane as shown in Fig. 2(*b*). Find the magnitude of the forces P required to give the block an acceleration of 3 m/s^2 to the right. The coefficient of kinetic friction between block and plane is μ_s = 0.25. [6]

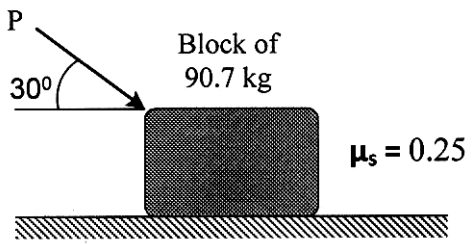

Fig. 2(*b*)

3. (*a*) The spring ABC has a stiffness of 500 N/m and an unstretched length of 6 m as shown in Fig. 3(*a*). Determine the horizontal force F applied to the cord which is attached to the small pulley C, so that the displacement of the pulley from the wall is d = 1.5 m. [7]

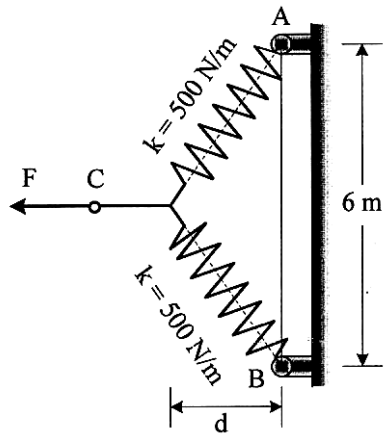

Fig. 3(*a*)

(*b*) The uniform concrete slab has a weight of 5500 N. Determine the tension in each of the three parallel supporting cables when the slab is held in the horizontal plane as shown in Fig. 3(*b*). [6]

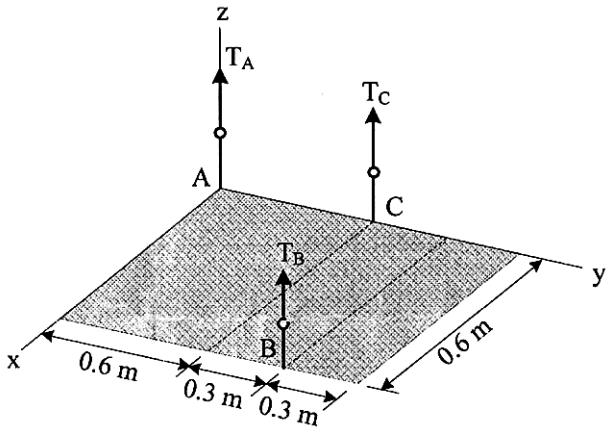

Fig. 3(*b*)

(*c*) A model rocket is launched from point A with an initial velocity v_0 = 86 m/s. If the rocket lands 104 m from A, determine :

(*a*) the angle α that v_0 forms with vertical,

(*b*) the maximum height reached by the rocket,

(*c*) the duration of the flight.

Refer Fig. 3(*c*). [6]

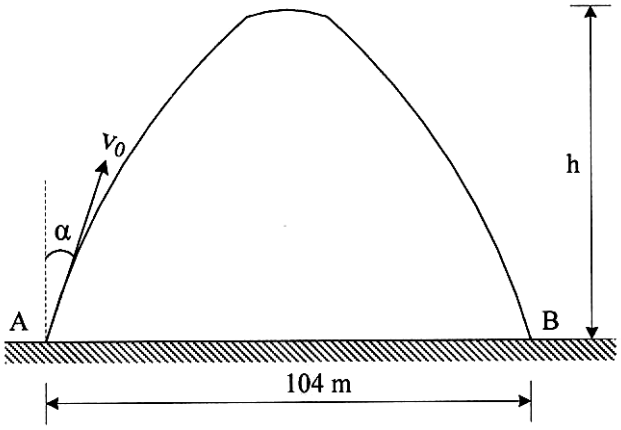

Fig. 3(*c*)

Or

4. (*a*) Determine the support reactions for a beam loaded and supported as shown in Fig. 4(*a*). [6]

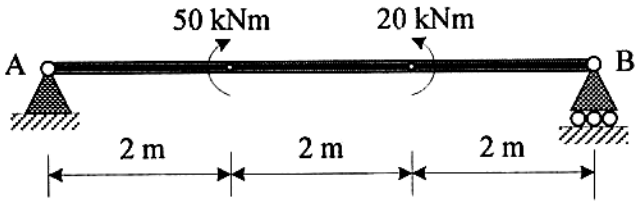

Fig. 4(*a*)

(*b*) A 16 kg triangular plate is supported by three wires as shown in Fig. 4(*b*). Knowing that a = 200 mm, determine the tensions in each wire. [7]

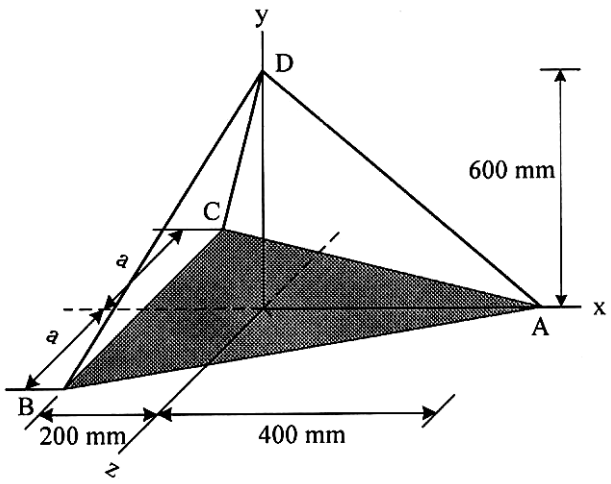

Fig. 4(*b*)

(*c*) A bob of 2 m pendulum describes an arc of a circle in vertical plane as shown in Fig. 4(*c*). If the tension in the chord is 2.5 times the weight of the bob for the position shown, determine the velocity and acceleration of the bob in that position. [6]

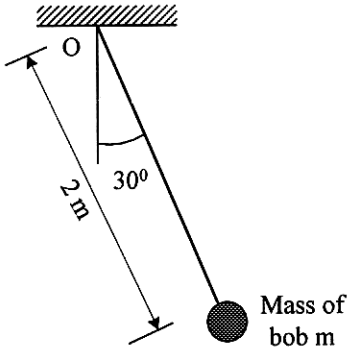

Fig. 4(*c*)

5. (*a*) Determine the forces in the members BD, BE and CE of the truss as shown in Fig. 5(*a*). State whether each member is in tension or compression. [7]

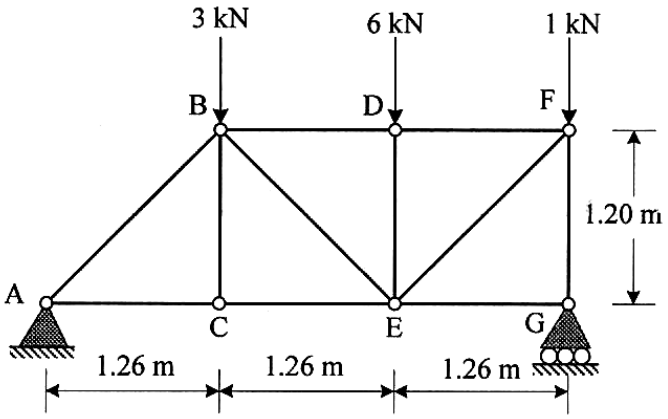

Fig. 5(*a*)

(*b*) A force P applied at B and a block attached at C to maintain the cable ABCD as shown in Fig. 5(*b*) is in equilibrium. Knowing that P = 1.32 kN, determine the reactions at A and magnitude of mass *m* of the block. [6]

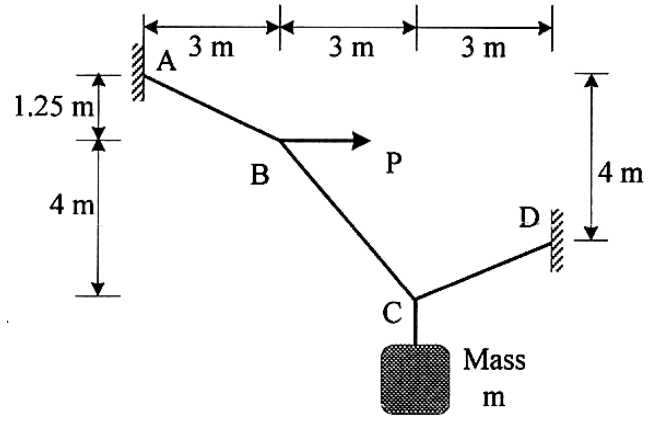

Fig. 5(*b*)

(*c*) A 40 kg package is at rest on the inclination as shown in Fig. 5(*c*), when a force P is applied. Determine the magnitude of force P if 4 seconds are required for the package to travel 10 m up the incline. The coefficients static and kinetic of friction between the package and incline are μ_s = 0.30 and μ_k = 0.25 respectively. [6]

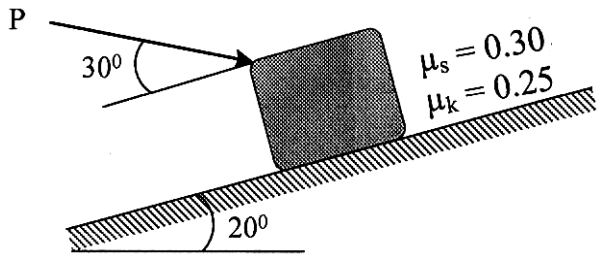

Fig. 5(*c*)

Or

6. (*a*) Determine the forces in the members DF, DE and EF of the truss loaded and supported as shown in Fig. 5(*a*). [7]

(*b*) A 0.54 kg ball A moving with a velocity u_A when it struck to a 1 kg ball B which is moving with with 5.5 m/s in opposite direction. Knowing that the ball B comes to rest after the impact and e = 0.8, determine the velocity of the ball A before and after impact. [6]

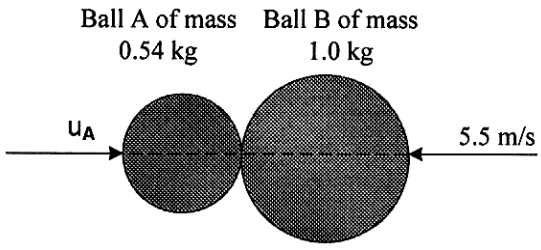

Fig. 6(*b*)

(*c*) Determine the maximum tension in the rope at points A and B that is necessary to maintain equilibrium as shown in Fig. 6(*c*). Take μ_s = 0.3 between the rope and fixed post D. [6]

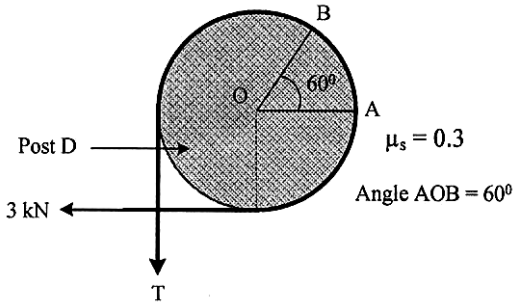

Fig. 6(*c*)