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

[2758]-101

MAY-2005

F.E. (2003 COURSE) EXAM.-2005

ENGINEERING MATHEMATICS - I

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) Answers to the two sections should be written in separate books.

(2) In Section I attempt Q. 1 or Q. 2, Q. 3 or Q. 4 and Q. 5 or Q. 6. In Section II attempt Q. 7 or Q. 8, Q. 9 or Q. 10 and Q. 11 or Q. 12.

(3) Neat diagrams must be drawn wherever necessary.

(4) Figures to the right indicate full marks.

(5) Use of Non-programmable Electronic Pocket Calculator is allowed.

(6) Assume suitable data, if necessary.

SECTION - I

Q.1) (a) If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, find two non-singular matrices P and Q such that PAQ = I, where I is the unit matrix and hence find A^{-1}. **[06]**

(b) Define linear dependence and linear independence of vectors. Examine for linear dependence of vectors (1, 2, – 1, 0), (1, 3, 1, 2), (4, 2, 1, 0), (6, 1, 0, 1) and find a relation between them if dependent. **[06]**

(c) Find the eigen values and eigen vectors of the matrix

$$A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$$

[05]

OR

Q.2) (a) Show that the system :

$3x + 4y + 5z = \alpha$,

$4x + 5y + 6z = \beta$,

$5x + 6y + 7z = \gamma$ is consistent only when α, β, γ are in arithmetic progression.

[05]

(b) Verify Caley - Hamilton theorem for $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ and use it to find the matrix

$A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$ **[07]**

(c) Determine the values of a, b, c when $\begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$ orthogonal. **[05]**

Q.3) (a) If z_1 and z_2 are the roots of the equation $z^2 - az + a^2 = 0$, where a is a complex number, show that the points z_1 and z_2 are vertices of an equilateral triangle described on opposite sides of the line joining origin to point a. **[06]**

(b) Prove that $\left(\frac{-1+i\sqrt{3}}{2}\right)^n + \left(\frac{-1 - i\sqrt{3}}{2}\right)^n$ has value -1 if $n = 3k \pm 1$, and 2 if $n = 3k$, where k is an integer. **[06]**

(c) If $\cos hx = \sec \theta$, then prove that $\theta = \frac{\pi}{2} - 2 \tan^{-1}(e^{-x})$. **[05]**

OR

Q.4) (a) Show that the points representing the roots of the equation $z^3 = i(z - 1)^3$ on Argand's diagram are collinear. **[06]**

(b) If $\cos h^{-1}(x + iy) + \cos h^{-1}(x - iy) = \cos h^{-1}a$, then prove that $2(a - 1)x^2 + 2(a + 1)y^2 = a^2 - 1$. **[06]**

(c) Prove that if $(1 + i \tan\alpha)^{(1 + i \tan\beta)}$ can have real values, one of them is $(\sec\alpha)^{\sec 2\beta}$, considering only principal value. **[05]**

Q.5) (a) If $f(x) = \tan x$, then prove that

$$f^n(0) - {}^nC_2 f^{n-2}(0) + {}^nC_4 f^{n-4}(0) - \ldots = \sin\left(\frac{n\pi}{2}\right).$$ **[05]**

(b) Show that $\frac{\tan x}{x} > \frac{x}{\sin x}$, for $0 < x < \frac{\pi}{2}$. **[06]**

(c) Prove that the n^{th} derivative of $y = \tan^{-1}x$ is

$$(n - 1)! \sin n\left(\frac{\pi}{2} - y\right) \sin^n\left(\frac{\pi}{2} - y\right).$$ **[05]**

OR

Q.6) (a) Discuss the applicability of Rolle's mean value theorem for

$$f(x) = \begin{cases} x^2 + 1 \text{ for } 0 \le x \le 1 \\ 3 - x \text{ for } 1 \le x \le 2. \end{cases}$$ **[05]**

(b) Using the function $f(x) = x^{1/x}$, $x > 0$ determine the bigger of the two numbers e^{π} and π^{e}. **[05]**

(c) If $f'(x)$ exists for all points on [a, b] and $\frac{f(c) - f(a)}{c - a} = \frac{f(b) - f(c)}{b - c}$ where $a < c < b$ then there exists a number ξ such that $a < \xi < b$ and $f'(\xi) = 0$. **[06]**

SECTION - II

Q.7) (a) Obtain the range of convergence of $\sum_{n=1}^{\infty} \frac{1}{x^n + x^{-n}}$. **[05]**

(b) Test for convergence of the following series : **(Any One)** **[04]**

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

(2) $1 + \frac{2^2}{3.4} + \frac{2^2.4^2}{3.4.5.6} + \frac{2^2.4^2.6^2}{3.4.5.6.7.8} + ...$

(c) Attempt **any two** of the following : **[08]**

(1) Show that $\log\left[\frac{1+e^{2x}}{e^x}\right] = \log 2 + \frac{x^2}{2} - \frac{x^4}{12} + \frac{x^6}{45} - .....$

(2) Prove that $x \operatorname{cosec} x = 1 + \frac{x^2}{6} + \frac{7}{360} x^4 + ...$

(3) Show that $\frac{1}{2}[f(x) - f(2a - x)] =$

$(x - a) f'(a) + \frac{(x - a)^3}{3!} f'''(a) + \frac{(x-a)^5}{5!} f^{v}(a) + ...$

OR

Q.8) (a) Obtain the range of convergence of the series : **[05]**

$$\sum_{n=1}^{\infty} \frac{1.2.3....n}{4.7.10....(3n+1)} x^n$$

(b) Test for convergence of the following series : **(Any One)** **[04]**

(1) $\log\left(\frac{1}{2}\right) - \log\left(\frac{2}{3}\right) + \log\left(\frac{3}{4}\right) - \log\left(\frac{4}{5}\right) + ...$

(2) $\frac{2}{7} + \frac{2.5}{7.10} + \frac{2.5.8}{7.10.13} + ...$

(c) Attempt **any two** of the following : **[08]**

(1) Prove that $\cos^{-1}(\tan h(\log x)) = \pi - 2\left(x - \frac{x^3}{3} + \frac{x^5}{5} - .....\right)$

(2) Expand $\sqrt{1 + \sin x}$ upto x^6.

(3) Prove that

$$\tan^{-1}x = \frac{\pi}{4} + \frac{1}{2}(x-1) - \frac{(x-1)^2}{4} + \frac{(x-1)^3}{12} + ...$$

Q.9) (a) Attempt **any two** of the following : **[08]**

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

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

(3) $\lim_{x \to a} \left(\frac{f'(x)}{f(x) - f(a)} - \frac{1}{x - a}\right)$

(b) If u is a homogeneous function of x, y of degree n and $X = \frac{\partial u}{\partial x}$, $Y = \frac{\partial u}{\partial y}$ and u = f(X, Y), prove that

$$X \frac{\partial f}{\partial x} + Y \frac{\partial f}{\partial y} = \left(\frac{n}{n - 1} \right) u.$$ [06]

(c) If $ax^2 + by^2 + cz^2 = 1$ and $lx + my + nz = 0$, prove that

$$\frac{dx}{bny - cmz} = \frac{dy}{clz - anx} = \frac{dz}{amx - bly}$$ [03]

OR

Q.10)(a) Attempt **any two** of the following : [08]

(1) $\lim_{x \to 2} \left[\frac{1}{x - 2} - \frac{1}{\log(x - 1)} \right]$

(2) Find a, b if

$$\lim_{x \to 0} \frac{a \sin^2 x + b \log \cos x}{x^4} = -\frac{1}{2}$$

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

(b) If u = f(r) where $r = \sqrt{x^2 + y^2 + z^2}$, prove that

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = f''(r) + \frac{2}{r} f'(r)$$ [05]

(c) If ϕ (x, y, z) = 0, prove that $\left(\frac{\partial z}{\partial y} \right)_x \left(\frac{\partial x}{\partial z} \right)_y \left(\frac{\partial y}{\partial x} \right)_z = -1$ **(04)**

Q.11)(a) If $u = xyz$, $v = x^2 + y^2 + z^2$, $w = x + y + z$, find $\frac{\partial x}{\partial u}$. **[06]**

(b) Find the possible percentage error in computing the parallel resistance r of two resistances r_1 and r_2 from the formula :

$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$, where r_1 and r_2 are both in error by 2% each. **[04]**

(c) Discuss the maxima and minima of the function : $3x^2 - y^2 + x^3$ **[06]**

OR

Q.12)(a) If $x^2 + y^2 + u^2 - v^2 = 0$ and $uv + xy = 0$, prove that

$$\frac{\partial(u,v)}{\partial(x,y)} = \frac{x^2 - y^2}{u^2 + v^2}$$ **[05]**

(b) Prove that the functions $u = y + z$, $v = x + 2z^2$, $w = x - 4yz - 2y^2$ are functionally dependent and find the relation between them. **[05]**

(c) Find the points on the surface $z^2 = xy + 1$ nearest to the origin, by using Legrange's method. **[06]**

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

[2758]-104

F.E. (2003 COURSE) EXAM.-2005

BASIC ELECTRICAL ENGINEERING

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

*(1) From section I, attempt **one** question each from the pairs of Q.No. 1 & 2, 3 & 4, and 5 & 6. From section II, attempt **one** question each from the pairs of Q.NOs. 7 & 8, 9 & 10 and Nos. 11 & 12.*

(2) Answers to the two sections should be written in separate books.

(3) Neat diagrams must be drawn wherever necessary.

(4) Black figures to the right indicate full marks.

(5) Use to logarithmic tables, slide rule and non-programmable electronic pocket calculator is allowed.

(6) Assume suitable data, if necessary.

SECTION - I

Q.1) (a) A single-core insulated cable of length 'L' metre has its conductor diameter 'd' metre and the thickness of insulation surrounding the conductor is 't' meter. Derive the expression for its insulation resistance, if the resistivity of the insulating material is 'ϱ' ohm metre. **[06]**

(b) An electric furnace is used to melt aluminium. Initial temperature of the solid aluminium is 32°C and its melting point is 680°C. Specific heat capacity of aluminium is 0.95 kJ/kg/K, and the heat required to melt 1 kg of aluminium at its melting point is 450 kJ. If the input power drawn by the furnace is 20-kW and its overall efficiency is 60%, find the mass of aluminium melted per hour. **[08]**

(c) Show how four cells, each rated 1.5V, 0.1 A, can be connected as batteries in three different ways to obtain different voltage and current ratings. State the voltage and current ratings of each type. **[02]**

OR

Q.2) (a) At 0°C, the resistances and their temperature coefficients of resistance of two resistors 'A' and 'B' are 80 ohm and 120 ohm, and 0.0038 per °C and 0.0018 per °C, respectively. Find the temperature-coefficient of resistance at 0°C of their series combination. **[08]**

(b) In a thermal generating station the heat energy obtained by burning 1 kg of coal is 16,000 kJ. Find the mass of coal required to get an output electrical energy of 1 kWh from the station, if its overall efficiency is 18%. **[04]**

(c) Enlist the various types of storage batteries. State the application of each. **[04]**

Q.3) (a) State and explain with a suitable example, the Superposition Theorem as applied to d.c. resistive networks. **[06]**

(b) For the circuit shown in Fig. 1, write the Kirchhoff's law equations for loops BCDB, CEDC, and ABDEFA in terms of the branch currents I_1, I_2 and I_3 as shown. Find current I_1 by solving these equations. **[10]**

The numbers indicate resistance values in ohm.

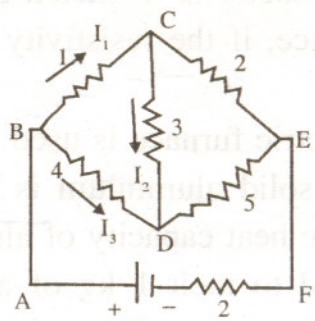


Fig. 1

OR

Q.4) (a) State Kirchhoff's laws and explain these with suitable example. **[06]**

(b) For the network shown in Fig. 1, find the current I_2 in the 3 ohm resistance, by applying Thevenin's Theorem. **[10]**

Q.5) (a) Compare the magnetic circuit with the electric circuit. Bring out clearly the dissimilarities between them. **[04]**

(b) An iron ring has its mean length of flux path as 60 cm and its cross-sectional area as 15 cms^2. Its relative permeability is 500. Find the current required to be passed, through a coil of 300 turns wound uniformly around it, to produce a flux denstiy of 1.2 tesla. What would be the flux density with the same current, if the iron ring is replaced by air-core ? **[06]**

(c) Two long, single-layered solenoids 'x' and 'y' have the same length and the same number of turns. The cross-sectional areas of the two are 'a_x' and 'a_y' respectively, with 'a_y' < 'a_x'. They are placed coaxially, with solerioid 'y' placed within the solenoid 'x'. Show that the coefficient of coupling between them is equal to $\sqrt{a_y / a_x}$. **[08]**

OR

Q.6) (a) A conductor of length 10 cm carrying 5 A is placed in a uniform magnetic field of flux density 1.25 tesla. Find the force acting on the conductor, if it is placed (i) along the lines of magnetic flux, (ii) perpendicular to the lines of flux, and (ii) at 30° to the flux. **[04]**

(b) In which type of materials hysterisis and eddy current losses occur ? Under what conditions do they occur ? How can these be reduced ? **[06]**

(c) A magnetic core is in the form of a closed ring of mean length 20 cm and cross-sectional area 1 cms^2. Its relative permeability is 2400. A coil of 2000 turns is uniformly wound around it. Find the flux density set up in the core if a current of 66 mA is passed through the coil. Find the energy stored in the magrietic field set up.

Find the inductance of the coil, if an air gap of 1 mm is cut in the ring perpendicular to the direction of the flux. **[08]**

SECTION - II

Q.7) (a) Derive the expression for parallel plate capacitor when medium is composite. **[06]**

(b) In a certain circuit supplied from 50Hz mains, the potential difference has a maximum value of 500 volt and the current has a maximum value of 10 Amp. At the instant t = 0, the instantaneous values of potential difference and current are 400 volt and 4 Amp respectively both increasing in positive direction. State expressions for instantaneous values of potential difference and current at time 't'. Calculate the instataneous values at time t = 0.015 second. Find phase angle between potential difference and current. **[08]**

(c) Find the r.m.s value of full wave sinusoidal current whose maximum value is I_m. **[04]**

OR

Q.8) (a) A capacitor is made of two parallel plates with an area of $11cm^2$ and are separated by mica sheet 2 mm thick. If for mica $\in_r = 6$, find its capacitance. If now, one plate of capacitor is moved further to give an air gap of 0.5 mm wide between the plates and mica. Find the new value of capacitance. **[08]**

(b) A 50 Hz sinusoidal current has peak factor 1.4 and form factor 1.1. Its average value is 20 Amp. The instantaneous value of current is 15 Amp at t = 0 sec. write the equation of current and draw its waveform. **[06]**

(c) Define r.m.s. value, form factor and peak factor of sinusoidal current. **[04]**

Q.9) (a) A series circuit consisting of a coil and a variable capacitance having reatance Xc. The coil has resistance of 10Ω, inductive reactance of 20Ω. It is observed that at certain value of capacitance current in the circuit is maximum, find (1) this value of capacitance (2) impedance of the circuit (3) power factor (4) current, if applied voltage is 100V, 50Hz. **[08]**

(b) Two impedences $(R_1 - jx_{c1})$ and $(R_2 + jx_{L2})$ are connected in parallel across supply voltage $v=(100\sqrt{2})$ sin (314 t). The current flowing through the two impedences are given by $i_1 = 10\sqrt{2}$ sin $(314\ t + \pi/4)$ and $i_2 = 10\sqrt{2}$ sin $(314\ t - \pi/4)$ respectively.

Find equation for instantaneous value of total current drawn from supply. Also find values of R_1, R_2, X_{L1} and X_{L2}. **[08]**

OR

Q.10) (a) A coil connected across a 250 volt, 50 Hz supply takes a current of 10 Amp at 0.8 power factor lag. What will be the power taken by the choke coil, when connected across a 200 volt, 25 Hz. supply ? Also caculate resistance and inductane of the coil. **[08]**

(b) An alternating voltage $v = 141.4 \sin(157.08t + \pi/12)$ volts is applied to a circuit and an a.c. ammeter, wattmeter and power factor meter are connected to measure the respective quantities. Reading of ammeter is 5 Amp. and that of power factor meter is 0.5 lagging, find (i) the expression for the instantaneous value of current, (ii) the wattmeter reading (iii) impedence of the circuit in rectangular form. **[08]**

Q.11) (a) Write the advantages of 3-phase A.C. system over 1-phase A.C. system. **[04]**

(b) Write the relationship between phase quantities and line quantities in 3 phase Delta connected load.

Draw the connection diagram for a 3 phase balanced star connected inductive load, showing phase and line quantities of voltage and currents. **[04]**

(c) A single phase transformer when connected to a lamp load gave following results : **[08]**

Sr. No.	V_1	I_1	W_1	V_2	I_2	W_2
1.	200	1.5	60	100	0	0
2.	200	12.9	2510	97	25	2425

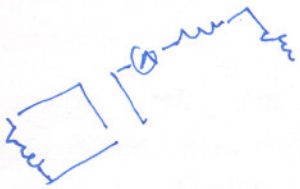
Calculate efficiency and % Regulation of transformer at $I_2 = 25$ Amp (second reading). **[04]**

OR

Q.12) (a) A symmetrical 3 phase, 400 volt system supplies a balanced load of 0.8 lagging power factor and connected in star. If the line current is 34.64 Amp, find (i) impedance (ii) resistance and reactance per phase (iii) total power and (iv) total reactive voltamperes. **[08]**

(b) Explain why the secondary terminal voltage of transformer is reduced on load. **[02]**

(c) With the help of neat circuit diagram, describe the method of testing a single phase transformer by direct loading it, Explain how efficiency and regulation are calculated. **[06]**



Total No. of Questions : 12] [Total No. of Printed Pages : 4

[2758]-103

F.E. (2003 COURSE) EXAM.-2005

BASIC MECHANICAL ENGINEERING

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

*(1) Answer **one** question from each unit.*
(2) Answers to the two sections should be written in separate books.
(3) Neat diagrams must be drawn wherever necessary.
(4) Figures to the right indicate full marks.
(5) Use of logarithmic tables, electronic pocket calculator and steam tables is allowed.
(6) Assume suitable data, if necessary.

SECTION - I

UNIT - 1

Q.1) (a) In a steady flow device, the inlet and outlet conditions are given below. Determine the heat loss/gain by the system :

Property	**Inlet**	**Outlet**
Pressure (bar)	12	0.14
Specific volume $\left(\frac{m^3}{kg}\right)$	0.241	8.952
Specific Internal Energy $\left(\frac{kJ}{kg}\right)$	2945	2451
Velocity $\left(\frac{m}{s}\right)$	21	125
Elevation (m)	3.4	2.5

The fluid flow rate through the device is 3 kg/s. The work output of the device is 850 kW. **[10]**

(b) Why does one require only one reference point of triple point of water for construction of absolute scale of temperature ? **[06]**

OR

Q.2) (a) Explain Intensive and Extensive Property. Which one of the following properties is extensive property ? Why ?

Specific Enthalpy, Pressure, Volume, Temperature [06]

(b) A non-flow system undergoes a frictionless process according to the law $P = \frac{4.5}{v} + 2$ where P is in bar, v in m^3/kg. During this process volume changes from 0.12 m^3/kg to 0.04 m^3/kg and temperature increases by 133°C. The change in internal energy of fluid is given by $du = C_v dT$ where C_v = 0.71 kJ/kg k and dT is temperature change. Find out (i) Heat transfer (ii) Work done. Assume fluid mass of 5 kg. [10]

UNIT - 2

Q.3) (a) Explain with neat sketch working of a window air conditioner. Why is smoking prohibited in air conditioned office ? [06]

(b) Explain working of a two stroke petrol engine with the help of neat sketch. Why are such engines not popular now-a-days ? [06]

(c) Explain working of centrifugal pump with the help of a neat sketch. What is the function of foot valve ? [06]

OR

Q.4) (a) Explain working of a reciprocating air compressor with the help of a neat sketch. Why is the mass of air handled by the compressor less when the delivery pressure is more ? [06]

(b) Explain working of a fire tube boiler with the help of a neat sketch. [06]

(c) Explain working of the centrifugal compressor with the help of a neat sketch. [06]

UNIT - 3

Q.5) (a) Draw a neat labelled diagram of Nuclear Power Plant. [03]

(b) Write a short note on Fuel Cells. [05]

(c) A steam pipe having 4 cm outer diameter is to be insulated by two layers of insulation each 2 cm thick. The material M_1 has conductivity K and the material M_2 has conductivity 3K. Assuming that the inner and outer surface temperatures of composite insulation to be used are T_1 and T_2. Find (i) What arrangement would give less heat loss rate; M_1 near the pipe surface and M_2 as outer layer or vice versa ? (ii) What is the percentage reduction ? [08]

OR

Q.6) (a) What do you mean by Insulating Materials ? Give any two applications of insulating materials. State any four desirable properties of insulating materials. Also mention any two insulating materials. **[05]**

(b) Derive an expression for heat flow through a hollow sphere. **[04]**

(c) The heat loss through a fire brick furnace wall, 0.2 m thick ($k = 1.5$ w/m°k) insulated from outside by a brick wall ($k = 0.4$ w/m°k) is 400 w/m^2. The inside fire brick wall temperature is 1573°k and outside ambient air temperature is 293°k. Heat transfer coefficient at the exterior surface is given by $h = 3\ (\Delta T)^{0.25}$ where ΔT is temperature difference between the surface and ambient air. Find thickness of insulating brick. **[07]**

SECTION - II

UNIT - 4

Q.7) (a) What do you mean by Welding ? Give classification of welding. Explain TIG welding with a suitable sketch. **[07]**

(b) Draw a neat labelled diagram of Centre Lathe Machine. Mention various operations performed on it. **[07]**

(c) Write a short note on 'CNC machine'. **[04]**

OR

Q.8) (a) Explain any four operations performed on drilling machine, with a suitable sketch. **[08]**

(b) Write a short note on 'Reciprocating Power Saw'. **[06]**

(c) Explain Soldering and Brazing in brief. **[04]**

UNIT - 5

Q.9) (a) Define the following : **[04]**

(1) Design size

(2) Allowance

(3) Tolerance

(4) Actual size

(b) What do you mean by Factor of Safety ? What are the parameters affecting selection of factor of safety ? **[04]**

(c) Explain with suitable sketch, the following : [08]

(1) Deep Drawing

(2) Wire Drawing

OR

Q.10) (a) Explain stress strain diagram for a mild steel with a suitable sketch. Show salient features on it. [08]

(b) Write a short note on 'Ergonomic Considerations in Design'. [04]

(c) Explain with suitable sketch, the following : [04]

(1) Blanking

(2) Notching

UNIT - 6

Q.11) (a) Differentiate between Flat belt and V-belt drive. Draw suitable sketches of their cross-sections. [04]

(b) Write a short note on 'Bushed Pin Type Flexible Coupling'. [06]

(c) Explain with suitable sketch, Centrifugal Governor. State its applications. [06]

OR

Q.12) (a) Write a short note on 'Centrifugal Clutch' giving its applications. [06]

(b) Explain in brief following with a sketch : [06]

(1) Woodruff key

(2) Taper roller bearing

(c) Suggest a suitable element for the following : [04]

(1) To transmit power when the axes of the shafts are neither parallel nor intersecting.

(2) To transmit power when the axes of the shafts are intersecting.

(3) To transmit power when the axes of the shafts are parallel with slight misalignment.

(4) To transmit power when the distance between shaft is 2-4 mtrs.

Total No. of Questions : 12] [Total No. of Printed Pages : 4

[2758]-102

F.E. (2003 COURSE) EXAM.-2005

APPLIED SCIENCE - I

Time : 3 Hours] [Max. Marks : 100

Instructions :

(1) Answer 3 questions from Section I and 3 questions from Section II.

(2) Answers to the two sections should be written in separate books.

(3) Neat diagrams must be drawn wherever necessary.

(4) Figures to the right indicate full marks.

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

Constants :

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

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

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

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

SECTION - I

Q.1) (a) Explain the following engineering applications of interference : **[07]**

(1) Non-reflecting coating

(2) Cornu's method for determination of Young's modulus

(b) Derive the equation for Mass-Energy Equivalence. **[05]**

(c) When a thin film of glass of $\mu = 1.5$ is interposed in the path of one of the interfering beams of Michelson's Interferometer, a shift of 30 fringes of sodium light is observed across the field of view. If the thickness of the film is 0.018 mm, calculate the wavelength of light used. **[04]**

OR

Q.2) (a) How can Newton's rings be obtained in the laboratory ? Prove that for the Newton's rings in the reflected light the diameter of bright rings are proportional to the square root of odd natural numbers. **[06]**

(b) State the fundamental postulates of relativity. Write down equations of Lorentz transformation. How are they superior to Galilean transformation ? **[06]**

(c) An observer on earth sees two events occuring simultaneously at two places separated by a distance 10^4 m. How much apart with respect to time will they appear to an observer on a rocket, if the relative velocity of rocket is 0.95 c ? **[05]**

Q.3) (a) Obtain the condition for maxima in the Fraunhoffer diffraction due to single slit. **[06]**

(b) What is Piezo-Electric Effect ? Describe how piezo-electric effect can be used for generating ultrasonic waves. **[06]**

(c) Write down short note on 'Bragg's Law'. **[05]**

OR

Q.4) (a) State and explain Rayleigh's criterian of resolution of two point objects. Derive an expression for the R.P. of a telescope. **[06]**

(b) What are Ultrasonic Waves ? Give any eight applications of ultrasonic waves. **[06]**

(c) A beam of X-rays of wavelength 0.842 A^o is incident on a crystal at a glancing angle of 8.58^o when the first order Bragg's reflection occurs. Calculate the glancing angle for the third order reflection. **[05]**

Q.5) (a) Explain the term 'Double Refraction' and hence explain the phenomenon of it on the basis of Huygen's Wave Theory. **[06]**

(b) Derive the four factor formula of a chain reaction. **[06]**

(c) If the frequency of the A.C. potential applied to the dees of a cyclotron is 9MHz, calculate the magnetic flux density to accelerate α particles. Given : mass of α - particles = 6.643×10^{-27} kg. **[04]**

OR

Q.6) (a) Explain the principle, construction and working of Nicol Prism. **[06]**

(b) Explain the principle, construction and working of Betatron. **[06]**

(c) What do you mean by 'Quarter Wave Plate' ? Deduce the expression for its thickness in terms of the refractive indices of the quartz crystal. **[04]**

SECTION - II

Q.7) (a) What are the types of symmetries in crystals ? Discuss them with respect to cubic crystals. **[06]**

(b) Classify the solids on the basis of bonding in them and explain any one type in detail. **[06]**

(c) How is radius ratio derived for ionic crystal with co-ordination number as 3 ? **[04]**

OR

Q.8 (a) Define and explain the following terms : **[06]**

(1) Anisotropy

(2) Atomic packing factor

(3) Frenkel defect

(b) Explain HCP, BCP and CCP types of packings of atoms in metals. **[06]**

(c) Give the applications of 'liquid crystals'. **[04]**

Q.9) (a) Give theory and procedure for quantitative determination of Cl^- ions in water. **[04]**

(b) How is water containing ionic pollutants treated by using exchanger resins ? **[04]**

(c) How is COD of a waste water found out ? Give difference in BOD and COD. [05]

(d) A zeolite bed gets exhausted on softening 2500 litres of a water sample and requires 10 litres of 10% NaCl for regeneration. Find the hardness of the water sample. [04]

OR

Q.10)(a) Explain the treatment of domestic waste water. [07]

(b) Give the causes of boiler corrosion and propose the methods to minimize the corrosion. [06]

(c) 50 ml of a water sample requires 3.7 ml of 0.025 N H_2SO_4 upto phenolphalein end point and further 4.8 ml upto methyl orange end point during the titration. Calculate types and amounts of alkalinities in the water sample. [04]

Q.11)(a) Give any two methods for finding average molecular weights of thermo-softening polymers. [05]

(b) Give the cationic chain mechanism for polymerisation of vinylic monomers. [04]

(c) Describe the technique of polymerisation in which a thermo-softening polymer is obtained as beads. [03]

(d) Give a note on 'polymer composites'. [05]

OR

Q.12)(a) Give formation reaction, properties and uses of **any two** of the following : [06]

(1) ABS plastics

(2) Chloroprene

(3) Silicone rubber

(b) Compare : [07]

(1) Addition and condensation polymerisations

(2) LDPE and HDPE

(c) Give a note on "Glass Transition Temperature". [04]

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

[2758]-105

F.E. (2003 COURSE) EXAM.-2005

BASIC CIVIL ENGINEERING

Time : 3 Hours] [Max. Marks : 100

Instructions :

(1) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 from section I and Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12 from section II.

(2) Answers to the two sections should be written in separate books.

(3) Neat diagrams must be drawn wherever necessary.

(4) Figures to the right indicate full marks.

(5) Use of logarithmic tables, non-programmable electronic pocket calculator and steam tables is allowed.

(6) Assume suitable data, if necessary.

SECTION - I

Q.1) (a) Compare Roadways and Railways w.r.t. any four points. **[04]**

(b) State any two practical applications of each of the following : **[04]**

(1) Irrigation Engineering

(2) Foundation Engineering

(c) State clearly the four basic roles of a Civil Engineer in any type of construction work. **[04]**

(d) Define the term "GAUGE" and state the types of Gauges. Also give their values. **[05]**

OR

Q.2) (a) Draw a neat figure to show all the details of a permanent way of a Railway Track. **[04]**

(b) Write short notes on the following : **[04]**

(1) Structural Engineering

(2) Geo-technical Engineering

(c) State the importance of Civil Engineering in laying a foundation for a big machine. **[04]**

(d) Enlist and explain in brief various types of roads based on materials used. **[05]**

Q.3) (a) Define Surveying. State clearly 2 principles of surveying. Also draw sketches. **[04]**

(b) Differentiate between the following : **[04]**

(1) Plan and Map

(2) Check line and Tie line

(3) Cloth tape and Steel tape

(4) Magnetic bearing and True bearing

(c) Write in a tabular form how the conversion of R.B. is done into W.C.B. system. **[04]**

(d) A regular pentagon (closed traverse) PQRST was traversed in clockwise direction such that the F.B. of the line RS was observed to be 85° 30'. Find the F.B. and B.B. of all the lines. Determine each interior angle also. Draw the rough sketch of the traverse. **[05]**

OR

Q.4) (a) State the importance (or use) of the following : **[04]**

(1) Tie line

(2) Arrow

(3) Ranging rod

(4) Open cross staff

(b) Define F.B. and B.B. of a line with the aid of a neat sketch. Hence find the interior angle MNO when F.B. and B.B. of the lines MN and NO respectively are 120° 15' and 220° 00'. **[04]**

(c) What is Local Attraction ? How it can be detected ? State clearly. **[02]**

(d) State principles of surveying and briefly describe any one of them. **[03]**

(e) Differentiate between the following : **[04]**

(1) Magnetic bearing and True bearing

(2) Base line and Check line

(3) Dip and Declination

(4) Offset rod and Ranging rod

Q.5) (a) State any two practical applications of – **[02]**

(1) E.D.M.

(2) Electronic Theodolite

(b) Define the following terms in one or two sentences – **[03]**

(1) Bench Mark

(2) Change point

(3) Fore Sight

(c) Write any 3 uses of Contour Maps. **[03]**

(d) During a levelling work started from an A.B.M. of known RL = 100.000 m the following staff readings were obtained : (1) 0.850 (2) 1.555 (3) 1.725 (4) 0.455 (5) 1.800 (6) 1.750 (7) 0.950 and (8) 1.555. The instrument was shifted after 3rd and 6th readings. Enter correctly all the readings in a field book page and determine the reduced levels of all stations showing calculations by Rise and Fall method. Apply usual arithmetic check. **[08]**

OR

Q.6) (a) Compare between H.I. method and Rise and Fall method of levelling w.r.t. any 3 points. **[03]**

(b) State any 3 characteristic properties of Contour Line with proper sketches. **[03]**

(c) State any 2 practical applications of – **[02]**

(1) Digital theodolite

(2) G.I.S.

(d) Define the following : **[03]**

(1) Change point

(2) Contour interval

(3) Bench Mark

(e) Find the missing values shown as X in the following Level field book page. Also show usual arithmetic check : **[05]**

Stn.	B.S.	I.S.	F.S.	H.I.	R.L.	Rem.
P	X			X	105.000	P.B.M.
Q		1.525			X	
R		1.600			104.250	
S	X		2.450	X	103.400	X
T		1.250			103.050	
U		1.855			X	
V			X		101.315	Last pt.

SECTION - II

Q.7) (a) State any two uses of each : **[03]**

(1) Stones

(2) Cement

(3) 1st class Bricks

(b) Write a note on classification of bricks. Also state any three requirements to ascertain the quality of good bricks for building. **[05]**

(c) How do you differentiate Mortar with Concrete ? State clearly. Also mention their specific uses. **[03]**

(d) State any 3 advantages of Framed Structure over the Load Bearing Structure. **[03]**

(e) Point out the necessity of doors and windows in buildings. Also name the type of door used in Residential building and in College building. **[03]**

OR

Q.8) (a) State the different components of a Super Structure and also the types of Loads to be considered. **[04]**

(b) Sketch a conventional brick showing a frog. Also state the importance of frog. **[03]**

(c) Explain the terms : **[03]**

(1) Safe bearing capacity

(2) Differential settlement

(d) Write a note on classification of stones and state any two uses of stones. **[04]**

(e) Mention any two uses or applications of : **[03]**

(1) R.C.C.

(2) Plain cement concrete

(3) P.S.C.

Q.9) (a) State any 3 objectives of Land Acquisition Act. **[03]**

(b) With the help of sketches state the necessity of set back distance and side margins for a building. **[04]**

(c) Enlist various principles of planning and explain in brief Aspect and Prospect with sketches. **[07]**

(d) State the necessity of building bye-laws and also state whether these are Universal ? **[03]**

OR

Q.10) (a) Write short note on Environmental Protection Act. **[03]**

(b) Draw illustrative sketches to show how prospect can be achieved. **[04]**

(c) State any 4 important factors which are to be considered during the selection of an ideal site for residential building. **[04]**

(d) State the minimum requirements of any six internal dimensions of the rooms in a residential building. **[03]**

(e) How privacy is achieved in the building ? Describe briefly. **[03]**

Q.11) (a) Enlist various Conventional and Non-conventional Energy Sources. **[03]**

(b) What is Acid Rain ? State any three ill effects of it. **[03]**

(c) What are the effects of Air Pollution on – **[06]**

(1) Humans

(2) Vegetation

(3) Materials and Structures

State clearly.

(d) State 2 advantages and 2 applications of – **[04]**

(1) Wind energy

(2) Solar energy

OR

Q.12)(a) Write short note on 'Green House Effect' with sketches. **[04]**

(b) Enlist and briefly explain various causes and effects of Water Pollution. **[05]**

(c) Write a short note on Biomass Energy. **[04]**

(d) Briefly explain various remedial measures to reduce Land Pollution. **[03]**
