F 3438 (Pages : 2) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2010

Third Semester

Branch : Electrical and Electronics Engineering

MECHANICAL TECHNOLOGY (L)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

1. Define surface tension. Derive an expression for the surface tension for a hollow bubble exposed to air.
2. Explain the stability conditions of floating and submerged bodies.
3. Explain the working principle of a pitot tube.
4. Write the Bernoulis equation for an ideal flow. What are the limitations of Bernoulis equation ?
5. Explain with a neat sketch the governing of a pelton turbine.
6. Define specific speed of a turbine. Explain its significance.
7. Why printing is necessary for a centrifugal pump ?
8. Explain the meaning of manometric efficiency of a centrifugal pump.
9. With neat sketch explain the working principle of a gear pump.
10. What do you mean by negative slip? Under what conditions negative slip will occur ?

(10 × 4 = 40 marks)

Part B

11. A circular plate 3 m diameter is immersed in water in such a way that its greatest and least depths below the free surface of water are 4 m and 1.5 m. respectively. Find the total pressure on one face of the plate and position of centre of pressure. (12 marks)

Or

12. Express the value of atmospheric pressure in (a) Pascal (b) N/m^2 (c) Bar (d) meters of water (e) meters of mercury (f) meters of an oil of specific gravity 0.8. (12 marks)

Turn over

13. Derive Hagen-Poiseuille formula. (12 marks)

Or

14. An oil of viscosity 0.1 Nsce/m^2 and relative density 0.09 is flowing through a circular pipe of diameter 50 mm and of length 300 mm. The rate of flow of fluid through the pipe is 3.5 litres/sec. Find the pressure drop for a length of 300 mm and also the shear stress at the pipe wall. (12 marks)

15. Explain different efficiencies of a turbine. (12 marks)

Or

16. A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m3/s. If the overall efficiency is 90% find :

(a) Specific speed, (b) Power generated and (c) Type of turbine. (12 marks)

17. Derive an expression for the minimum starting speed of a centrifugal pump.

Or

18. (a) Explain the significance of NPSH. (12 marks)

(b) Explain with neat sketch how multistaging of centrifugal pumps is used to obtain higher head and discharge. (6 + 6 = 12 marks)

19. Derive an expression for the power required to derive a reciprocating pump. (12 marks)

Or

20. A double acting reciprocating pump running at 40 r.p.m. is discharging 1 m^3 of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction heads are 20 m and 5 m respectively. Find the slip and power required to drive the pump. (12 marks)

(5 ×12 = 60 marks)

F 3468 (Pages : 2) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2010

Third Semester

Branch : Electical and Elctronics Engineering

POWER GENERATION AND DISTRIBUTION (E)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*

Each question carries 4 *marks.*

1. Explain load curve and load duration curve in a power system.
2. Explain the straight line method for determining depreciation.
3. Briefly explain the ring main and radial distribution systems.
4. Discuss relative merits and demerits of underground cables and overhead lines.
5. Write a short note on rules for supply of electricity.
6. Explain the importance of power factor improvement in power system.
7. Derive an expression for insulation resistance of a cable.
8. Explain Varley loop test for locating faults in underground cables.
9. Explain the basic principle of electrostatic machines.
10. What is the principle of operation of resonant transformer? Mention its merits and demerits over the cascade connected transformers.

(10 × 4 = 40 marks)

Part B

11. (a) Explain the terms load factor and diversity factor. How do these factors influence the cost of generation?

(b) A power station has a daily load cycle as follows: 260 MW for 6 hours; 200 MW for 8 hours; 160 MW for 4 hours, 100MW for 6 hours. If the power station is equipped with 4 sets of 75 MW each, calculate (i) daily load factor (ii) plant capacity factor and (iii) daily requirement if the calorific value of oil used were 10,000 kcal/kg and the average of station were 2860 kcal/kwh. (6 + 6 = 12 marks)

Or

(c) What is tariff? Explain different types of tariff in power system.

(d) Calculate annual bill of a consumer whose maximum demand is 100 kW. p.f. = 0.8 lagging and load factor = 60%. The tariff used is Rs.75 per kVA of maximum demand plus 15 paise per kWh consumed. (7 + 5 = 12 marks))

Turn over

12. (a) A two wire DC distribution system AB, 6000 m long is fed from both ends at 220 V. Loads of 20A, 40A, 50A and 30A are tapped at distances of 100 m, 250 m, 400 m and 500 m from the end A respectively. If the area of X-section of distributor conductor is 1 cm^2, find the minimum consumer voltage. Take $\rho = 1.7 \times 10^{-6} \Omega cm$. (12 marks)

Or

(b) A single phase distributor 1000m long has resistance and reactance per conductor of 0.1 Ω and 0.15 Ω respectively. At the far end the voltage V_B = 200 V and the current is 100 A at a p.f. of 0.8 lagging. At the midpoint M of the distributor, a current of 100 A is tapped at a p.f. of 0.6 lagging with reference to the Voltage V_M at the midpoint. Calculate (i) Voltage at midpoint (ii) sending end voltage V_A (iii) Phase angle between V_A and V_B. (12 marks)

13. (a) What is Kelvin's law? Explain its limitations.

(b) The cost per km for each of the copper conductor of a section 'a' sq.cm for a transmission line is Rs. (2800 a + 1300). The load factor of the load current is 80% and the load factor for the losses is 65%. The rate of interest and depreciation is 10% and the cost of energy is 10 paisa per kwh. Find the most economical current density for the transmission line by the use of Kelvin's law. Given $\rho = 1.78 \times 10^{-8}$ Ω–m. (7 + 5 = 12 marks)

Or

(c) Derive an expression for the most economical power factor in power system.

(d) Expain any *one* method for the improvement of power factor. (7 + 5 = 12 marks)) (9 + 3 = 12 marks)

14. (a) Derive an expression for dielectric stress in a single core cable.

(b) An 11 kV, 50 Hz single phase cable 2.5 km long, has a diameter of 20 mm and internal sheath radius of 15 mm. If the dielectric has a relative permittivity of 2, 4 determin (i) Capacitance, (ii) Charging current and (iii) total charging kVAR. (6 + 6 = 12 marks)

Or

(c) What is grading of cables? Explain the different methods used for grading of cables. (12 marks)

15. (a) Why is a Cockcroft - Walton circuit is preferred for voltage multiplier circuits? Explain its working with a schematic diagram. (12 marks)

Or

(b) With help of neat sketches explain the Marx circuit arrangement for multistage impulse generation.

(c) A 12 stage impulse generator has 0.126 μF capacitors. The wave front and wave tail resistance connected are 800 ohms and 5000 ohms respectively. If the load capacitor is 1000 μF, find the front and tail times of the impulse wave produced. (7 + 5 = 12 marks)

(5 ×12 = 60 marks)

Module 5

5. (a) A solid of revolution is formed by rotating about x-axis the area between x-axis, the lines $x = 0$, and $x = 1$ and the curve through following points. Find the volume of the above by Simpson's rule :

x :	0	0.25	0.5	0.75	1.0
y :	1	0.9897	0.9588	0.9088	0.8415

(10 marks)

(b) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ using trapezoidal rule taking 12 equal parts and compare with the exact value of $\tan^{-1} 6$.

(10 marks)

Or

(c) Evaluate $\int_0^1 \frac{dx}{1+x}$ with $h = 0.25$ and $h = 0.5$ using tarapozoidal and Simpson's $\frac{1}{3}$ rule and compare.

(12 marks)

(d) Find the first and second derivatives of $f(x)$ at $x = 1.5$ if :

x :	1.5	2	2.5	3	3.5	4
$f(x)$:	3.375	7	13.65	24	38.5	59

(8 marks)

[5 × 20 = 100 marks]

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F 3434 (Pages : 4) Reg. No.....EEE.....

Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2010

Third Semester

Branch—Civil, Mechanical, Electrical and Electronics, Polymer Electronics and Communication, Electronics and Instrumentation, Automobile Engineering and Aeronautical Engineering

ENGINEERING MATHEMATICS—II (CMEPLANSU)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Answer **one** *full question from each module.*
Each full question carries 20 *marks.*

Module 1

1. (a) Define a scalar point function, its gradient and directional derivative if $\phi = r^m$ where $r = \left|\vec{r}\right|$, and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k} + z\vec{k}$, find $\nabla\phi$.

(6 marks)

(b) Show that $\nabla \times \left(\phi \vec{A}\right) = (\nabla\phi) \times \vec{A} + \phi\left(\nabla \times \vec{A}\right)$.

(6 marks)

(c) Expand $\nabla \cdot \left(\phi \vec{A}\right)$. Hence evaluate $\nabla \cdot \left(r^3 \vec{r}\right)$, where $r = \left|\vec{r}\right|$, and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$.

(8 marks)

Or

(d) If $\vec{r}$ is the position vector of the point $p(x, y, z)$, then prove :

(i) $\text{div}\ \vec{r} = 3$.

(ii) $\text{curl}\ \vec{r} = \vec{0}$.

(iii) $\nabla r^n = nr^{n-2}\vec{r}$, where $r = \left|\vec{r}\right|$.

(3 × 5 = 15 marks)

Turn over

(e) For every vector point function $\vec{F}$, prove that div curl $\vec{F} = 0$. (5 marks)

Module 2

2. (a) Using Green's theorem, evaluate $\int_c \left(xy^2\,dy - x^2y\,dx\right)$ where C is the Cardioid $r = a(1 - \cos\theta)$. (5 marks)

(b) Find the flux of the vector find $\vec{A} = (x - 2z)\hat{i} + (x + 3y + z)\hat{j} + (5x + y)\hat{k}$ through the upper side of the triangle ABC with vertices at points A (1, 0, 0), B (0, 1, 0), C (0, 0, 1). (7 marks)

(c) Using divergence theorem, evaluate $\int_s \vec{f} \cdot \hat{n}\,ds$, where $\vec{f} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ and S is the surface enclosing the region for which $x^2 + y^2 \le 4$ and $0 \le z \le 3$. (8 marks)

Or

(d) Verify Stoke's theorem for $\vec{f} = y\hat{i} + z\hat{j} + x\hat{k}$ for the upper part of the sphere $x^2 + y^2 + z^2 = 1$. (9 marks)

(e) Show that the vector $\left(\frac{\vec{r}}{r^3}\right)$ is both solenoidal and irrotation. (6 marks)

(f) Show that $\int_c \vec{F} \cdot d\vec{r} = 3\pi$, given $\vec{F} = 2\vec{i} + x\vec{j} + \vec{k}$ and C is the arc of the curve :

$$\vec{V} = \cos t\,\vec{i} + \sin t\,\vec{j} + t\vec{k}$$

from $t = 0, t = 2\pi$. (5 marks)

Module 3

3. (a) Define an analytic function. Show that the function $f(z) = xy + iy$ is not analytic. (5 marks)

(b) Show that $u = x^2 - y^2 + \frac{x}{(x^2 + y^2)}$ is harmonic. Find its harmonic conjugate and the analytic function $f(z)$ whose real part is u. (8 marks)

(c) If $f(z) = u + iv$ is analytic function, prove that $\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right]|f(z)|^2 = 4\,|f'(z)|^2$. (7 marks)

Or

(d) Derive the Cauchy-Riemann equations satisfied by an analytic function, in polar form. (6 marks)

(e) Show that $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ is a harmonic function. Find v such that $u + iv$ is analytic. (7 marks)

(f) Find the bilinear transformation which maps $z_1 = 1, z_2 = i, z_3 = -1$ onto $w_1 = 2, w_2 = i, w_3 = -2$. (7 marks)

Module 4

4. (a) Determine $f(x)$ of the following data using Newton's divided difference :

x	:	-4	-1	0	2	5
$f(x)$	:	1235	36	5	9	1325

(10 marks)

(b) Find $f(x)$ using Stirling's formula :

x	:	20	30	40	50	60
$f(x)$	:	512	438	356	243	140

(10 marks)

Or

(c) Find the missing value using backward difference formula :

x	:	0	1	2	3	4
y	:	1	3	9	?	81

Explain why the result differs from $3^3 = 27$. (10 marks)

(d) Use Lagrange interpolation to fit a polynomial to the data :

x	:	-1	0	2	3
y	:	-8	3	1	2

(10 marks)

MODULE 4

14. (a) (i) Three equal inductors connected in star take 5kW at 0.7 pf where connected to a 400V, 50Hz three-phase, three wire supply. Calculate the line currents.

1 if one of the inductors is disconnected, and

2 if one of the inductors is short circuited.

(6 marks)

(ii) Three non-inductive resistances of 25Ω, 10Ω and 15Ω are connected in star to a 400V symmetrical supply. Calculate the line currents and the voltage across each load phase.

(6 marks)

Or

(b) A symmetrical three-phase 100V, three-wire supply feeds on unbalanced star connected load, with impedances of the load as $Z_R = 5\angle 0^\circ\ \Omega$, $Z_Y = 2\angle 90^\circ\ \Omega$, and $Z_B = 4\angle -90^\circ\ \Omega$. Find the : (i) line currents ; (ii) voltage across the impedances and ; (iii) the displacement neutral voltage.

(12 marks)

MODULE 5

15. (a) Obtain the oriented graph and KVL equations for the Fig.10. Also obtain the basic cut set matrix.

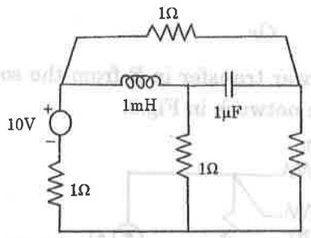

Fig.10.

(12 marks)

Or

(b) For the network shown in Fig.11, obtain :

(i) the oriented graph.

(ii) basic tie-set matrix.

(iii) incidence matrix.

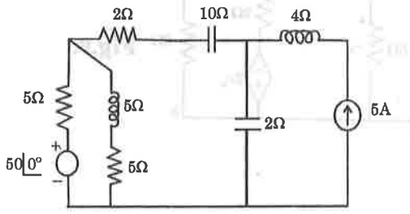

Fig.11.

(12 marks)

[5 × 12 = 60 marks]

F 3446 (Pages : 4) Reg. No.....

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B.TECH. DEGREE EXAMINATION, NOVEMBER 2010

Third Semester

Electrical and Electronics Engineering

ELECTRIC CIRCUIT THEORY (E)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions briefly.*
Each question carries 4 *marks.*

1. Define and distinguish between :
   (i) Circuit and network. (ii) Linear and non-linear.
   (iii) Active and passive. (iv) Unilateral and bilateral.
2. Compare node and mesh analysis as applied to an electric circuit.
3. Define coefficient of coupling and state methods to maximise the same.
4. With necessary equations, show how a transformer can provide impedance matching ?
5. State and explain Tellegen's theorem.
6. Illustrate compensation theorem, with a general example.
7. The total power supplied to three similar resistors connected in (i) wye ; (ii) delta from a balanced 3-phase source is P. One of the resistors is burnt out. Calculate the power now in terms of P in both the above cases.
8. From basics, derive an expression for the potential difference between star point of the load supply neutral. Can this be greater than the supply line voltage ? Explain.
9. Define the terms : graph, tree, co-tree and basic tie-set.
10. Explain the procedure of using pSPICE for simple electric circuit analysis.

(10 × 4 = 40 marks)

Part B

Answer **either** *Section* (*a*) **or** (*b*) *from each module.*
Each full question carries 12 *marks.*

MODULE 1

11. (a) (i) Find the voltage drop across 1Ω resistor and power loss across 2Ω resistor in Fig.1.

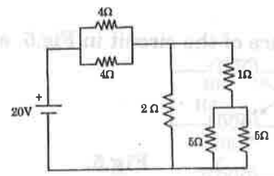

Fig.1.

(6 marks)

(ii) Using Source transformation prinicples, determine the current through the 5Ω resistor in Fig.2.

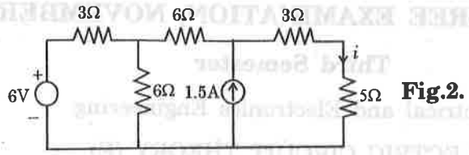

Fig.2.

(6 marks)

Or

(b) Find the voltage between A and B in Fig.3. and the current through 1Ω resistor.

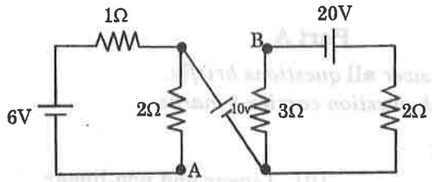

Fig.3.

(12 marks)

MODULE 2

12. (a) (i) An ideal transformer has N_1 = 1000 turns and N_2 = 10000 turns. What is the value of the impedance referred to as the primary, if a 1kΩ resistor is placed across the secondary ?

(4 marks)

(ii) An amplifier with an output impedance of 2 kΩ is to feed a loud-speaker with an impedance of 4 Ω.

1 Calculate the required turns ratio for an ideal transformer to connect the two units.

2 An r.m.s. current of 20 mA at 500 Hz is flowing in the primary. Calculate the r.m.s. value of current in the secondary at 500 Hz.

3 What is the power delivered to the load ?

(8 marks)

Or

(b) (i) The resonant frequency of the tuned circuit in Fig.4. is 1000 rad/sec. Calculate the self inductances of the two coils and the optimum value of the mutual inductance.

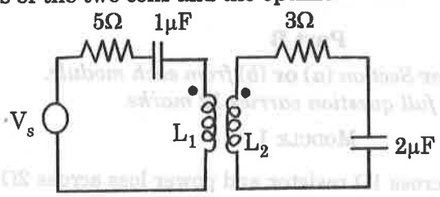

Fig.4.

(6 marks)

(ii) Calculate the effective inductance of the circuit in Fig.5. across XY.

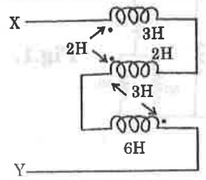

Fig.5.

(6 marks)

MODULE 3

13. (a) (i) Determine the current drawn by the circuit shown in Fig.6.

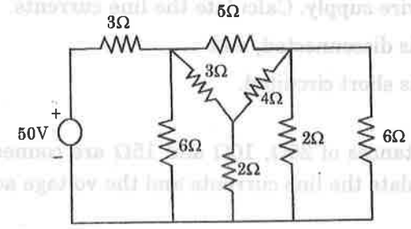

Fig.6.

(6 marks)

(ii) Find the power loss in 5Ω resistor of Fig.7. by superposition theorem.

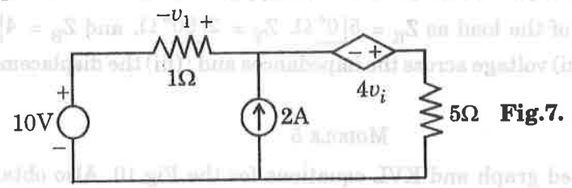

Fig.7.

(6 marks)

Or

(b) (i) Obtain maximum amount of power transfer in R from the sources using the theorem of maximum power transfer in the network in Fig.8.

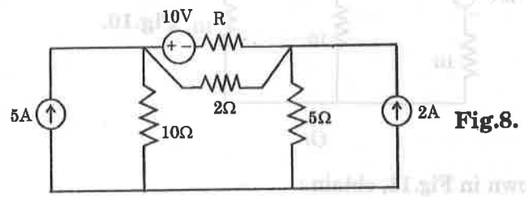

Fig.8.

(6 marks)

(ii) Find the current through 3Ω resistor in the circuit of Fig.9. using Norton's theorem.

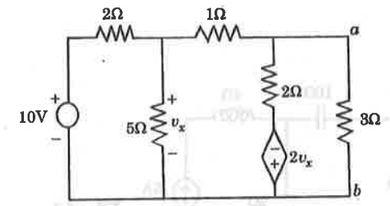

Fig.9.

(6 marks)

Turn over

F 3454 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2010

Third Semester

Electrical and Electronics Engineering

ELECTROMAGNETIC THEORY (E)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 4 marks.

1. Find the electric field at a distance Z above the midpoint of a straight line segment of length 2L, which carries a uniform line charge λ.
2. Give the vector at point A (2, – 1, – 3) that extends to point B(1, 3, 4) using cylindrical coordinate system.
3. How is an electric dipole set up ? Derive an expression for the potential at a distant point P at a distance r from the centre of a dipole.
4. Derive an expression for the potential due to an infinite line charge.
5. What are the conditions for field continuity at boundary surfaces, in the case of electric field ?
6. State the boundary conditions for electric field at the interface of two perfect dielectrics.
7. State and explain Stoke's theorem.
8. Derive an expression for the inductance of a toroid.
9. State and prove Poynting theorem.
10. Explain Faraday's laws of electromagnetic induction.

(10 × 4 = 40 marks)

Part B

Answer **either** *Section* (*a*) **or** (*b*) *from each module.*
Each full question carries 12 *marks.*

Module 1

11. (a) State and prove the Divergence theorem for the data :

$$\bar{D} = \left(x^2 - yz\right)\hat{a}_x + \left(z^2 - xz\right)\hat{a}_y + \left(y^2 - xy\right)\hat{a}_z,$$

for a rectangular parallelopiped bounded by the region $0 \le x \le a, 0 \le y < b, 0 \le z \le c$.

(12 marks)

Or

Turn over

(b) A non-uniform surface charge density of $\frac{5\rho}{(\rho^2+1)} n \, C/m^2$ lies in the plane $z = 2$, when $\rho < 5$ and $\rho_s = 0$ for $\rho > 5$; (i) How much electric flux leaves the circular region, $z = 2$; (ii) How much electric flux crosses the plane $z = 0$ in $\hat{a}_z$ direction ?

(12 marks)

MODULE 2

12. (a) (i) Calculate the potential difference V_{AB} for a line charge $\rho_L = 2.5 \times 10^{-8}$ C on the z-axis where point A $\left(2m, \frac{\pi}{2}, 0\right)$ and B $\left(4m, \frac{\pi}{2}, 2m\right)$.

(5 marks)

(ii) An electric dipole located at the origin in free space has moment $\bar{p} = 3\hat{a}_x - 2\hat{a}_y + \hat{a}_z \, nCm$. Find V at (2, 3, 4).

(7 marks)

Or

(b) (i) Find the energy stored in free space for the region $0 < r < a, 0 < \phi < \pi, 0 < z < 2$. The potential is $V = \frac{V \cdot r}{a}$ volt.

(6 marks)

(ii) Calculate the work done in moving a 10μC charge from A (1, 30°, 120°) to B (4, 90°, 60°). Use spherical (r, θ, ϕ) coordinate system.

(6 marks)

MODULE 3

13. (a) Given the potential, $V = 100 (x^2 - y^2)$ and a point $p(2, -1, 3)$ that lies on conductor-free space boundary. Find V, $\bar{E}$, $\bar{D}$ and ρ_s at P.

(12 marks)

Or

(b) A parallel plate capacitor with 10 mm plate separation has a 5 mm thick dielectric $(\epsilon_r = 2.5)$ lying on the bottom plate. A voltage of 100V is applied across the capacitor. Find ρ_s on the plate E and energy density at all the points inside the capacitor.

(12 marks)

MODULE 4

14. (a) The magnetic field intensity is given in a region of space as $\bar{H} = \frac{x+2y}{z^2} \bar{a}_y + \frac{2}{y} \bar{a}_z$ A/m.

(i) Find $\nabla \times \bar{H}$;

(ii) Find $\bar{J}$;

(iii) Use $\bar{J}$ to find the total current passing through the surface $z = 4, 1 < x \leq 2, 3 < y < 5$ in the $\bar{a}_z$ direction.

(12 marks)

Or

(b) Determine the magnetic flux density both inside and outside an infinitely long, straight conductor with circular cross-section of radius r, carrying a steady current I. Plot the variation of the flux density with radial distance.

(12 marks)

MODULE 5

15. (a) (i) State and explain Maxwell's equations. (4 marks)

(ii) If $\sigma = 0, \epsilon = 2.5, \mu = 10\mu_0$, determine whether or not the following pairs of fields satisfy Maxwell's equations.

1 $\bar{E} = 100 \sin 6 \times 10^7 t \sin z \, \bar{a}_y$ and $\bar{H} = -0.1328 \cos 6 \times 10^7 t \cos z \, \bar{a}_x$.

2 $\bar{D} = \left(z + 6 \times 10^7 t\right) \bar{a}_x$ and $\bar{B} = \left(-754z - 452 \times 10^{10} t\right) \bar{a}_y$.

(8 marks)

Or

(b) A lossy dielectric has $\mu = 4\pi \times 10^{-9}$ H/m and $\epsilon = \frac{10^{-8}}{36\pi}$ F/m, $\sigma = 2 \times 10^{-8}$ S/m. The electric field $\bar{E} = 200 \sin wt \, \bar{a}_z$ V/m exists at a certain point in the dielectric.

(i) At what frequency will the conduction current density and displacement current densities have equal magnitudes?

(4 marks)

(ii) At this frequency calculate the instantaneous displacement current density.

(5 marks)

(iii) What is the phase angle between the conduction current and the displacement current ?

(3 marks)

[5 × 12 = 60 marks]

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Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2010

Third Semester

Branch : Electrical and Electronics Engineering

ELECTRICAL AND ELECTRONIC MEASUREMENTS (E)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 4 *marks.*

1. Explain Lloyd-Fisher square and mention its advantages.
2. Derive the dimensions of m.m.f. and e.m.f. and state its units in SI system.
3. List the uses of potentiometer.
4. What are the advantages and applications of bridge circuits ?
5. Discuss the sources of error in a.c. bridges ? How they can be eliminated ?
6. What are the limitations of Wheatstone's bridge ? How they can be overcome ?
7. Draw the wiring diagrams for current and potential transformers.
8. What are random errors ? State the common causes for their occurrence.
9. What is a polar curve ? How is it useful to an illumination engineer ?
10. State and explain Seeback effect.

(10 × 4 = 40 marks)

Part B

Answer **either** *section (a)* **or** *(b) of each module.*
Each full question carries 12 *marks.*

Module 1

11. (a) With neat diagrams, explain the construction and working of a ballistic galvanometer ? Explain with necessary equations, how it can be used as a flux meter.

Or

(b) An iron ring, 3.5 $cm.^2$ cross-sectional area with a mean length of 100 cm., is wound with a magnetising winding of 100 turns. A secondary coil, with 200 turns of wire, is connected to a ballistic galvanometer having a constant 1 μC per scale division, the total resistance of the secondary circuit being 2 kΩ. On reversing a current of 10A in the magnetising winding, the galvanometer shows a deflection of 100 scale divisions. Compute the value of flux density in the specimen, and also the value of its permeability at this flux density.

Turn over

Module 2

12. (a) With neat circuit diagrams and equations, show how (i) low ; (ii) medium ; and (iii) high resistances are measured ?

(3 × 4 = 12 marks)

Or

(b) (i) With neat circuit diagram, explain the method of measurement of resistance by Kelvin's double bridge method.

(6 marks)

(ii) In a Kelvin double bridge, there is error due to mismatch between the ratios of outer and inner arm resistance. The following data relate to this bridge :

Standard resistance = 100.03 μΩ, inner ratio arms = 100.21 Ω and 200 Ω outer ratio arms = 100.14 Ω and 200 Ω. The resistance of the connecting leads from standard to unknown resistance is 700 μΩ. Calculate the unknown resistance.

(6 marks)

Module 3

13. (a) Draw a neat diagram of the Anderson bridge. Deduce the equations when the bridge is under balance condition. Explain clearly how you may measure self-inductance by using this bridge. Draw phasor diagram of the voltages and currents of the bridge arms at balance.

Or

(b) (i) Draw the block diagram of Wheatstone bridge with digital readout and explain it briefly.

(6 marks)

(ii) Determine the equivalent parallel resistance and capacitance that causes a Wien bridge to null with the following component values :

$R_1 = 3.1\ k\Omega$, $C_1 = 5.2\ \mu F$, $R_2 = 25\ k\Omega$, $R_4 = 100\ k\Omega$, $f = 2.5\ kHz$. (6 marks)

Module 4

14. (a) (i) Define the following terms as applied to instrument transformers :—

(1) Actual transformation ratio.

(2) Nominal transformation ratio.

(3) Turn ratio.

(3 × 2 = 6 marks)

(ii) Derive the expressions for "actual transformation (voltage)", "ratio and phase angle" in case of a potential transformer.

(6 marks)

Or

(b) By using a micrometer screw the following readings were taken of a certain physical length :

1,43, 1.38, 1.56, 1.42, 1.43, 1.44, 1.53, 1.48, 1.40, 1.52 mm.

Assuming that only random errors are present, calculate the following :—

(i) arithmetic mean. (ii) average deviation.

(iii) standard deviation. (iv) variance.

(4 × 3 = 12 marks)

Module 5

15. (a) (i) Describe the construction and use of any one type of photometer. (6 marks)

(ii) The candle power of a lamp is 100. A plane surface is placed at a distance of 2 metres from this lamp. Calculate the illumination on the surface when it is (1) normal ; (2) inclined to 45° ; and (3) parallel to the rays.

(6 marks)

Or

(b) Suggest a complete instrumentation scheme to measure high temperature of a furnace using thermocouple. Explain its functioning with appropriate diagrams. What are the precautions to be taken up while carrying out this measurement.

(12 marks)

[5 × 12 = 60 marks]