PHY 401 **Reg No.....**

CREDIT BASED FOURTH SEMESTER B.Sc. DEGREE EXAMINATION - APRIL 2012

PHYSICS

PAPER IV: ELECTROMAGNETISM AND ELECTRICITY

Duration: 3 Hours **Max Marks: 80**

PART –A

1.A. Answer any TEN of the following. **1x10=10**

(y) Define a vector field.

(z) What is an irrotational field?

(aa) What is the direction of propagation of electromagnetic wave if $\vec{E}$ and $\vec{B}$ are electric and magnetic vectors?

(bb) State Kirchoff's Voltage Law.

(cc) Why a parallel resonant circuit is called a rejector circuit?

(dd) Give the ratio of apparent power to the True Power in an electric circuit.

(ee) Why a pure inductance is a short for steady current?

(ff) What is a band stop filter?

(gg) What is the potential difference between ground and neutral wire when all phase are equally loaded?

(hh) Give the expression for the power consumed in delta configuration.

(ii) Draw the frequency response curve for a band pass filter.

(jj) Why the coil of a BG does come to rest immediately when it is shorted?

B. Answer any FIVE of the following. **2x5=10**

(a) If $\vec{r}$ is a position vector, find div $\vec{r}$.

(b) Define Poynting Vector and explain its significance.

(c) Define an active circuit element. Give an example.

(d) What are half power points? Explain.

(e) Show that the term RC has dimension of time.

(f) What are the advantages of 3 phase system over single phase system?

PART-B

UNIT-I

2. Answer TWO full questions of the following. **10x2=20**

(a) What is divergence and curl of a vector? Express them in Cartesian coordinates. Explain the significance of divergence and curl of a vector.

(b) If $\vec{A} = xz^3\hat{i} - 2x^2yz\hat{j} + 2yz^4\hat{k}$ find $\vec{\nabla} \times \vec{A}$ at point (1, -1, 1) **(6+4)**

3. (a) Derive the equation of continuity. Write Maxwell's field equations for an isotropie homogeneous dielectric medium.

(b) Find div (grad ϕ) if $\phi = x^2y^2z^2$. **(6+4)**

4. (a) Derive the wave equation for field vectors $\vec{E}$ and $\vec{B}$. Hence arrive at the equation for velocity of electro magnetic waves in a medium.

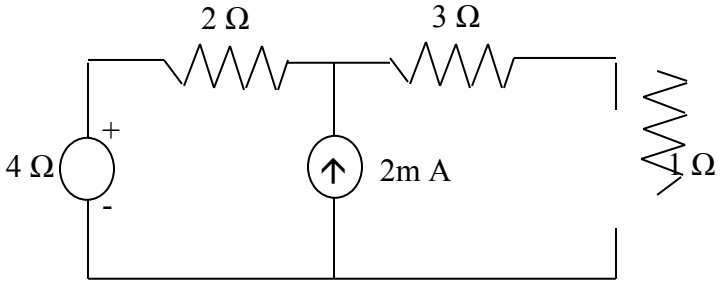
   (b) Prove that vector $\vec{A} = 3y^2\hat{i} + 4x^2\hat{j} - 3xz\hat{k}$ is solenoidal. **(6+4)**

UNIT-II

Answer <u>TWO</u> full questions of the following. **10x2=20**

5. (a) State and explain Thevenin's theorem by considering a general dc network. Explain how Norton's equivalent can be obtained from Thevenin's equivalent by source transformation.

   (b) Using superposition theorem calculate p.d. across 2 Ω resistor. **(6+4)**



6. (a) How do you convert a voltage source into current source? With a general network explain the steps involved in findng the branch currents using nodal voltage method.

   (b) A coil of inductance of 10mH and a resistance of 50 Ω are connected in series to a 200V, 50Hz a.c. main. Calculate the value of capacitor to be connected in series to make the power factor unity. Also calculate the current in the circuit. **(6+4)**

7. (a) Obtain expression for current in a series LCR circuit and write the condition for resonance.

   (b) A sinusoidal AC having a frequency of 60Hz has a peak value of 5A. Calculate:

   (i) r.m.s. value (ii) Average value (iii) current after $\frac{1}{300}$ Se from zero **(6+4)**

UNIT-III

Answer <u>TWO</u> full questions of the following. **10x2=20**

8. (a) Obtain an expression for decay of current in a LR circuit and hence define time constant. How do you increase the time constant of LR circuit.

   (b) A capacitor charged by a D.C. source through a resistance of 2M Ω takes o.5 sec. to reach ¾ of its final value. Find the capacitance of capacitor. **(6+4)**

9. (a) What is RC high pass filter? Draw the circuit diagram and explain how a CR circuit can be used as a high pass filter. Obtain expression for cut off frequency for a RC high pass filter.

   (b) Calculate the resistance required to design a RC low pass filter circuit for a cut off frequency of 1 KHz using a capacitor of o.1μF. Draw the necessary circuit and frequency response curve. **(6+4)**

10. (a) Give the theory of Anderson's Bridge with a circuit diagram.

    (b) A capicitor of capacitance 1000pF is charged to a potential difference of 1V and discharged through BG. The first throw on a scale 1m away is 62.2 cm. If time

period of BG coil is 10s, logarithmic decrement is 0.02, calculate the charge sensitivity of BG.

(6+4)

*****

PHY 401.1 **Reg No.....**

CREDIT BASED FOURTH SEMESTER B.Sc. DEGREE EXAMINATION - APRIL 2013

PHYSICS

PAPER IV: ELECTROMAGNETISM AND ELECTRICITY

Duration: 3 Hours **Max Marks: 80**

PART –A

1.A. Answer any <u>TEN</u> of the following. **1x10=10**

i) State any TEN of the following.

ii) Write the equation of continuity and mention the terms used.

iii) Write Maxwell's relation for refractive index.

iv) Write differential form of Gauss law.

v) What is an ideal current source?

vi) What is the maximum resistance offered by a carbon resistor having colour bands – Brown Black Red?

vii) Why a parallel resonant circuit is called a rejector circuit.

viii) What is the phase difference between voltage and current in a series LCR circuit at resonance?

ix) What is a transient current?

x) Draw the frequency curve for band-stop filter.

xi) What is the potential difference between the ground and the neutral wire when all phasesare equally loaded?

xii) Why the coil of a BG does come to rest immediately when it is shorted?

1.B. Answer any <u>FIVE</u> of the following. **5x2=10**

i) Explain why displacement current is necessary for the equation of continuity to hold good.

ii) Distinguish between normal and anomalous dispersion.

iii) State and explain Kirchoff's voltage law.

iv) Define mean value and rms value of ac.

v) Draw the circuit diagram for a CR low pass filter and give the expression for the cut-off frequency.

vi) Mention any two factors causing damping of the BG coil.

PART-B

UNIT-I

Answer any <u>TWO</u> of the following. **2x10=20**

2. (a) Deduce Maxwell's field equation $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ with usual symbols and give the physical meaning of this equation.

(b) The relative permittivity of distilled water is 81. Calculate the refractive index and velocity of wave. **(6+4)**

3. (a) Using Maxwell's field equations, show that electromagnetic waves are transverse in nature.

   (b) Elective potential in a region of space is given by $V(x,y,z) = 5x^2 - 7z$. Find the magnitude of electric field at point (1, 1, 0) and charge density.

   $(\epsilon_0 = 8.85 \times 10^{-12}$ SI units$)$ **(6+4)**

4. (a) Derive the law of conservation of energy, for an electromagnetic wave using Poyntings theorem.

   (b) A em wave with a frequency of 100 MHz travels in an insulating ferrite material with the properties M=10, ε=1000 at this frequency. The intensity of the wave is 2×10^{-7} Wm^{-2}. What is the speed of propagation of the wave? What are the amplitudes of the electric and magnetic fields in the material $C = 3 \times 10^8 ms^1$
   (6+4)

UNIT-II

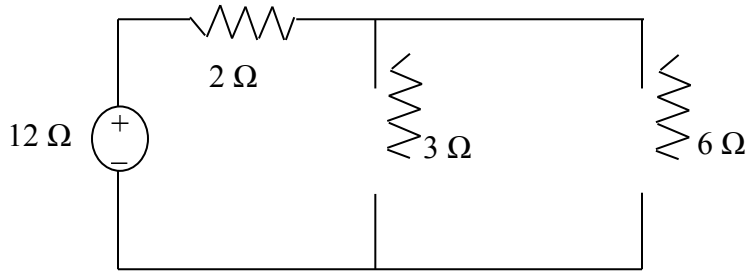
Answer any <u>TWO</u> of the following. **2x10=20**

5. (a) State and explain Norton's theorem by considering a general dc network. Explain how Thevenin's equipment can be obtained from Norton's equivalent by source transformation.

   (b) A series LCR circuit has an inductance of 9H, capacitor of 4μF and a resistance of 10Ω. It is tuned to resonance by connecting it across a variable frequency ac supply. Calculate the ratio of the voltage across the inductance to that across the resistance. **(6+4)**

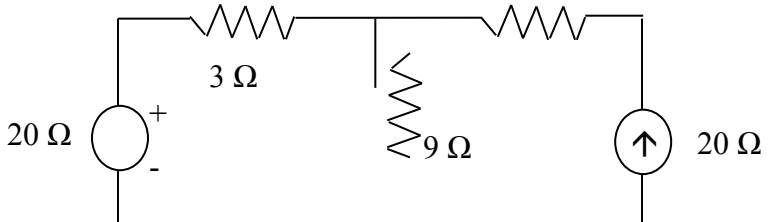
6. (a) State and prove Maximum Power Transfer theorem.

   (b) Determine the Norton's equivalent circuit of the network given below and calculate the current flowing through 6Ω resistor. **(6+4)**



7. (a) Obtain the expression for current in a parallel LCR circuit at resonance.

   (b) Using superposition theorem find current through 3Ω register in the following circuit and also find the power dissipated through it. **(6+4)**



UNIT-III

Answer any TWO of the following. **2x10=20**

8. (a) Derive an expression for the growth of change in a CR circuit and define time constant.

   (b) Find whether the discharge of the capacitor through the following inductive circuit is oscillatory. C = 0.2 μF, L = 10 mH, R = 250 Ω. If so, calculate the frequency. **(6+4)**

9. (a) Draw the diagram for delta in a three-phase system configuration and derive the relation between line current and phase current.

   (b) Calculate the resistance required to design a RC high pass filter for a cut off frequency of 1kHz using a capacitor of 0.1 μF . Draw the necessary circuit and frequency response curve. **(6+4)**

10. (a) Give the theory of Anderson's bridge.

    (b) When 0.1 μC of charge is passed through a moving coil BG, a deflection of 30 mm is observed on a scale 1 m away. Find the current sensitivity of the galvanometer, if the time period of the coil is 10.8. **(6+4)**

*****

PHY 401.1 **Reg No.....**

CREDIT BASED FOURTH SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2014

PHYSICS

PAPER IV: ELECTROMAGNETISM AND ELECTRICITY

Duration: 3 Hours **Max Marks: 80**

PART –A

1. (A) Answer any TEN of the following.
1X10=10

(kk) What is ether?

(ll) Write the differential form of Gauss law.

(mm) Define current density vector.

(nn) Draw graph showing the variation of refractive index with wavelength.

(oo) What is meant by linear circuit?

(pp) Define half power frequency.

(qq) What is an ideal current source?

(rr) Define mean value of AC.

(ss) What is transient current?

(tt) Define cutoff frequency.

(uu) What are eddy currents?

(vv) What is band stop filter?

(b) Answer any FIVE questions of the following.
2X5=10

i) Derive the equation of continuity.

ii) Distinguish between normal and anomalous dispersion.

iii) State and explain Kirchoff's current law.

iv) What are phasor? Why voltage and current are phasors?

v) A CR circuit has time constant of ls. It is almost fully charged in 5s by connecting it to a dc voltage source. Explain.

vi) Draw the circuit diagram of Anderson Bridge.

PART-B

UNIT-I

Answer any TWO from the following:
10x2=20

2. (a) Deduce the Maxwell's field equation for .

(b) The relative permittivity of a transparent medium is 5, calculate the refractive index and velocity. **(6+4)**

3. (a) What is normal dispersion? Derive Cauchy's constants A and B for normal dispersion.

(b) Electric potential in a region of space is given by . Find the magnitude of electric field at the point (1, 1, 0) and charge density.
SI units) **(6+4)**

4. (a) Show that electromagnetic waves are transverse in nature.

(b) An electromagnetic wave with a frequency of 200 MHz travels in an insulating ferrite material with properties at this frequency. The intensity of the wave is . What is the speed of propagation of the wave? Calculate the amplitudes of the electric and magnetic field in the material.
(6+4)

UNIT-II

Answer any TWO of the following. **10x2=20**

5. (a) State the steps employed in the circuit analysis using the superposition theorem.

   (b) A series LCR circuit has an inductance 100 mH, a capacitor of 5 micro farad and a resistance of 25 Ω. It is tuned for resonance. Find resonant frequency and impedance at resonance. **(6+4)**

6. (a) State and prove maximum power transfer theorem. Mention two applications of maximum power transfer theorem.

   (b) Calculate the current, voltage and power dissipated through 250 Ω resistor in the circuit given below using Thevenins theorem. **(6+4)**

7. (a) Obtain an expression for current in a series LCR circuit at resonance.

   (b) Calculate current in each branch of network using mesh current method. **(6+4)**

UNIT-III

Answer any TWO of the following. **10x2=20**

8. (a) Obtain an expression for the instantaneous charge on the capacitor when it is discharged through series LCR circuit.

   (b) Three similar coils of 20 Ω resistance and 10 Ω inductive reactance are connected in delta-configuration. Find phase current, line current and power if a 400 V, 50Hz is supplied to it. **(6+4)**

9. (a) Derive the relation between line voltage and phase voltage in the case of delta configuration in a 3 phase system.

   (b) Calculate the resistance required to design a RC low pass filter for a cut off frequency 1 kHz using a capacitor of 0.02 μF. Draw the necessary circuit and frequency response curve. **(6+4)**

10. (a) Obtain the expression for charge passing through B.G.

    (b) For a balanced Anderson's bridge, find the value of R and L if P = 10 Ω, Q = 10 Ω, S = 600 Ω, r = 700 Ω, C = 0.1 μF. **(6+4)**

PHY 401.1 **Reg. No.....**

CREDIT BASED FOURTH SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2015

PHYSICS – IV

Electromagnetism and Electricity

Duration: 3 Hours **Max Marl**

PART – A

1. A. Answer any TEN of the following: **10×**

i) Equate Maxwell's field equations of electromagnetic induction.
ii) State law of conservation of charge.
iii) Give example for the existence of displacement current.
iv) What is anomalous dispersion?
v) What is meant by network analysis?
vi) State maximum power transfer theorem.
vii) Define rms value of an ac circuit.
viii) Define half power frequency.
ix) Define time constant during charging of CR circuit.
x) Draw frequency response curve for band pass filter.
xi) What is the current through the neutral wire when three phases are equally loaded?
xii) What are eddy currents?

B. Answer any FIVE of the following: **5×**

i) Distinguish between normal and anomalous dispersion.
ii) Show that 
iii) State and explain Kirchhoff's voltage law.
iv) Explain the importance of Thevenin's theorem
v) Deduce the expression for mean value of alternating current.
vi) Draw the labeled diagram for BG.

PART - B

UNIT - I

Answer any TWO of the following: **2×1**

2. (a) Derive the wave equation for the field vectors  and  . Hence arrive at the equation for the velocity of electromagnetic waves in a medium.

(b) A beam of electromagnetic wave travelling through glass prism get dispersed into different spectral lines. The relative permitivities of yellow and violet lines are 2.856 and 2.722 respectively. Find the mean velocity of em wave travelling through glass prism. **(6+4)**

3. (a) Deduce Maxwell's field equation $\vec{\nabla} \times \vec{B} = \mu\left(\sigma\vec{E} + \frac{\partial \vec{D}}{\partial t}\right)$ with usual symbols. Explain the concept of displacement current.

   (b) Electric potential at a region of space $V(x,y,z) = 3x^2y + 2y^2z - 3z^2$. Find components and magnitude of electric field at the point $(1,-1,1)$ **(6+4)**

4. (a) What is normal dispersion? Derive Cauchy's constants for normal dispersion.

   (b) Show that $\vec{\nabla} \times \vec{E} = -\frac{\partial B}{\partial t}\hat{i}$ $\vec{E} = \cos(y-t)\hat{i}$ and $\vec{B} = \cos(y-t)\hat{k}$. **(6+4)**

UNIT - II

Answer any <u>TWO</u> of the following: **2×1**

5. (a) With a general network, explain the steps involved in finding the branch currents using mesh current method.

   (b) Using mesh current method calculate current in each branch for the following circuit.

(6+4)

6. (a) State and explain Norton's theorem by considering a general dc network. Explain how Norton's equivalent can be obtained from Thevenin's equivalent using source transformation.

   (b) Calculate the value of R_L required for maximum power transfer and also power transmitted through the load for the circuit given below.

7. (a) Derive an expression for phase difference between current and voltage in a series LCR circuit. What is the condition for resonance? Deduce an expression for resonance frequency in this case.

   (b) An AC voltage source of 230V 50Hz is applied to a circuit which contains an inductance of 0.2H and a resistance of 120Ω in series. Calculate impedance, current and power factor.

UNIT - III

Answer any <u>TWO</u> of the following: **2×1**

8. (a) Obtain an expression for the charge on the capacitor during the discharge of series LCR circuit.

   (b) A battery of emf 100V is connected in series with an inductance of 10mH, a capacitor of 0.05μF and a resistance of 100Ω. Show that circuit is oscillatory. Also find the frequency of oscillation.

9. (a) What is a low pass filter? Explain how CR circuit can be used as a low pass filter and obtain expression for cutoff frequency.

   (b) Design following RC filter circuits.

   i) RC low pass filter for cut off freq 1kHz and capacitor 0.1μF.

   ii) RC high pass filter for cut of frequency 6kHz and capacitor 560Pf.

10. (a) Give the theory of Anderson's bridge.

    (b) A condenser is charged to a potential of 2V and then discharged through a B.G. giving a throw of 10cm. If its period is 7.2 sec and current sensitivity is $\frac{1}{30}\mu A/cm$. Calculate the capacitance of the condenser. **(6+4)**

*****

PHY 401.1 Reg. No. .....

CREDIT BASED FOURTH SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2016
PHYSICS
PAPER – IV: ELECTROMAGNETISM AND ELECTRICITY

Time: 3 Hrs. **Max. Marks: 80**

PART – A

I. A. Answer any TEN of the following: **10×1=10**

a. Define poynting vector.
b. What is anomalous dispersion?
c. What is displacement current?
d. State Faraday's law of electromagnetic induction.
e. Define power factor of AC circuit.
f. Define node in network.
g. Why series resonance circuit is called acceptor circuit?
h. Find the value of carbon resistor having colour code red black green?
i. What is an advantage of 3 phase systems over single system?
j. What is transient phenomenon in direct current?
k. Draw frequency response of band stop fitter.
l. What are eddy currents?

B. Answer any FIVE of the following: **5×2=10**

a) Show that $\nabla.\vec{B} = 0$ with usual symbols.
b) Write Ampere's circuital law in vector form and show that it is inconsistent with the equation of continuity.
c) Explain why capacitor blocks dc but transmits ac.
d) State and explain Kirchoff's laws.
e) Show that CR has the dimensions of time.
f) Mention any 2 factors causing damping of a BG coil.

PART – B
UNIT - I

Answer any TWO of the following questions: **2×10=20**

2. a) Show that electromagnetic waves are transverse in nature.
   b) For non-sinusoidal wave, suppose $E = 100Vm^{-1}$, find the value of B, the energy density and the rate of energy flow per unit area$\varepsilon_o = 8.85 \times 10^{-12}\ C^2N^{-1}m^{-2}$ **(6+4)**

3. a) Assuming the equation for velocity of electromagnetic wave in a medium, prove that light waves are electromagnetic in nature.
   b) Electric potential in a region of space is given by $V(x, y, z) = 3x^2 + 2y^2 - z^2$. Find the magnitude of electric field at the point (1, 1, 1) and potential gradient. **(6+4)**

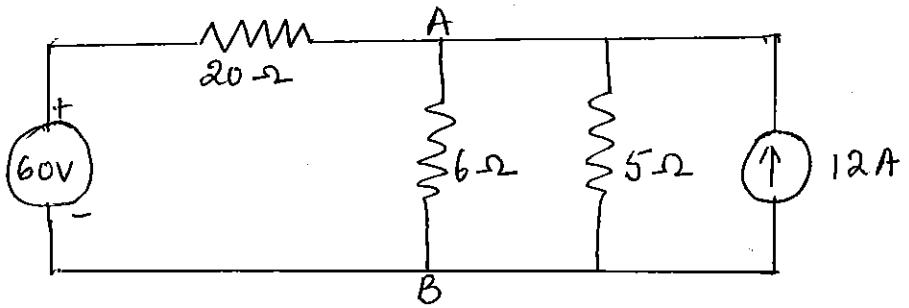
4. a) Deduce Maxwell's field equation $\nabla.\vec{E} = \frac{\rho}{\epsilon}$ with usual symbols.
   b) An electromagnetic wave travels in a medium with properties $\mu_r = 1, \varepsilon = 3$ has peak electric field intensity $6Vm^{-1}$. Find the speed of propagation of the wave? Calculate the peak poynting vector? **(6+4)**

UNIT – II

Answer any TWO of the following: **2×10=20**

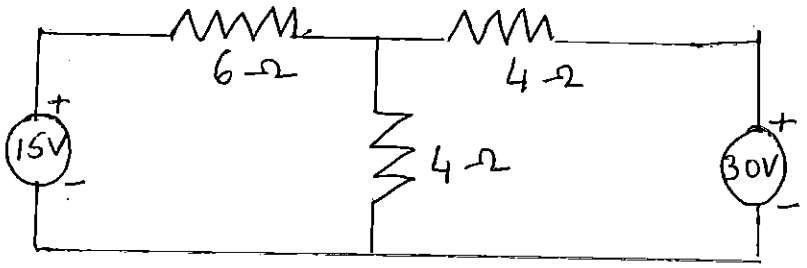
5. a) With a general network explain the steps involved in finding the branch currents using mesh current method.
   b) A series LCR circuit has an inductance of 10H, a capacitor of 2μF and a resistance 8Ω. It is tuned for resonance. Find resonant frequency and impedance at resonance.

6. a) State and prove maximum power theorem. Mention its two applications.
   b) Calculate the current, voltage and power dissipated through 6Ω resistor in the circuit given below using Norton's theorem.



(6+4)

7. a) Obtain an expression for current in a parallel LCR circuit at resonance.
   b) Using superposition theorem calculate current in each branch of network given in the fig below.



(6+4)

UNIT – III

Answer any TWO of the following: **2×10=20**

8. a) Obtain an expression for the growth of current in a circuit containing an inductance and a resistance connected in series with a steady emf. Define time constant of the circuit.
   b) A condenser of 1μF is charged and then discharged through a high resistance. If half the charge leaks in half a minute, calculate the value of high resistance. **(6+4)**

9. a) Derive the relation between line voltage and phase voltage in the case of star configuration in a 3 phase system.
   b) Calculate the resistance required to design a RC high pass filter for a cut off frequency 2kHz using a capacitor of 0.01μF. Draw the necessary circuit and frequency response curve. **(6+4)**

10. a) Give the theory of Anderson Bridge.
    b) A capacitor of capacitance 1000pF is charged to a potential difference of IV an discharged through B.G. The first throw on a scale placed 1m way is 62.2cm. If time period of BG coil is 10s, logarithmic decrement is 0.02, calculate the charge sensitivity and current sensitivity of B.G. **(6+4)**

****

PHY 401.2 Reg. No. .....

CREDIT BASED FOURTH SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2016
PHYSICS
PAPER – IV: ELECTROMAGNETISM AND ELECTRICITY

Time: 3 Hrs. **Max. Marks: 80**

PART – A

I. A. Answer any TEN of the following: **10×1=10**

i. What is a point function?
ii. What is a conservation field?
iii. What is the significance of the equation $\nabla.\vec{B} = 0$?
iv. State Ampere's circuital law.
v. State Kirchhoff's current law.
vi. Write the condition for maximum power to be transferred to the load.
vii. Give the expression for frequency of oscillation of a LCR circuit.
viii. What is a transient current?
ix. Write the condition for resonance of series LCR circuit.
x. What is a filter circuit?
xi. Draw the diagram for delta configuration.
xii. How is damping reduced in a BG?

B. Answer any FIVE of the following: **5×2=10**

i) State Stoke's theorem and express it in vector form.
ii) Derive the equation of continuity.
iii) Explain how Thevenin's equivalent is obtained from Norton's equivalent by source transformation.
iv) Show that CR has the dimension of time.
v) Explain the sharpness of resonant frequency and quality factor in a series LCR circuit.
vi) Write any differences between low pass and high pass filters.

PART – B
UNIT - I

Answer any TWO of the following: **2×10=20**

2. a) What is normal dispersion? Derive Cauchy's constants for normal dispersion.
   b) Find div grad ϕ if $\phi = 2x^3y^2z^4$. **(6+4)**

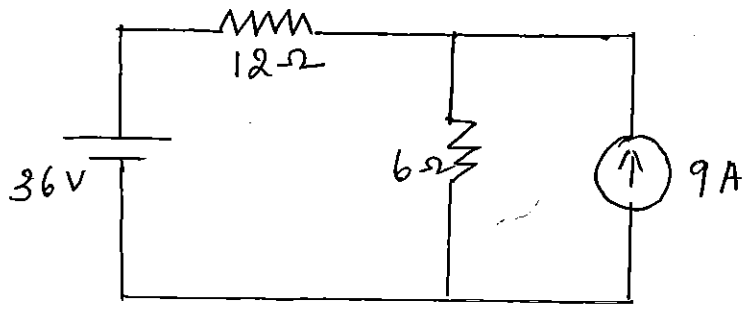
3. a) Deduce Maxwell's field equation $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ with usual symbols.
   b) If $\vec{F} = 2xz\hat{i} - yz\hat{j} + 3xz\hat{k}$ find the divergence of curl $\vec{F}$. **(6+4)**

4. a) Using Maxwell's field equations show that electromagnetic wages are transverse in nature.
   b) If $\vec{A} = x^3z\hat{i} + 3y^2z^2\hat{j} - 4xyz^2\hat{k}$. Find div $\vec{A}$ at $(2,-1,1)$. **(6+4)**

UNIT – II

Answer any TWO of the following: **2×10=20**

5. a) With a general network explain the steps involved in finding the branch currents using mesh current method.
   b) Using superposition theorem find the current through the 6Ω resistor of the network.



(6+4)

6. a) State and explain Norton's theorem by considering a general network.
   b) A 1μF condenser is connected to a 20V d.c source through a resistance of 1MΩ. Calculate the charge on the condenser at 0.5 sec. Also calculate the p.d. across the condenser and the value of the current at this instant. **(6+4)**

7. a) Obtain an expression for the charge on the capacitor when it is discharged through series LCR circuit.
   b) A circuit has an inductance of 10 mH, capacitance 0.1μF and resistance 100Ω. Is the circuit oscillatory? If 10^5 volts is in the circuit, what is the final charge an the capacitor? **(6+4)**

UNIT – III

Answer any TWO of the following: **2×10=20**

8. a) Draw the parallel LCR circuit and obtain the expression for impedance and current in a parallel LCR circuit at resonance.
   b) A series LCR circuit consists of 50Ω resistance, 0.2H inductance and 10μF capacitor with an applied voltage of 20V. Determine the resonant frequency. Find the Q factor of the circuit. Compute the lower and upper half frequency limits and also find the band width of the circuit. **(6+4)**

9. a) What is a high pass filter? Explain how a CR circuit can be used as a high pass filter and obtain the expression for cut-off frequency.
   b) In a balance Anderson's bridge, find the value of R and L, if P = 1000Ω, Q = 1000Ω, S = 500Ω, r = 200Ω & C = 0.2μF **(6+4)**

10. a) Draw the diagram for star configuration in a 3 Phase system and derive the relation between line voltage and phage voltage.
    b) When 0.1C of change in passed through a moving coil Ballistic galvanometer a deflection of 30 mm is observed on a scale 1 m away. Time period of the coil is 10s. Find the current sensitivity of the galvanometer. **(6+4)**

****