

**E 2146**

(Pages : 3)

Reg. No.....

Name.....

**B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, APRIL 2016**

**Fourth Semester**

Core Course—ELECTRICITY AND ELECTRODYNAMICS

(For the Programme : B.Sc. Physics – Model I, B.Sc. Physics – Model II,  
B.Sc. Physics – EEM, B.Sc. Physics – Instrumentation)

(2013 Admission onwards)

Time : Three Hours

Maximum : 60 Marks

*Candidates can use Clark's tables and Scientific Non-programmable calculators.*

**Part A**

*Answer all questions.*

*Each question carries 1 mark.*

1. What does an uncharged capacitor look like at the instant of switching on the circuit ?
2. How a rejector circuit works ?
3. What is meant by time constant of a circuit containing an inductor and a capacitance ?
4. State and explain Laplace's equations.
5. Define divergence and explain its meaning.
6. Explain the properties of conductors on the context of electromagnetic waves.
7. Define workdone in electrostatic field. Write expression for the workdone in moving a point charge  $Q$  in the electric field.
8. What is uniform plane wave ? What is meant by transverse electromagnetic wave ?

(8 × 1 = 8)

**Part B**

*Answer any six questions.*

*Each question carries 2 marks.*

9. What is meant by quality factor of an ac circuit ? Give expressions for the same of RLC, RL and LC circuits.
10. State and explain Thevenin's theorem. How  $V_{th}$  and  $R_{th}$  are determined ?
11. State and explain Superposition theorem.
12. Find the maximum value of resistance in RLC circuit so that the circuit can just oscillate.
13. Obtain expression for the energy per unit volume stored in an EM field.
14. "No work is done by a magnetic field on a charged particle moving in it." Prove.
15. Explain reflection of plane wave at boundaries.

**Turn over**

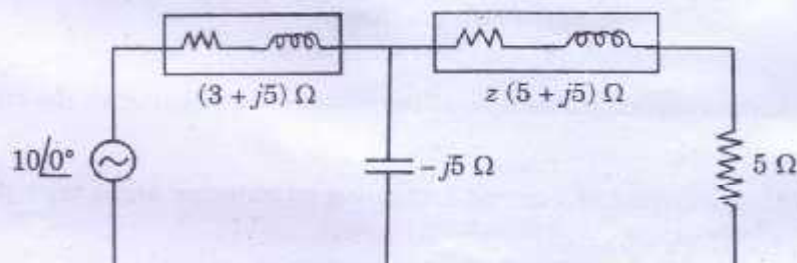
16. List Maxwell's equations in time varying field along with its significance (Integral form).
17. What do you mean by line integral of a vector field? Show that electric field is conservative.
18. What are the boundary conditions when the uniform plane wave is normally incident on a boundary between two media?

(6 × 2 = 12)

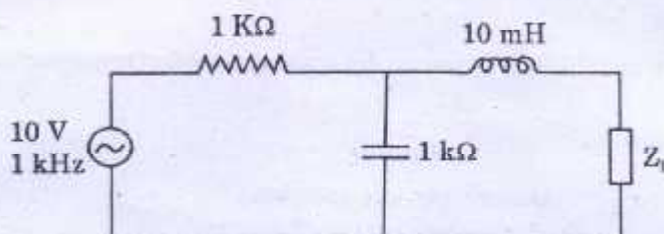
### Part C

Answer any **four** questions.  
Each question carries 4 marks.

19. An e.m.f. of 20 V is applied to a circuit built with a resistance of  $10\ \Omega$  in series with an inductance of 1H. Calculate the time required to attain 50 % of the final value. Also calculate the time constant of the circuit.
20. Calculate the power in the impedance  $Z = (5 + j5)\ \Omega$  in the following circuit, using Norton's theorem;



21. Determine the components of the load impedance  $Z_L$  that will develop maximum power;



22. Calculate the electric field 16 cm. above the center of a line charge 5 cm. long having  $2\ \mu\text{C}$ .
23. Two identical line charges of  $\rho_L = 10\ \mu\text{C}/\text{m}$  lie on the  $x$  and  $y$  axes. Calculate  $\vec{D}$  at point (2, 2, 2).
24. The magnetic vector potential is  $\vec{A} = \frac{5}{x^2 + y^2 + z^2} \hat{a}_x$  weber/meter. Find the magnetic vector density.

(4 × 4 = 16)



**Part D**

*Answer any two questions.  
Each question carries 12 marks.*

25. With neat circuit diagrams, describe the two-watt meter and three-wattmeter methods of measurement of three-phase a.c. circuit. Discuss the related equations also.
26. State and explain Maxwell's equations for static fields. Explain how they are modified for time varying electric and magnetic fields.
27. What is polarization of uniform plane waves ?

Explain :

- (i) Linear polarization.
  - (ii) Elliptical polarization ; and
  - (iii) Circular polarization.
28. Deduce the equation of propagation of the plane electromagnetic waves in free space. Show that electric and magnetic field vectors are normal to each other and to the direction of propagation.

(2 × 12 = 24)