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ABP/CCM-23/XIV

ELECTRICAL ENGINEERING 2015

FIRST PAPER

Full Marks : 200

Time : 3 Hours

*The figures in the margin indicate full marks for the questions*

Answer **any ten** questions.

1. (a) State and prove maximum power transfer theorem for *dc* circuits.
- (b) Whether maximum power transfer theorem can be applied to *AC* circuits? Then what is the condition to be fulfilled? What happens to load voltage if maximum power transfer theorem is applied for power transfer?

Contd.

- (c) For the circuit shown in fig.1, find current  $i_x$  using superposition theorem.

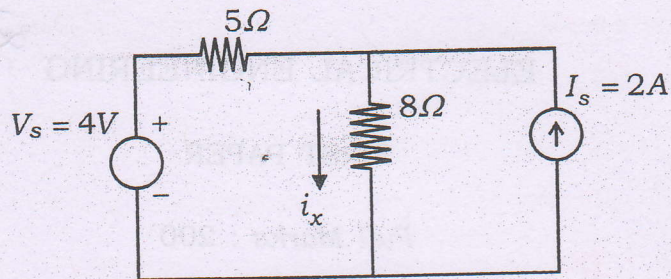


fig.1

$$7+5+8=20$$

2. (a) Discuss what is meant by even symmetry, odd symmetry and half wave symmetry as applied to Fourier series of wave-form.

(b) Obtain the Fourier series of the output wave obtained from a half wave rectifier.

- (c) Write a note on auto-transformer.

$$8+8+4=20$$

3. (a) State and prove Thevenin's theorem.

(b) What is meant by source transformation technique ?



- (c) Find the current through  $R_L$  in the circuit shown in fig.2 using Thevenin's theorem. 7+5+8=20

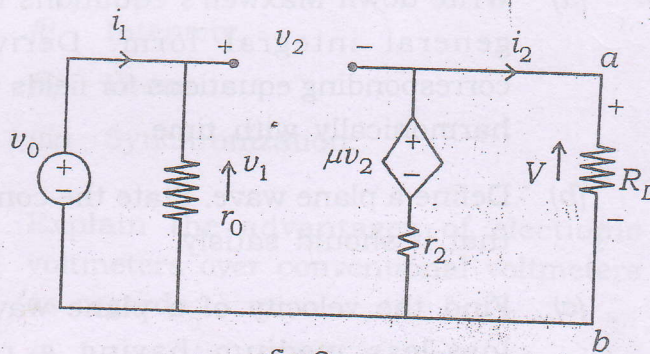


fig.2

4. (a) Explain, what is meant by 'Network synthesis'. Describe Foster-II method to achieve it.
- (b) Find poles and zeros for the circuit in fig.3. Draw pole-zero plot on s-plane.

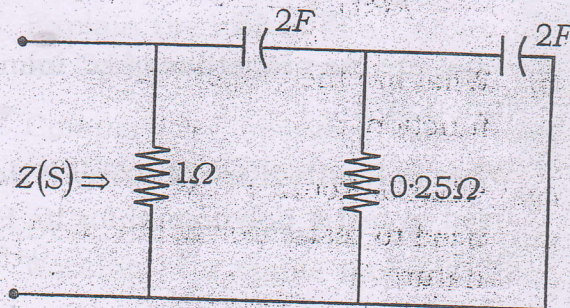


fig.3



- (c) Distinguish between network analysis and network synthesis. 8+8+4=20
5. (a) Write down Maxwell's equations in their general integral form. Derive the corresponding equations for fields varying harmonically with time.
- (b) Define a plane wave. State the conditions that it should satisfy.
- (c) Find the velocity of a plane wave in a loss-less medium having a relative permittivity of 5 and relative permeability of unity. 10+5+5=20
6. (a) Write the properties of positive real functions. Test whether the following function is a positive real function or not.
- $$F(s) = \frac{S^2 + 1}{S^3 + 4S}$$
- (b) What are the properties of LC immittance function ?
- (c) What is Routh-Hurwitz array ? How it is used to test a polynomial for its Hurwitz nature ? 9+5+6=20

7. (a) Draw the block diagram of a general purpose CRO and explain the functions of the following controls
- (i) Intensity
  - (ii) Focus
  - (iii) Synchronization.
- (b) Explain the advantages of electronic voltmeters over conventional voltmeters as regards
- (i) detection of low level signals
  - (ii) power consumption
  - (iii) loading effect
  - (iv) frequency range.
- (c) How a millivoltmeter may be converted into an ammeter ?  $8+8+4=20$
8. (a) Explain the circuit of a Colpitt oscillator for production of radio frequencies.
- (b) Compare its operation with that of a Hartley-Oscillator.
- (c) Describe in details the circuit and working of a stable multivibrator.  $8+4+8=20$



9. (a) What is the basic principle of a *dc* generator ? Write the necessary conditions for voltage build-up in a *dc* shunt generator.

(b) Describe how open circuit characteristic of a *dc* shunt generator is drawn by performing experiment in a laboratory.

(c) What is meant by critical resistance as referred to a *dc* shunt generator ?

$$8+8+4=20$$

10. (a) What are the *two* tests to determine the losses and parameters of a transformer ?

(b) State and prove the conditions under which a transformer operates at its maximum efficiency.

(c) A 1100/230 Volt 15 kVA, 1-ph transformer has a core loss of 1.6 kW, determine

(i) the kVA load for maximum efficiency

(ii) efficiency curve from 25% to 125% of full load at a *p.f.* of 0.8 lagging.

$$4+8+8=20$$

11. (a) Describe how Schering bridge can be used to measure capacitance and power factor of a capacitor.

(b) What are the advantages and disadvantages of Anderson's bridge ?

(c) Estimate the inductance of a solenoid of 2500 turns wound uniformly over a length of 0.5 metre on a cylindrical paper tube 4cm in diameter. The medium is air.  $8+4+8=20$

12. (a) A 550V, 55kVA, 1-phase alternator has an effective resistance of 0.2 ohm. A field current of 10A produces an armature current of 200A on short circuit and an emf of 450V on open circuit.

Calculate :

(i) The synchronous impedance

(ii) full load regulation with power factor 0.8 lagging.

(b) What is a damper winding ?

(c) Describe a speed control method for an induction motor (3-phase).  $8+4+8=20$



13. (a) Determine Z-parameters of the network in fig.4.

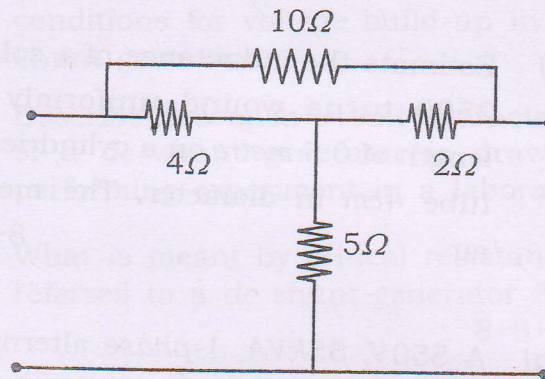


fig.4

- (b) Find also [Y].
- (c) What is meant by reciprocity and symmetry of two port networks ?  
8+8+4=20
14. (a) Explain the process of hole formation in a semiconductor. Define the terms
- (i) doping
  - (ii) doping agent
  - (iii) donor
- (b) Explain V-I characteristic of a P-N junction diode.



(c) What is a Zener diode ? Mention *one* important use of Zener diode.

8+7+5=20

15. Write short notes on **any four** of the following :

(i) Wave-shaping circuit.

(ii) Parallel operation of 3-*ph* alternator

(iii) Reactive power measurement by a wattmeter

(iv) Photo diode and tunnel diode

(v) Compensation theorem

(vi) Traction motors. 5×4=20