

**EE101 - Electrical Engineering - Specimen Questions**

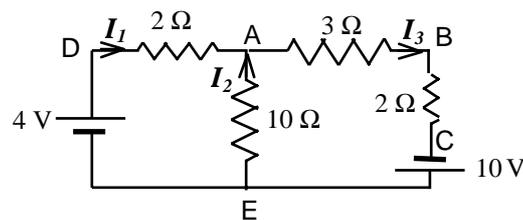
Answer All Questions. Very short answers are expected and only the important steps need to be shown.

Time ... hours.

Relative permittivity of free space =  $8.854 \times 10^{-12}$  F/m, Permeability of free space =  $4\pi \times 10^{-7}$  H/m

- 1 What is the domestic voltage (single phase) in Sri Lanka ?
  - 2 What is the frequency of the industrial voltage supply in Sri Lanka ?
  - 3 Give a typical medium voltage distribution voltage (three phase) in Sri Lanka.
- For Q4 -Q6: The instantaneous voltage of phase R in a balanced 3 phase system is given as  $326 \sin(100\pi t + \pi/6)$  V
- 4 give an expression for the instantaneous voltage of the phase Y,
  - 5 give the effective value of the phase R voltage (show steps), and
  - 6 give the effective value of the line voltage (show steps).
  - 7 State the main reason for using high voltage for transmission of electricity.
  - 8 Name two sources of bulk energy supply in very common use for generation of electricity.
  - 9 State two main uses of electricity.
  - 10 State the correct names and the symbols of the following quantities (a) electric current, (b) capacitance.
  - 11 What physical quantities do the following units measure ? (a)  $C/m^2$ , (b) radian/second
  - 12 What are the two factors that make the mechanical energy output of an electric motor to be different from the electrical energy input ?
  - 13 What are the two windings usually found in a d.c. motor ?
  - 14 Sketch the basic connection diagram of a series excited d.c. motor.
  - 15 Sketch the speed-torque characteristic of a dc shunt motor.
  - 16 State the expression for the slip of an induction motor in terms of speeds.
  - 17 The synchronous speed of a 4-pole synchronous motor operating from the Sri Lankan mains is (a) 500 rpm, (b) 1000 rpm, (c) 1500 rpm, (d) 2000 rpm, (e) 2500 rpm, (f) 3000 rpm.
  - 18 "A squirrel cage induction motor requires a commutator" True/False
  - 19 Which of the following motors would usually be used for small power appliances ? (a) single phase induction motors, (b) three phase synchronous motors
  - 20 Sketch the typical torque-speed characteristic of a squirrel cage induction motor.
  - 21 Give the basic equation relating the instantaneous values of  $v$  and  $i$  in (a) an inductor and (b) a capacitor.
  - 22 Give an expression for the energy stored in (a) an inductor and (b) a capacitor using the instantaneous values of  $v$  and  $i$  and any other values.

Figure for Q23-Q34:



- 23 Write down the Kirchoff's current law equation at node E.
- 24 Write down the Kirchoff's voltage law equation for the loop DABCE.
- 25 When the 10V supply is short-circuited, the current  $I_1$  supplied by the 4V supply only, is 0.75 A, and when the 4 V supply is short-circuited, the current  $I_3$  supplied by the 10V supply is 1.5 A, using superposition theorem determine the current  $I_3$  when both supplies are present.
- 26 If the voltage  $V_{AC} = 10V$ , using the voltage division rule, determine the voltage  $V_{AB}$ .
- 27 Find the Thevenin's voltage source across AB (with branch AB disconnected).
- 28 Find the Thevenin's impedance across AB (with branch AB disconnected).
- 29 Using the results of Q27 and Q28, draw the Thevenin's equivalent circuit across AB, with branch AB in place.
- 30 Find the Norton's current source across AE (with branch AE short circuited).
- 31 Find the Norton's admittance (or impedance) across AE (with branch AE disconnected).
- 32 Using the results of Q30 and Q31, find the Norton's equivalent circuit across AE, with branch AE in place.

- 33 For the star-connected network between D, B, E and A, if the potentials of D, B and E are 6V, 2V and  $-4V$  with respect to a common reference N, find the voltage of A with respect to the common reference N.
- 34 For the star-connected network between D, B, E and A, determine the impedance of the element DB in the equivalent delta connected network.
- 35 A certain delta-connected network PQR has impedances  $5\Omega$ ,  $6\Omega$  and  $4\Omega$  across arms PQ, QR and RP respectively. Find the value of PS in the equivalent star connected network with star point S.
- 36 A certain source is capable of giving a maximum power of 100 W to a load. If the load voltage under this condition is 25 V, determine the supply voltage and the internal impedance of the load.
- 37 A certain car battery has an internal emf of 13 V and an internal resistance of  $0.025\Omega$ . Determine and sketch the Norton's equivalent circuit.
- 38 A certain car battery has an internal emf of 13 V and an internal resistance of  $0.025\Omega$ . Find the maximum power that can be delivered from the battery. What would be the terminal voltage under this condition.

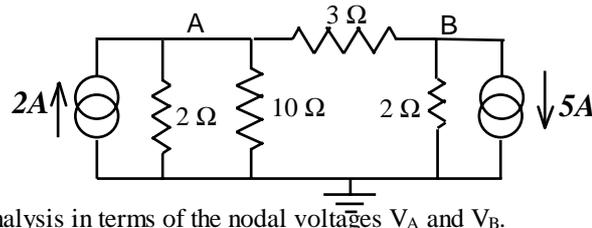
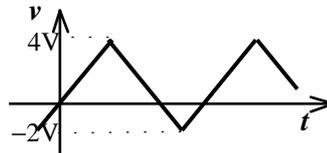


Figure for Q39-Q40:

- 39 Write down the equations for nodal analysis in terms of the nodal voltages  $V_A$  and  $V_B$ .
- 40 Convert the 5A current source to an equivalent voltage source.

Figure for Q41-Q43:



- 41 Find the peak value of the waveform.
- 42 Find the mean value of the waveform.
- 43 Find the average value of the waveform.
- 44 A parallel plate capacitor has a cross-section area of  $100\text{ mm}^2$  and a spacing of 1 mm. If the dielectric material has a relative permittivity of 3.5, find the capacitance.
- 45 Two point charges of 1 C and 5 C are separated in air by a distance of 150 mm. Determine the force between the point charges.
- 46 A point charge of 10 C is placed in an electric field of 10 kV/mm. Find the force acting on it.
- 47 A capacitor of  $10\mu\text{F}$  has a charge of  $500\mu\text{C}$ . What is the voltage across its plates ?
- 48 A capacitor of  $10\mu\text{F}$  has a voltage of 100 V across its plates. What is the energy stored ?
- 49 A coil of 200 turns has a current of 4A passing through it. What is the mmf produced ?
- 50 A certain toroid has a mean magnetic length of 100 mm and a uniform cross section of  $5\text{ mm}^2$ . If it is wound with 200 turns and carries a current of 4A, find the magnetic field inside the toroid.
- 51 A certain magnetic material has a relative permeability of 2000, and a magnetic flux density of 1.2 T. Find the magnetic field in the material.
- 52 The flux in a certain core of cross-section  $25\text{ mm}^2$  is  $15\mu\text{Wb}$ , find the magnetic flux density.
- 53 When an mmf of 1000A is applied to a magnetic core, the flux is found to be 2 mWb. Find the reluctance.
- 54 Find the reluctance of a material of length 0.5m, relative permeability 1200 and cross sectional area  $0.01\text{ m}^2$ .
- 55 Find the inductance of a coil of 200 turns wound on a magnetic core of length 0.5m, relative permeability 1200 and cross sectional area  $0.01\text{ m}^2$ .
- 56 A magnetic core has a reluctance of  $10^6\text{ H}^{-1}$ , and 100 turns are wound on it. Find the inductance of the coil.
- 57 Find the mutual inductance between two coils of 200 turns and 100 turns wound on a magnetic core of length 0.5m, relative permeability 1200 and cross sectional area  $0.01\text{ m}^2$  if the coefficient of coupling is 0.9.
- 58 A magnetic core has a reluctance of  $10^6\text{ H}^{-1}$ , and coils of 100 turns and 200 turns are wound on it. If the coefficient of coupling is 0.85, find the mutual inductance of the pair of coils.
- 59 An inductor of 10 mH has a current of 10A passing through it. What is the energy stored ?
- 60 What is the force exerted in a magnetic field in air with an effective flux density of 0.8 T and a cross section area of  $10^4\text{ mm}^2$ .

Note: Questions such as 24, 25, 27, 28, 30, 31, 33, 34, 36, 37, 38, 39, 50, 56 would probably be 2 mark questions while the remaining questions would probably be 1 mark questions.