B. Tech.
(SEM. I) EXAMINATION, 2008-09
ELECTRICAL ENGINEERING

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions.

1. Attempt any four parts of the following : 5×4=20

(a) A series RLC circuit is connected to a variable
frequency source. Derive an expression for the
quality factor.

(b) Three impedances \((6 + j5), (8 - j6)\) and
\((8 + j10)\) are connected in parallel. Calculate
the current in each branch, when the total current
is 20 A.

(c) For the circuit shown in Fig. 1. \(R = 2 \Omega\),
\(L = 0.02 \, H\) and \(V = 200 \, V\).
What capacitor must the condenser have in order that the maximum current may occur at:
(a) 25 Hz
(b) 100 Hz?
Find also the current and the voltage across the condenser in each case.

(d) Define power factor.
A resistance of $10 \Omega$ is connected in series with an inductance of $0.05 \, \text{H}$ and capacitance of $300 \, \mu\text{F}$ to a 100 V a.c. supply. Calculate the value of current and power factor when the frequency is:
(a) 25 Hz (b) 50 Hz.

(e) Determine the power factor and power consumed by the circuit shown in Fig. 2.
(f) Draw and explain the B-H curve for air and a magnetic material.

2 Attempt any four parts of the following: 5x4=20

(a) Explain maximum power transfer theorem, also show that at maximum power point efficiency of the circuit is 50%.

(b) Using Norton's theorem determine the current in 10 Ω resistance, in the circuit shown in Fig. 3.

(c) Using superposition theorem determine I in the network of Fig. 4.
(d) Obtain the Norton's equivalent circuit at terminals AB of the network given in Fig. 5.

![Circuit Diagram]

Fig. 5

(e) Derive an expression for the torque of an induction type wattmeter.

(f) A moving coil instrument has a resistance of 10 Ω and gives a full scale deflection when carrying 50 mA. Show how the instrument can be used to measure voltages up to 750 V and currents up to 100 A.

3 Attempt any two parts of the following: 2 x 10 = 20

(a) Three arms of a three phase load each comprises an inductor of resistance 25 Ω and of inductance 0.15 H in series with 120 μF capacitor. The supply is 415 V, 50 Hz. Calculate line current and voltage and power and power factor if load is delta connected.
(b) Explain the operation of a single phase transformer, explaining clearly the functions of the different parts. What are the iron and copper losses of the transformer? How these losses can be minimized?

(c) The following test results were obtained on a 20 kVA, 200/220 V transformer.

OC Test (LV) : 220 V, 1.1 A, 125 W.
SC Test (HV) : 52.7 V, 8.4 A, 287 W :

(i) Assuming p.f. to be 0.8 (lag) determine efficiency at \( \frac{1}{2} \) and full load.

(ii) If transformer is fully loaded, determine the load p.f. for zero regulation.

4 Attempt any two parts of the following : \( 2 \times 10 = 20 \)

(a) Explain the principle of torque production in a d.c. motor. Derive an expression for the torque. Also explain the need of starter to start a d.c. motor and the working of a 3-point starter.

(b) (i) Explain open circuit characteristics of a d.c shunt generator. How voltage is build up in this generator?
(ii) A 215 V dc machine has an armature resistance of 0.4 \( \Omega \). It is supplying 5 kW as a generator when run at 1000 rpm and is excited to give a terminal voltage of 215 V. At what speed would it run as a motor if it is fed at the same terminal voltage draws same armature current but the flux per pole is increased by 10%.

(c) Explain the operation of a synchronous motor and give its applications.

5 Attempt any two of the following: 2 \( \times \) 10 = 20

(a) Explain the principle of operation of an induction motor. What is meant by slip? Derive an expression for the frequency of rotor current in an induction motor.

(b) An 8-pole, 50 Hz, 3-phase induction motor has rotor resistance and standstill reactance of 0.5 \( \Omega \) and 5 \( \Omega \) respectively. Calculate:

(i) the speed at which the torque is maximum

(ii) the ratio of maximum torque to starting torque.

Neglect stator impedance.
(c) Discuss why single phase induction motors do not have a starting torque. Describe two methods of producing starting torque in a single phase induction motor.