

BITS, PILANI – DUBAI  
 SECOND SEMESTER 2010– 2011  
 ES C 272 ELECTRICAL SCIENCES – II  
 COMPREHENSIVE EXAMINATION (CLOSED BOOK)

MAXIMUM MARKS: 120  
 DATE: 30/05/11

WEIGHTAGE: 40%  
 DURATION: 180 MINUTES

Answer Part A, Part B and Part C in separate answer sheets

PART A

1. A coil when connected across a 100 V d.c supply dissipates 500 W of power. The same coil when connected across a 100 V a.c supply of frequency 50 Hz, dissipates 200 W. Calculate the value of resistance and Inductance of the coil (a) For d.c Supply (b) For a.c supply. [10 Marks]

2. A 10 KVA load at 0.7 power factor lagging is fed from a 230V, 50 Hz supply as shown in Figure 1. Calculate the KVA capacity and capacitance value of the shunt capacitor required to improve the overall power factor (load + shunt capacitor) to 0.93 lagging. Compare the current drawn from the supply before and after installing the capacitors. [10 Marks]

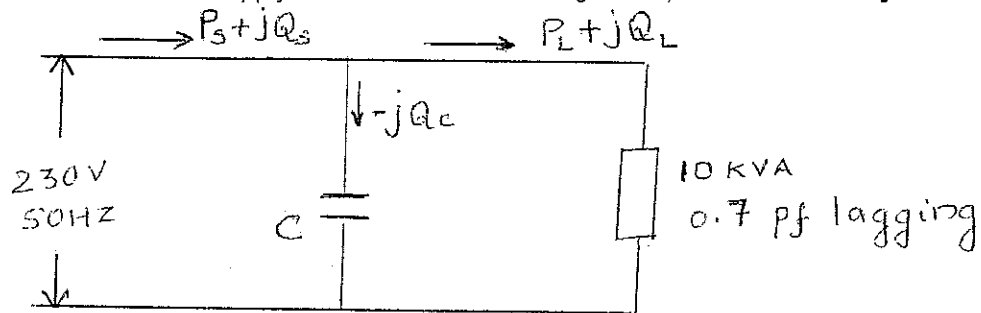


Figure 1

3. As shown in Figure 2, a three- phase 400 V source (terminal voltage assumed constant independent of the load) supplies a load with an equivalent star impedance of  $(60+j15)$   $\Omega$ /phase through a transmission line of impedance  $(0.3+j1)$   $\Omega$ /phase. Compute

- (a) The Line current
- (b) The Load voltage
- (c) The Real, Reactive and the VA consumed by the load
- (d) The Real and Reactive power loss in the line.

[20 Marks]

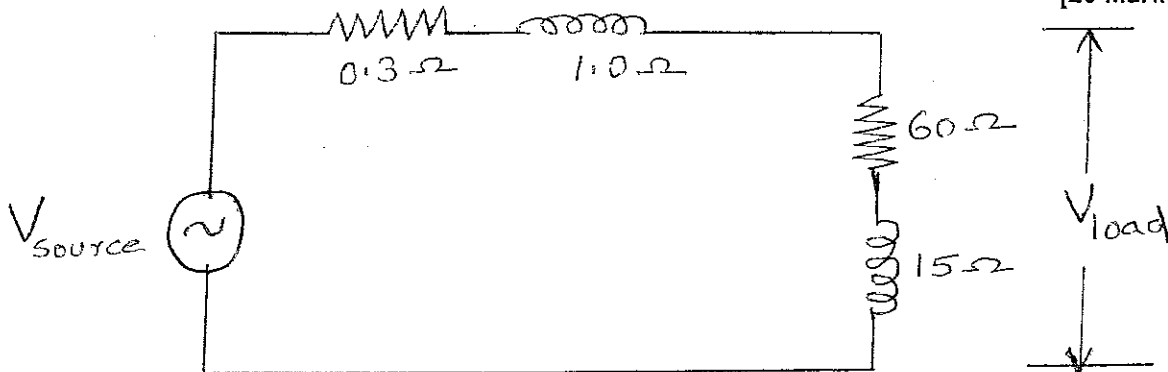


Figure 2

PTO

## PART B

4. A ring of magnetic material has rectangular cross section. The inner diameter of the ring is 15 cm and outer diameter is 25cm its thickness being 2.5 cm. An air-gap of 2 mm length is cut across the ring. The ring is wound with 1500 turns carrying current of 2A. The permeability of the magnetic material is 5000.

Find the following (i) Flux density in the air-gap (ii) Inductance of the coil (iii) Energy stored in the magnetic material. (iv) Energy stored in the air gap (v) rms value of emf induced in the coil when carrying alternating current of  $4 \sin 314t$

[20 marks]

5. A 15KVA, 2200/220V, 50 Hz single phase transformer gave the following test results

OC test (LV side): 220V, 2.72A, 185W

SC test (HV side): 112V, 6.82A, 231 W

Compute the following

- (a) Core loss and full load Copper loss
- (b) Efficiency at full load, 0.85 lagging power factor
- (c) R and X referred to HV side
- (d) Voltage regulation at full load 0.8 p.f lagging
- (e) Power factor for maximum voltage regulation

[20 marks]

## PART C

6. A 6 pole dc machine armature has 36 slots, 2 coil-sides/slot, 8 turns/ coil and is lap-wound. Determine the following when the machine is running as a generator at 1000 rpm with an armature current of 10 A, flux per pole of 0.01 Wb and armature resistance of 0.4  $\Omega$ .

- (i) Terminal voltage
- (ii) Net electrical output
- (iii) Armature copper loss

[15 marks]

7. A 50 kVA, 3 phase, 50 Hz, 480 V, 6 pole star connected synchronous generator has a synchronous reactance of 1  $\Omega$  per phase. Determine

- (i) the speed of rotation of this generator
- (ii) Excitation voltage needed to give rated voltage at full load, 0.8 power factor lagging.
- (iii) Voltage regulation for the above load.

[15 marks]

8. Plot the complete torque-slip characteristics of a 3-phase induction motor and clearly state its various modes of operation.

[10 marks]

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TEST 2 (OPEN BOOK)

MAXIMUM MARKS: 60  
DATE: 08/ 05/11

WEIGHTAGE: 20%  
DURATION: 50 MINUTES

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1. A circular iron ring has a mean circumference of 1.5 m and a cross sectional area of  $0.01\text{m}^3$ . A saw cut of 4mm wide is made in the ring. Neglect leakage effect.

- (a) Calculate the exciting current required to produce a flux of 0.8 mwb in the air gap if the ring is wound with a coil of 175 turns. Assume relative permeability of iron as 4000.
- (b) Find the inductance of the coil
- (c) Find the energy stored in magnetic material and in the air gap.

[20 Marks]

2) A 4-pole shunt motor has 944 lap-wound armature conductors. At a certain load, the flux per pole is 35 mWb and the mechanical power developed is 4 kW. Calculate the armature current and the speed at which the motor will run with an applied voltage of 230 V. The armature resistance is  $0.08\ \Omega$  and the field resistance is  $1.15\ \Omega$ .

[20 Marks]

3. A 5KVA 200/1000V, 50 Hz single phase transformer gave the following test results

OC test (LV side) : 200V, 1.2 A, 90W

SC test (HV side) : 50V, 5A, 110W

- (a) Calculate the parameters of the equivalent circuit referred to LV side
- (b) Calculate the parameters of the equivalent circuit referred to HV side
- (c) Draw the equivalent circuit diagram and label the parameters.

[20 Marks]

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SECOND SEMESTER 2010– 2011  
ES C 272 ELECTRICAL SCIENCES – II  
TEST 1 (CLOSED BOOK)

MAXIMUM MARKS: 75  
DATE: 20/03/11

WEIGHTAGE: 25%  
DURATION: 50 MINUTES

1. In an R-L series circuit  $R = 10\Omega$ ,  $X_L = 8.66\Omega$ . If the current in the circuit is  $5-j10$  A find (a) Applied voltage (b) power factor (c) real and reactive power. [15 Marks]

2. Use the voltage divider rule to find voltage across capacitor C for the circuit shown in Figure 1. [10Marks]

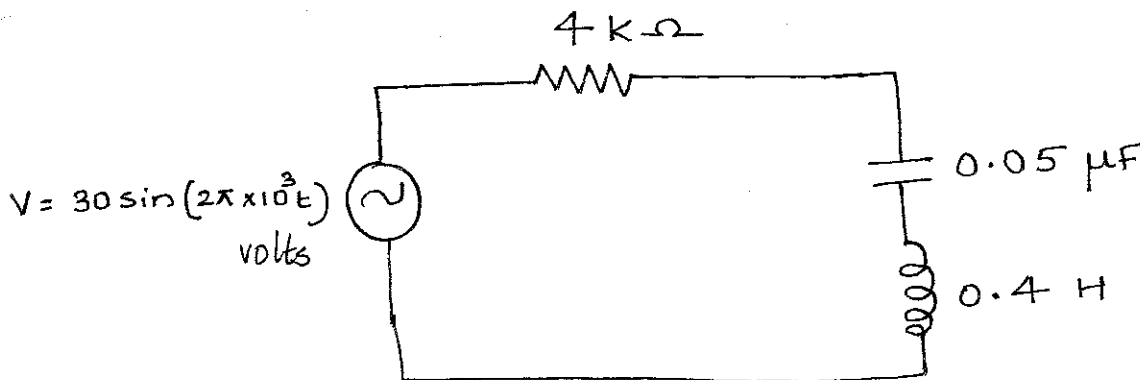


Figure 1

3. A three phase 400V source supplies a load with an equivalent star impedance of  $60 + j15\ \Omega$  per phase through a transmission line impedance of  $0.3 + j1\ \Omega$  per phase. Compute (a) Line current (b) Load voltage (c) the real and reactive power consumed by the load and supplied by the source. [25 Marks]

4. A 1-kV-rms 60 Hz voltage source delivers power to two loads in parallel. The first load is a  $10\text{-}\mu\text{F}$  capacitor, and the second load absorbs an apparent power of 10 kVA with an 80% lagging power factor. Find the following:

(i) Active power, reactive power and power factor for the source. (ii) rms value of source current.

[25 Marks]

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SECOND SEMESTER 2010– 2011  
ES C 272 ELECTRICAL SCIENCES – II  
QUIZ 2 (CLOSED BOOK)

MAXIMUM MARKS: 21  
DATE: 19.04.11

A

WEIGHTAGE: 7%  
DURATION: 20 MINUTES

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NAME:

ID NO:

- 1) The wattmeter reading in SC test is a measure of \_\_\_\_\_ loss only since \_\_\_\_\_ loss is negligible. [ 2 MARKS]
- 2) The core of the transformers that are meant for operation at 25 to 400 Hz are invariably of \_\_\_\_\_ type while radio devices require a \_\_\_\_\_ material for transformer core construction. [2 marks]
- 3) A magnetic circuit has a mean core length of 120 cm and uniform cross section of  $4 \text{ cm}^2$ . It has an air-gap of 0.5 mm and is wound with a coil of 1000 turns. If the core material has a relative permeability of 1600, the self inductance of the coil is \_\_\_\_\_ [3 MARKS]
- 4) If 25 W of power are applied to the primary of an ideal transformer with a turns ratio of 10, the power delivered to the secondary load is \_\_\_\_\_ [2 marks]
- 5) In a certain loaded transformer, the secondary voltage is one-fourth the primary voltage. The secondary current is \_\_\_\_\_ times of the primary current. [2 marks]

- 6) A transformer has full load copper loss of 800W and core loss of 600W. The total loss at no load will be approximately \_\_\_\_\_ [2 marks]
- 7) The chemical used in breather of the transformer is \_\_\_\_\_ [1 marks]
- 8) A ring of magnetic material has rectangular cross section. The inner diameter of the ring is 20cm and the outer diameter is 30 cm, its thickness being 4cm. The main flux path length \_\_\_\_\_ [3 marks]
- 9) Two coils of inductance  $L_1$  &  $L_2$  are placed close together such that magnetic flux ~~the coil~~ completely links the other. The mutual inductance between the coil is \_\_\_\_\_ [2 marks]
- 10) If the input power supply frequency  $f$  is increased by two times for a single phase transformer (Transformer being operated at constant magnetic flux density) its hysteresis loss increases \_\_\_\_\_ times and eddy current loss increases by \_\_\_\_\_ times [2 marks]



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ES C 272 ELECTRICAL SCIENCES – II  
QUIZ 1 (CLOSED BOOK)

MAXIMUM MARKS: 24  
DATE: 08.03.11



WEIGHTAGE: 8%  
DURATION: 20 MINUTES

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NAME:

ID NO:

1. Evaluate using phasor method  $e(t) = 50\sqrt{2} \cos(314t - 30^\circ) - 25\sqrt{2} \cos(314t + 90^\circ)$

Ans:  $e(t) =$  \_\_\_\_\_ [3 MARKS]

2. In a series circuit with  $R=10 \Omega$ ,  $X_L = 45 \Omega$ ,  $X_C = 35 \Omega$  and carrying an effective current of 5A, the real power dissipated P \_\_\_\_\_ and reactive power Q \_\_\_\_\_ [2 MARKS]

3. The KVA of an ac circuit having KW =100 and KVAR =40 is \_\_\_\_\_ [2 MARKS]

4. The RMS value of a sinusoidal alternating current is \_\_\_\_\_ times its maximum value [2 MARKS]

5. A circuit has  $X_C= 2000$  ohms if both its capacitance and frequency are doubled its reactance will become \_\_\_\_\_ [2 MARKS]

6. The current through inductor 80 mH is  $0.1\sin(440t-25)$  Amp. Write the mathematical expression for the voltage across it \_\_\_\_\_.  
**[3 MARKS]**

7. Frequency of an AC supply is 50 Hz. How many times the current signal becomes zero in one second \_\_\_\_\_.  
**[2 MARKS]**

8. The voltage of an ac means is  $V = 200\sqrt{2} \sin 100\pi t$  Volts. Time t is in seconds. Frequency of this supply is \_\_\_\_\_.  
**[2 MARKS]**

9. An inductor coil is connected to supply of 250 Volts at 50 Hz and takes a current of 5 Amperes. The coil dissipates 750 W. Calculate power factor and resistance of the coil. \_\_\_\_\_ & \_\_\_\_\_  
**[3 MARKS]**

10. An Inductor always \_\_\_\_\_ reactive power and capacitor \_\_\_\_\_ reactive power.  
**[2Marks]**

11. To improve the power factor of the power system network \_\_\_\_\_ are installed.  
**[1Mark]**