

BITS, PILANI – DUBAI, INTERNATIONAL ACADEMIC CITY, DUBAI

SECOND SEMESTER 2009– 2010

ES C272 ELECTRICAL SCIENCES – II

COMPREHENSIVE EXAMINATION (CLOSED BOOK)

MAXIMUM MARKS: 120

WEIGHTAGE: 40%

DATE: 20/05/10

DURATION: 3 hours

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

PART A

1A). A two element Series circuit is connected across an Ac source, $V = 200\sqrt{2} \sin(314t + 20^\circ)$ V. The current in the circuit then is found to be $i = 10\sqrt{2} \cos(314t - 25^\circ)$ A. Determine the parameters of the Circuit. [10 marks]

1B). Three impedances Z_1 , Z_2 and Z_3 are connected in series across a voltage source. The voltage drop across Z_1 is $(10 + j0)$ volts. The values of the Impedances are given by $Z_1 = (3 + j4)\Omega$, $Z_2 = (2 + j3.46)\Omega$, $Z_3 = (1 - j7.46)\Omega$. Find (i) Current in the circuit (ii) Voltage drop across Z_2 and Z_3 . (iii) Voltage of the generator. [10 marks]

2. The unbalanced star-connected load shown in Figure 1 is fed from a 440 V 3- phase supply. [20marks]

$V_{ab} = 440 \angle 0^\circ$, $V_{bc} = 440 \angle -120^\circ$, $V_{ca} = 440 \angle +120^\circ$. Calculate

- (a) The line currents
- (b) The load phase Voltages
- (c) Total Real Power consumed by the loads.

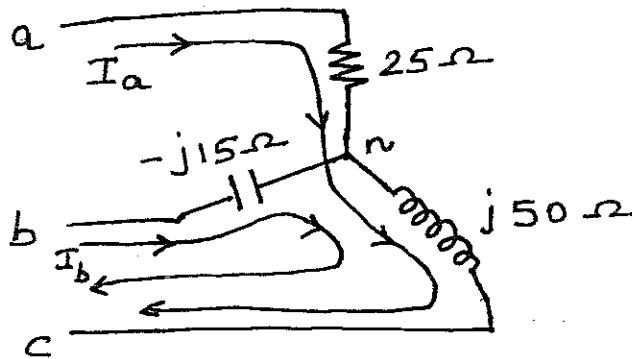


Figure 1

PART B

3A) The magnetic circuit of Figure 2 has a cast steel core with dimensions as shown. The area of cross section of the central as well as each outer limb is 16 cm^2 . Determine the current in the 500 turn exciting coil to establish a flux of 0.5 mWb in the air gap, if the relative permeability of the core material is [15 marks]

- i) 4000
- (ii) Infinity

Note: Maintain a minimum of four decimal accuracy in all steps.

3B) Describe what is meant by fringing and why it occurs.

[2 marks]

[P.T.O.]

If you account fringing in the calculations of part (i) of the previous question, find now the current in the coil. [3 marks]

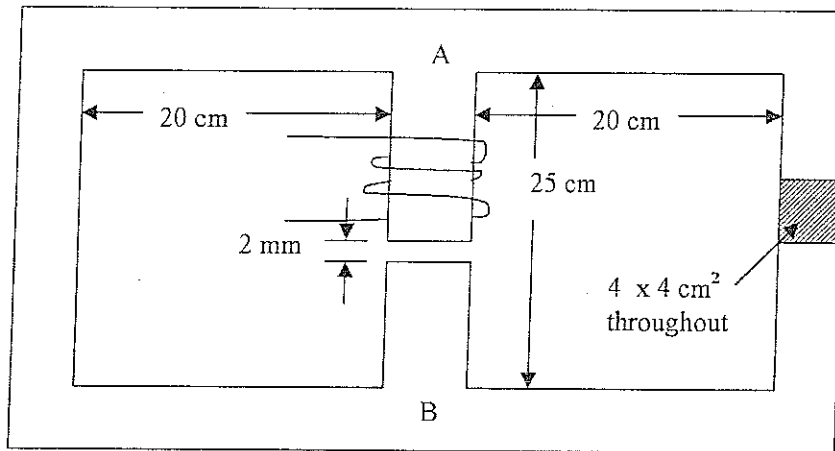


Figure 2

4. A 100 kVA , 1100/110V transformer when tested gave the following results

OC test measurements on LV side: 410 W, 10 A, 110V
SC test measurements on HV side: 650W, 20A, 50V.

Draw the circuit model of the transformer referred to the HV and LV sides. Label all the parameters. [20marks]

PART C

5A. A dc shunt motor runs at 450 rpm, when taking 230 A at 110 V. Assuming flux proportional to the field current, what will be the speed when taking 85 A at 210 V. Armature resistance is 0.03Ω and shunt field resistance is 45Ω . At what speed would it have to run as a generator to give 140 A at 200 V? [16 Marks]

5B. Draw the torque-speed characteristics of dc shunt and series motors. [4 Marks]

6. Draw the circuit model for slip ring induction motor and explain the impact of addition of resistance through slip rings at the time of starting? [5marks]

7. The OC and SC curve summary details of a 3-phase 1.5 MVA, 6 KV, and Star connected synchronous generator is given below:

Corresponding to $V_{oc} = 4500V$ (line to line) on the air gap line, pertaining to the unsaturated region, $I_{sc} = 98A$ for field current of 60A.

Corresponding to the rated voltage on the OCC pertaining to the saturated region, $I_{sc} = 150A$.

Find

[15marks]

- Unsaturated Synchronous reactance
- Adjusted Synchronous reactance
- Excitation voltage needed to give rated voltage at full load, 0.8 pf lagging
- Voltage regulation for the load specified in part c.

BITS, PILANI – DUBAI, INTERNATIONAL ACADEMIC CITY, DUBAI
SECOND SEMESTER 2009 – 2010
ES C272 ELECTRICAL SCIENCES – II
TEST II (OPEN BOOK)

MAXIMUM MARKS: 60
DATE: 11.04.10

WEIGHTAGE: 20%
DURATION: 50 MINUTES

- 1) For the 3 phase circuit shown in Figure 1 Determine the current in the neutral line. [20 Marks]

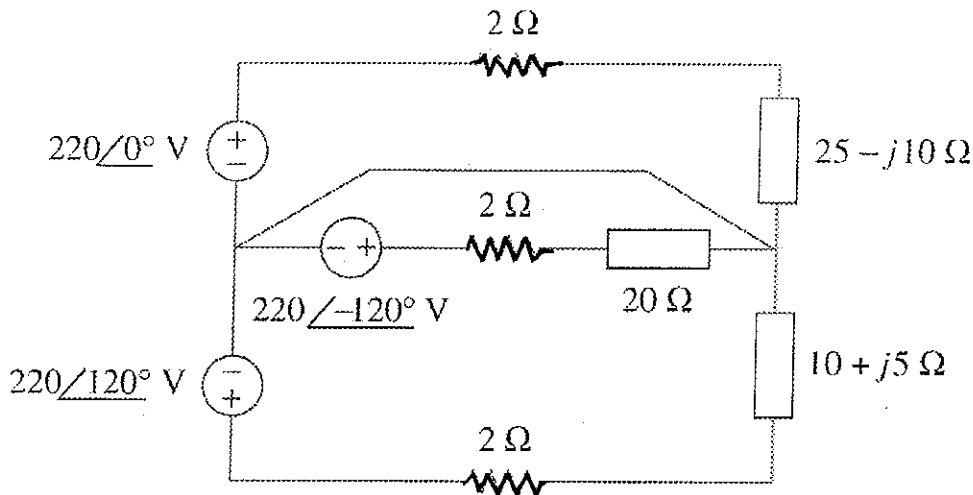


Figure 1

- 2) (a) An iron ring 200 mm mean diameter is made of 30 mm round iron of permeability 900, has an air gap 10 mm wide. It has 800 turns. If the current flowing through this winding is 6.8 amperes, determine:
- The magneto motive force
 - The total reluctance of the circuit
 - The flux in the ring
 - The flux density in the ring.

[15Marks]

- (b) Consider two magnetically coupled coils A and B having N_1 and N_2 turns respectively. From their individual Coefficients of Self- Inductance, prove that Mutual Inductance $M = K \sqrt{L_1 L_2}$.

[5 Marks]

- 3 (a) The total core loss of a specimen of silicon steel is found to be 2000 W at 50 Hz. Keeping the flux density constant, the loss becomes 6000 W when the frequency is raised to 100 Hz. Calculate separately the hysteresis and eddy current loss at 50 Hz and 100 Hz.

[15 MARKS]

- 3(b) Write the empirical equations for hysteresis and eddy current losses, mentioning each of its parameters.

[5 MARKS]

BITS, PILANI – DUBAI, INTERNATIONAL ACADEMIC CITY, DUBAI

SECOND SEMESTER 2009 – 2010

ES C272 ELECTRICAL SCIENCES – II

TEST I (CLOSED BOOK)

MAXIMUM MARKS: 75

DATE: 28.02.10

WEIGHTAGE: 25%

DURATION: 50 MINUTES

1. A reactor having negligible resistance and an inductance of 0.1H is connected in series with a resistor of 15Ω . The circuit is connected across a 230V , 50Hz , single phase ac supply. Find the

(i) Impedance of the circuit

(ii) current flowing in the circuit

(iii) power factor of the circuit

(iv) voltage across the reactor and

(v) voltage across the resistor.

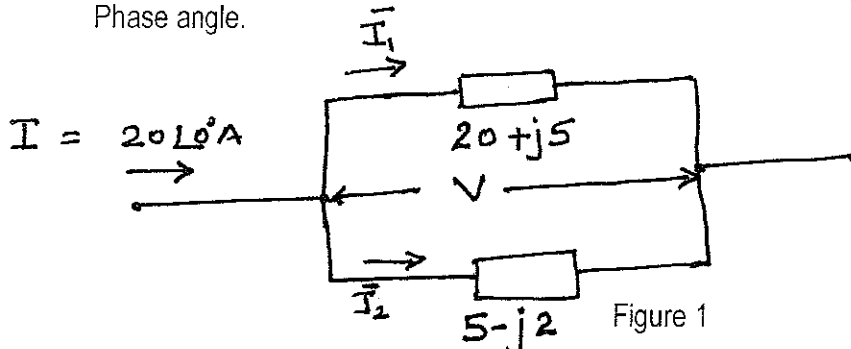
[25 Marks]

2. Derive the expression for RMS value and average value of an alternating sine wave. Also find the form factor and the peak factor

[15 marks]

3. For the circuit given in Figure 1 the total current is 20A , find the branch currents I_1 and I_2 and their phase angle with respect to total current. Also find the voltage across the combination and its Phase angle.

[10 Marks]



4. For the circuit given in Figure 2 find R and C . Given $V_b = 5 V_a$ and V_b and V_a are in quadrature. Find also the phase relation between V , V_b , V_a and I

[25 Marks]

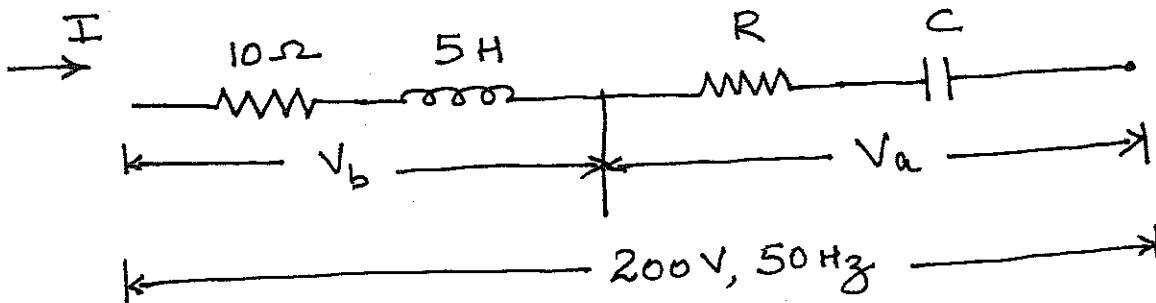


Figure 2

BITS, PILANI – DUBAI
SECOND SEMESTER 2009 – 2010
ES C 272 ELECTRICAL SCIENCES – II
QUIZ 2 (CLOSED BOOK)

MAXIMUM MARKS: 21

DATE: 27.04.2010

A

WEIGHTAGE: 7%
DURATION: 20 MINUTES

NAME:

ID NO:

1. The number of parallel paths in a dc machine armature is _____ in the case of lap winding and _____ in wave winding. [2 marks]

2. The armature reaction in a dc machine [1 mark]
 - a) are in the same direction as the main poles
 - b) are in direct opposition to the main poles
 - c) make an angle of 90° with the main pole axis
 - d) make an angle with the main pole axis greater than 90°

3. In an unsaturated dc machine the armature reaction effect is [1 mark]
 - a) demagnetizing
 - b) cross-magnetizing
 - c) magnetizing
 - d) dependent on whether the machine is generating or motoring

4. A series motor should not be run on no load because it will _____ [2 marks]

5. _____ chemical used in breather of the transformer. [1 mark]

6. A 2500/250V, 25KVA transformer has a core loss of 130W and full load copper loss of 320W. Calculate its efficiency full load at 0.8 power factor _____ [2 marks]

7. The core loss of a transformer is dependent on _____ and the copper loss is dependent on _____ [2 marks]

8. In d.c shunt motor _____ control is used for controlling the motor speed below rated speed. [1 mark]

9. A single-phase transformer is connected to a 230 V, 50HZ supply. The net cross-sectional area of the core is 60 cm^2 . The number of turns in the primary is 500 and in the secondary 100. Determine the maximum value of flux density in the core.

[3 marks]

10. A six-pole lap wound D.C. generator has 720 conductors, a flux of 40mWb per pole is driven at 400 r.p.m. Find the generated e.m.f.

[3 marks]

11. A 230 V D.C. shunt motor takes 32A at full load. Find the back e.m.f. on full load if the resistances of motor armature and shunt field windings are 0.2 ohm and 115 ohms respectively.

[3 marks]

BITS, PILANI – DUBAI
SECOND SEMESTER 2009 – 2010
ES C 272 ELECTRICAL SCIENCES – II
QUIZ 1 (CLOSED BOOK)

MAXIMUM MARKS: 24

DATE: 16.03.2010

A

WEIGHTAGE: 8%
DURATION: 20 MINUTES

NAME:

ID NO:

1. Evaluate using phasor method

$$e(t) = 200\sqrt{2} \cos(314t - 45^\circ) - 100\sqrt{2} \cos(314t + 60^\circ)$$

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

2. A balanced three phase, Δ connected load of 160 kW takes a leading current of 100 A with a line voltage of 1100 V, 50 Hz. Find the per phase impedance _____ and power factor of the load _____ [3 MARKS]

3. In this AC circuit (Fig.1), the resistor offers $3\text{k}\Omega$ of resistance, and the capacitor offers $4\text{k}\Omega$ of reactance. Together, their series opposition to alternating current results in a current of 1mA from the 5volt source:

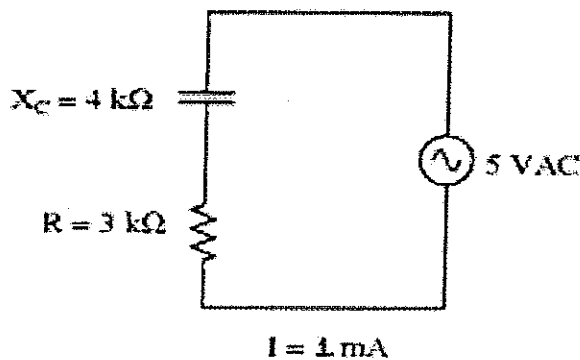


Fig.1

How many ohms of opposition does the series combination of resistor and capacitor offer? What name do we give to this quantity, and how do we symbolize it, being that it is composed of both resistance (R) and reactance (X)? [2 MARKS]

4. Reactive power consumed by the resistances, inductances and capacitances are:
 a) positive, negative and zero respectively
 b) negative, positive and zero respectively
 c) zero, positive and negative respectively
 d) zero, negative and positive respectively

[2 MARKS]

5. Calculate the amount of current through this impedance (Fig.2), and express your answer in both polar and rectangular forms:

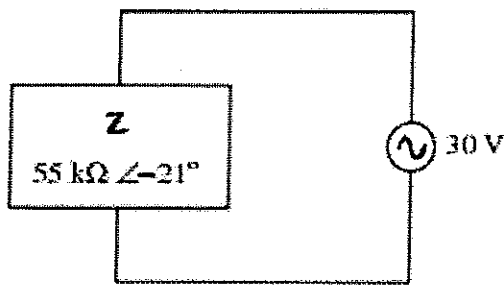


Fig.2

[2 MARKS]

6. Three equal impedances each having a resistance of 25Ω and reactance of 40Ω are connected in star to a 400V, 3-phase, 50 Hz system. Calculate the phase voltage and the phase current.

[4 MARKS]

7. In a balanced delta connected load phasor diagram fed from balanced 3 phase line voltages, the phase currents _____ the line currents by _____.

[2 MARKS]

8. The KVA of an ac circuit having $KW = 80$ and $KVAR = 60$ is _____.

[2 MARKS]

9. The RMS value of a sinusoidal alternating current is _____ times its maximum value

[2 MARKS]

10. A coil has $X_L = 1000 \text{ ohms}$ if both its inductance and frequency are doubled its reactance will become _____.

[2 MARKS]