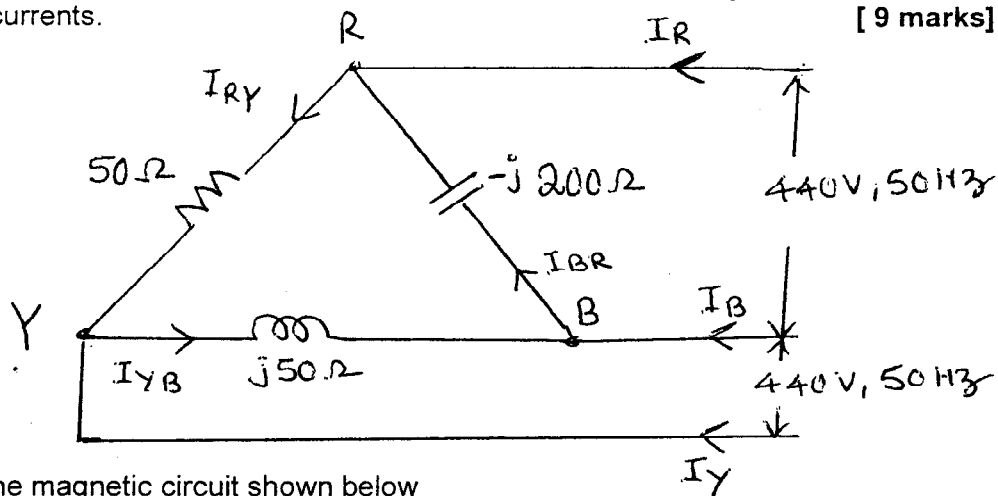


**BITS, PILANI – DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI**  
**SECOND SEMESTER 2006 – 2007**  
**ES UC272 ELECTRICAL SCIENCES – II**  
**COMPREHENSIVE EXAMINATION (CLOSED BOOK)**  
**MAXIMUM MARKS: 80** **WEIGHTAGE: 40%**  
**DATE: 27.05.2007** **DURATION: 3 hours**

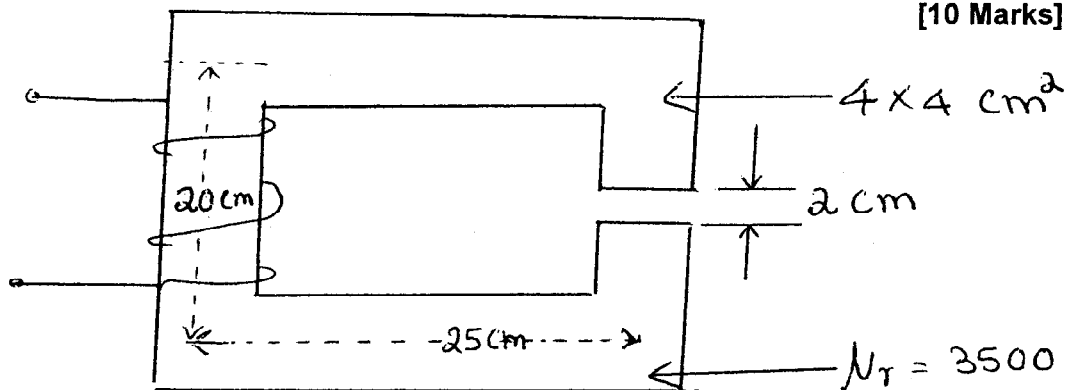
Note : Answer part A ,B &C in separate answer sheets.

**PART A**

1. Calculate the form factor and peak factor of a fully rectified voltage sine wave whose peak value is 10 V. [ 8 marks]
2. A 440V, 50 Hz, 3 phase supply has delta connected load as given below. Find the line currents. [ 9 marks]



3. For the magnetic circuit shown below



- a) Calculate the energy stored in the core and in the airgap for a coil current of 4 A. What will be these values if  $\mu_r = \infty$  ?
- b) Calculate the excitation current and induced emf in the coil to produce a flux of  $0.8 \sin 314 t$  mwb in the airgap.
- c) Calculate the inductance of the coil. What will be its value for  $\mu_r = \infty$  ?

**PART B**

4. A 5-kVA, 250/500-V, 50 Hz, 1-phase transformer gave the following test results:

No-load : 250 V, 0.75 A, 60 W (L.V. side)

[ 9 Marks]

Short circuit : 22 V, 10 A, 62 W (H. V. side)

- a. Draw the circuit model of the transformer referred to the HV and LV sides. Label all the parameters.
- b. Calculate the efficiency at half-load at 0.8 lagging power factor.

5. A dc motor takes an armature current of 110 A at 480 V. The resistance of the armature circuit is  $0.2 \Omega$ . The machine has 6 poles and the armature is lap connected with 864 conductors. The flux per pole is 0.05 Wb.

Calculate

[9 Marks]

- a. Speed
  - b. Torque developed by the armature.
  - c. Gross mechanical power developed by the armature.
  - d. Electrical input to the motor.
  - e. At what speed would it run as a generator if it delivers the same terminal voltage at the same armature current, but the flux per pole is decreased by 10%?
6. Explain armature reaction in a dc machine as per the following scheme.

[9 Marks]

- a. Definition for armature reaction.
- b. Nature and effect of armature reaction in unsaturated, saturated regions of magnetization.
- c. Use of compensating winding.

### PART C

7. A 6 pole 50 Hz, 3- Phase induction motor when running on full load develops a useful torque of 75 N-m while the rotor emf is observed to make 100 cycles /min. The total core loss is given as 600w. If torque lost on account of friction and core loss is 6 Nm.

Calculate

- (a) Shaft power output
- (b) rotor copper loss
- (c) motor input and
- (d) motor efficiency

[ 8 marks]

8. 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

[9 marks]

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

9. (a) Explain why phase-splitting is employed in single phase induction motor and explain the working of capacitor split - phase motor.

[5 marks]

- (b) With neat circuit diagram explain how the synchronous generator is synchronized to supply mains.

[4 marks]

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QUIZ 2 (CLOSED BOOK)

MAXIMUM MARKS: 10  
DATE: 09/5/07

B

WEIGHTAGE: 10%  
DURATION: 30 MINUTES

NAME:

ID NO:

**NOTE:** All questions carry 1 mark each. **Overwritten answers will receive no mark**

- \_\_\_\_\_ chemical used in breather of the transformer.
- 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 \_\_\_\_\_.
- \_\_\_\_\_ motor should not be started at no load.
- A 50 kVA single phase transformer has a full-load primary current of 250 A and total resistance referred to primary is  $0.006\Omega$ . If the iron loss is 200 W, the efficiency at full-load, unity power factor is \_\_\_\_\_%.(upto two decimal point)
- In d.c shunt motor \_\_\_\_\_ control is used for controlling the motor speed below rated speed.
- The effects are armature reactions are \_\_\_\_\_ and \_\_\_\_\_
- The magnetizing current in a transformer is typically in the range of \_\_\_\_\_ to \_\_\_\_\_% of the rated current and no load power factor is close to \_\_\_\_\_.
- A 30 kVA 200/2000 V single phase transformer has the following test results:  
O.C. test: 200 V, 6.2 A, 360 W on l.v. side  
S.C. test: 75 V, 18 A, 600 W on h.v. side  
The series parameters referred to 2000 V side is \_\_\_\_\_ and \_\_\_\_\_.
- The core loss of a transformer is dependent on \_\_\_\_\_ and the copper loss is dependent on \_\_\_\_\_
- A 220 V d.c. shunt motor runs at 500 rpm when the armature current is 50 A. Assume that  $R_a = 0.2 \Omega$  and flux remains constant. If the torque is doubled, the speed of the motor is \_\_\_\_\_.

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QUIZ 1(CLOSED BOOK)

MAXIMUM MARKS: 10  
DATE: 21.03.07

B

WEIGHTAGE: 10%  
DURATION: 30 MINUTES

NAME:

ID NO:

**NOTE:** All questions carry 1 mark each. **Overwritten answers** will receive **no mark**.

1. In a series circuit of  $R=20\ \Omega$  and  $L=0.6\ \text{H}$ , the  $I$  lags the voltage by  $80^\circ$ , The value of  $\omega$  will be \_\_\_\_\_.
2. A ring of magnetic material has circular cross section. The inner diameter of the ring is 20 cm and outer diameter is 26 cm. The length of the mean flux path \_\_\_\_\_.
3. If the flux density of 1.2 T makes an angle  $30^\circ$  with respect to the surface area of  $25\ \text{cm}^2$ . Then the flux is \_\_\_\_\_.
4. Real power consumed by a pure inductor or a pure capacitor circuit \_\_\_\_\_.
5. A coil has  $X_L = 1500\ \Omega$ . If both the inductance and frequency are doubled its reactance will become \_\_\_\_\_.
6. Relative permeability of the air \_\_\_\_\_.
7. A balanced positive sequence Wye connected 60 Hz three phase source has line voltages of 1000 V. This source is connected to a balanced Wye connected load. Each phase of the load consists of a 0.2 H inductance in series with a  $100\ \Omega$  resistance. The real power delivered to the load is \_\_\_\_\_.
8. The wrong expression for energy stored in the magnetic field is
  - a.  $\frac{1}{2} \lambda i$
  - b.  $\frac{1}{2} R\Phi^2$
  - c.  $(NI)^2 / 2R$
  - d.  $\frac{1}{2} R^2\Phi$
9. In a balanced delta connected load fed from balanced 3 phase line voltages, the phase currents \_\_\_\_\_ the line currents by \_\_\_\_\_.
10. When a certain inductive coil is connected to a d.c. supply of 240 V, the current in the coil is 16 A. When the same coil is connected to an a.c. supply of at 240 V, 50 Hz, the current is 12 A. Its resistance and reactance are \_\_\_\_\_ & \_\_\_\_\_.

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**TEST 1(CLOSED BOOK)**

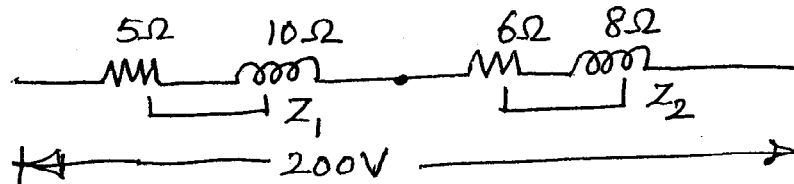
**MAXIMUM MARKS: 20**  
**DATE: 04.03.07**

**WEIGHTAGE: 20%**  
**DURATION: 50 MINUTES**

1. For the circuit shown below, calculate [7 MARKS]

- a) total impedance of the circuit
- b) current
- c) voltage drop in each of the impedances
- d) overall power factor of the circuit
- e) real and reactive powers consumed by the circuit and
- f) Draw the phasor diagram

[Note: For answers a), b) and c), the answers must be given in both polar and rectangular form]



2A. Find the RMS value, average value, form factor and peak factor for a half-rectified sine wave of maximum value  $V_m = 10$  V.

2B. A 50 mH inductance is connected in series with a resistance of  $10\Omega$  across a 100 V, 50 Hz, supply. Determine the value of the capacitance that must be connected across the coil to make the power factor of the overall circuit unity.

[4 + 3 MARKS]

3. Find the line currents for the unbalanced delta connected load shown below.

[Note: The phase sequence of the supply is c a b]

[6 MARKS]

