

BITS, Pilani-Dubai Campus, Knowledge Village, Dubai  
Second Semester 2003-2004

Comprehensive Exams

Course No ES UC 272  
Date: 8<sup>th</sup> June 2004

Course Title  
Max Marks 80

Electrical Sciences II  
Times: Three Hours

Answer any five Questions. Each question carries equal marks

- Q1 a) A resistance of 6 ohms is connected in series with an iron-cored choke coil ( $r$  in series with  $L$ ). The circuit draws a current of 5 Amperes at 240V, 50Hz. The voltage across the resistance is 120V and across the coils is 200V. Calculate:
- Resistance, reactance and impedance of coil.
  - The power absorbed by the coil
  - The overall pf.
- (8)
- b) Three star connected impedances  $Z_1=16 + j20$  per phase are connected in parallel with three delta connected impedances of  $Z_2=27 + j18$  per phase across a three phase, 400V supply. Find the line current and power factor of the combination. (8)

- Q2 a) In the magnetic circuit shown below in figure 1, the coil  $F_2$  is supplying 500 AT in the direction indicated. Find the AT that the coil  $F_1$  must provide to produce a flux of 4 mWb in the air-gap in the central limb from A to B. The relative permeability of the core is 4500. Cross-sectional area is 30 cm sq.  $AB=15$  cm,  $ABC=40$  cm and  $ABD=40$  cm (8)

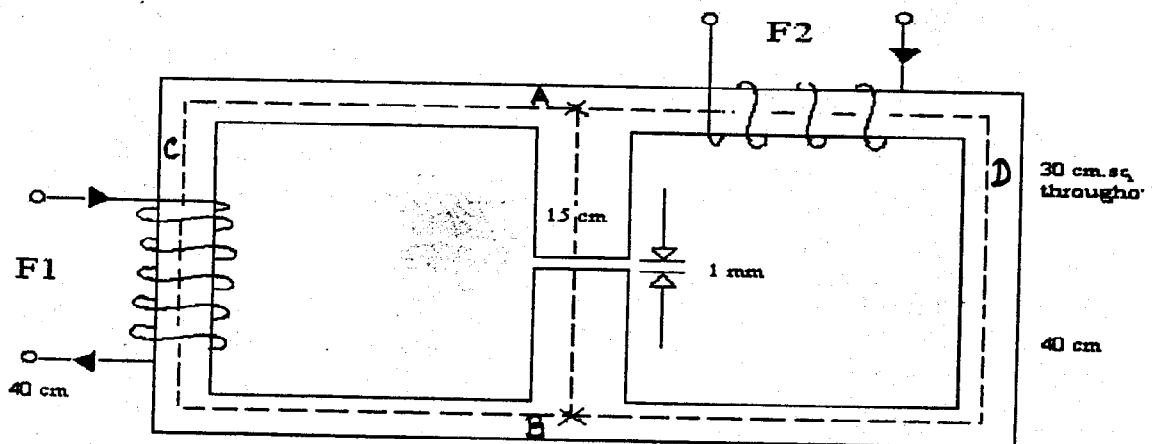


Figure 1

2 b) Explain B-H curves. Define hysteresis and eddy current losses occurring in electromagnetic circuits. Prove that  $M = k \sqrt{L_1 L_2}$ . (8)

3 a) A 100 Kva, 50 Hz, 440/11000 V single phase transformer has an efficiency of 98.5% when supplying full load current at 0.8 p.f and an efficiency of 99%, when supplying half full load current at unity p.f. find the iron losses and the copper losses corresponding to full load current. (8)

b) Define voltage regulation for single phase transformer. Prove that

$$(VA)_{\text{Auto}} > (VA)_{\text{Two winding}} \quad (8)$$

4 a) What is armature reaction phenomenon in DC Machines? Derive the torque equation for a D C Motor. (8)

b) A 220 V d c shunt motor has an armature resistance of 0.3 ohm and a field resistance of 200 ohm. The motor runs at 800 rpm with an armature current of 40 A. What resistance must be inserted in the field circuit to raise the motor speed to 1050 rpm, the load torque remaining constant? Assume linear magnetization characteristics. (8)

5(a) The no-load test data yielded the following parameters (on star basis) for the shunt branch of the circuit model of a 400V, 50Hz, 4 pole induction motor.

$$X_m = 31.25 \Omega, R_i = 242 \Omega$$

The motor develops a torque of 95.6 Nm at a slip of 5%. Calculate:

- (i) Mechanical output
- (ii) Rotor copper loss, and
- (iii) Motor efficiency. (8)

b) Explain equivalent circuit of an induction Machine. Prove that mechanical power developed per phase in an induction motor is  $I_2' (1/s - 1) R_2'$ , where  $R_2'$  and  $I_2'$  are rotor quantities. (8)

6 a) Derive an emf equation for three -phase alternator. Explain the effect of distribution of winding and use of short pitch coil on the magnitude and wave shape of the induced emf of an alternator (8)

b) A 3 phase, 50 Hz, star connected synchronous generator with double layer winding runs at 500 rpm. It has 12 turns/coil and 5 slots/pole/phase and coil pitch of 13 slots. If the flux/pole is 0.025 wb sinusoidally distributed, find the phase and line emf induces. Assume the total turns/phase are series connected. (8)

BITS, Pilani-Dubai Campus, Knowledge Village, Dubai

Second Semester 2003-2004

Test II (Closed Book)

Course No ES UC 272  
Date: 2/5/2004

Course Title  
Max Marks 40

Electrical Sciences II  
Times: 50 Minutes

Answer all questions.

Q 1

a) Draw and explain Torque-Speed Characteristics of DC Series motors and from the nature of curve explain the applications of DC Series motors. (8)

b) A 120 V d.c shunt motor having an armature circuit resistance of 0.2 ohms and field circuit resistance of 60 ohms. draws a line current of 40A at full load. The voltage drop is 3 volt and rated full load speed is 1800 rpm. Calculate

- i) The speed at half load
- ii) The speed at 125% of full load (12)

Q 2

a) Show how an Induction motor can be represented by an Equivalent circuit. Draw the all different equivalent circuits. Prove that power across air gap  $P_G = T \times \omega_s$ . (10)

b) The ratio of maximum torque to full load torque in a three phase induction motor is 2.5. The rotor resistance is 0.5 ohm and rotor standstill reactance is 5 ohm. Calculate the ratio of starting torque to full load torque for

- i) Direct on line starting
- ii) Auto transfer starting with tapping at 75%. (10)

Name

ID No

Section

BITS, Pilani-Dubai Campus, Knowledge Village, Dubai

Second Semester 2003-2004

Quiz

Course No ES UC 272

Course Title Electrical Sciences II

Date: 18<sup>th</sup> March 2004

Max Marks 30 Times: 40 Minutes

Answer all questions. Each question carries equal marks. Write your answer on this sheet only.

Q1 The Average value of the wave shown in Figure 1 over half cycle is .....

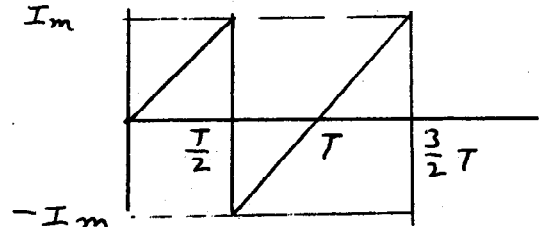


Figure 1

Q2 Define Voltage Regulation for transformer

Q3 Hysteresis losses can be minimized by

.....

Q4 Give three examples of Passive elements

i)..... ii)..... iii).....

Q5 If  $V_1 = 10\angle 45^\circ$  and  $V_2 = 3 + j4$  then

$V_1 + V_2 =$

Q6 Form Factor is the ratio of .....

Q7 In case of Symmetrical sine wave the average must be calculated over  
a) Full cycle b) the half cycle c) the quarter cycle d) none of these

Q8 Inductance is independent of Excitation and depends only upon its geometry

True / False

Q9 Eddy current losses are directly proportional to the frequency

True / False

Q10 Cu losses can be measured from open circuit test

True / False

Q11 An Ideal Transformer does not change

- b) Voltage      b) Current    c) Power      d) None of these

Q12 Power transformers are designed to have maximum efficiency around.....full load

- j) Nearly    b) 50% of    c) 25% of    d) 0% o

Q13 Unbalanced three phase powers can be measured by Two Watt Meter methods

True / False

Q14 The impedance of a circuit having a resistor of 10 ohm and a capacitor of  $50\mu\text{F}$  and fed by a supply of 200 V, 50 Hz is.....

Q15 The power consumed by pure capacitance is given by

- a)  $VI \cos\theta$                   b)  $VI \sin\theta$                   c)  $VI$                   d) Zero

Q16 If two sinusoidal of the same frequency but of different amplitudes and phase angles are subtracted, the resultant is sinusoidal.

True / False

Q17 The voltage applied to a parallel circuit is  $68+j154$  volts. The current in one branch is  $10+j14$  amperes and in the other is  $2-j8$  amperes. What is the circuit power factor?

Q18 Thumb in Fleming's right hand rule represents .....

Q19 Reactive Power converts one form of energy into another form.

True / False

Q20 The power factor of parallel a.c circuit is given by

- a)  $G/B$                   b)  $G/Y$                   c)  $G/Y^2$                   d)  $Y/G$

Q21 Define stacking factor.

- Q22 The frequency of a voltage at the secondary of the transformer is
- Greater than that of primary
  - Equal to that of primary
  - None
  - Less than that of primary

Q23 Open circuit test is conducted at Low Voltage winding side of transformer.

True / False

Q24 Short Circuit tests are conducted at rated voltage

True / False

Q25 If  $R_1=5$ ,  $R_2 = 5$  and  $R_3 =5$  are the three resistance of star connected load, then their equivalent delta connected resistances are

Q26 Write formula for equivalent impedance of the transformer referred to primary side.

Q27 Voltage regulation =  $(I R \cos \theta + I X \sin \theta) / V_2$  for lagging Power Factor

True/ False

Q28 The steel used for transformer cores has

- High Silicon Steel
- High Permeability
- Low Hysteresis losses and
- All of the above

Q29 Draw the Circuit diagram of current dependent Voltage source

Q30 Convert the Voltage source shown in Figure 2 into current source

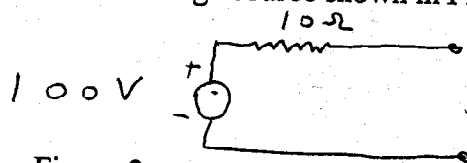


Figure 2

**BITS, Pilani-Dubai Campus, Knowledge Village, Dubai**  
**Second Semester 2003-2004**  
**Test I (Closed Book)**

Course No ES UC 272  
 Date: 21<sup>th</sup> March 2004

Course Title  
 Max Marks 20

Electrical Sciences II  
 Times: 50 Minutes

Answer all questions.

Q1 Find the form factor of the trapezoidal wave shown in figure 1 (4)

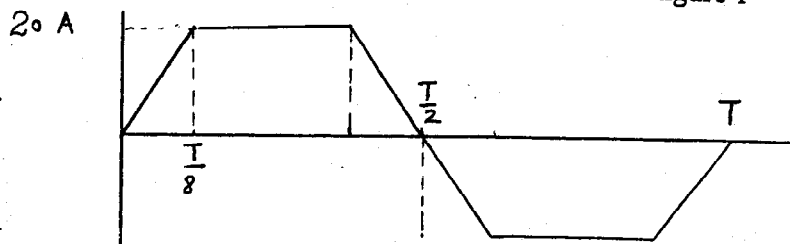


Figure 1

Q2 The three Impedances  $Z_1 = 80$  ohms,  $Z_2 = j100$  ohms and  $Z_3 = -j50$  ohm connected in star form are fed from a 400 V, three phase supply. Calculate the line currents. (6)

Q3 A 200 kva, 1 phase transformer with a voltage ratio of 6350/660 V has the following winding resistances and reactances  
 $R_1 = 1.56$  ohms  $R_2 = 0.016$  ohms,  $X_1 = 4.67$  ohms and  $X_2 = 0.048$  ohms. Calculate the resistance and reactance referred to the high voltage side. (3)

Q4 In the magnetic circuit shown below, the coil  $F_2$  is supplying 500 AT in the direction indicated. Find the AT that the coil  $F_1$  must provide to produce a flux of 4 m Wb in the air-gap in the central limb from A to B. The relative permeability of the core is 4500. (7)

