BITS, PILANI – DUBAI
Academic City, Dubai

Semester I 2008 – 2009
III Year (EIE)-CDC

Test -1 (Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 21.09.2008 **Time: 50**Minutes **M.M. = 25** (12.5 %)

Expected Answers:

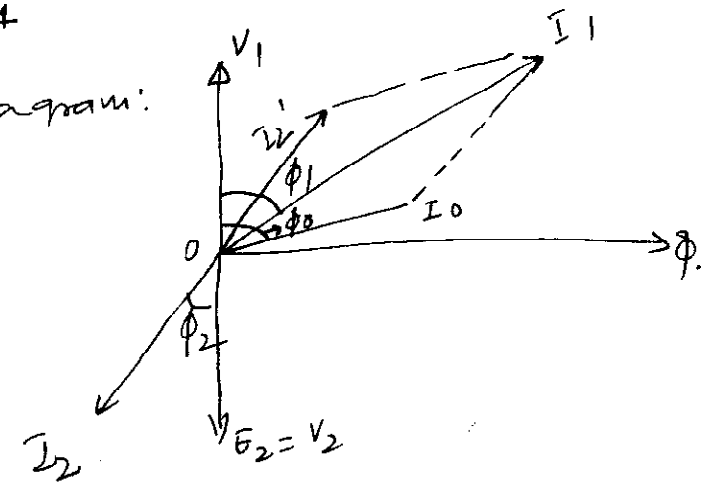
1. If the primary of a transformer is connected to DC supply, the primary will draw a steady current and hence produce constant flux. Consequently, no back emf will be produced. The primary will draw excessive current due to low resistance. The result is that it will overheat and burn out or the fuses will blow.

   When the primary is to be connected to a dc supply, a high resistance should be connected in series with primary, which limits the value of current to a safe limit, preventing it from burning out.

2. A magnetic circuit with Ferro magnetic core or other similar materials, may be having air gap, has flux mainly confined to core. Assuming no leakage of flux, the circuit can be modeled as interconnection of lumped reluctances and mmf, which is analogous to electric circuit, composed of resistances. Hence, Kirchhoff's laws apply to it. These can be stated as:
   - KVL- Sum of mmf drop across a magnetic loop equals zero.
   - KCL- sum of fluxes at a magnetic junction is zero.

3. $K = 432/144$

The phasor diagram:



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Test -2 (Open Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 02.11.2008 **Time:** 50Minutes **M.M. = 20** (10 %)

- ***Attempt all Questions, maintain the serial order.***
- ***Assume missing data, if any.***
- ***Only textbook and handwritten class notes in original are allowed.***

Q1. A cutting tool exerts a tangential force of 400 N on a steel bar of diameter 10 cm which is being turned in a simple lathe. The lathe is driven by a chain at 840 rpm from a 220 V DC motor which runs at 1800 rpm. Calculate the current taken by the motor if its efficiency is 80 %. What size is the motor pulley if the lathe pulley has a diameter of 24 cm? [3+2]

Q2. A 250 V shunt motor with a constant main field drives a load, the torque of which varies as the cube of the speed. When running at 500 rpm, it takes 40 A. Find the speed at which it will run if a 25 ohm resistor is connected in series with the armature. Neglect motor losses. [5]

Q3. Discuss Scott connection in Transformer with the help of a neat circuit diagram.

The total iron loss in a 460V, 50 Hz single phase transformer is 2400 W. when a 230 V, 25 Hz supply is applied, the total iron loss is 800 W. calculate the hysteresis loss and eddy current loss at normal voltage and frequency. [3+2]

Q4. Derive the EMF equation of a transformer.

A 40 kVA transformer has iron loss of 450 W and full load copper loss of 850 W. if the power factor of the load is 0.8 lagging, calculate full load efficiency, the kVA load at which maximum efficiency occurs and the maximum efficiency. [2+3]

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Quiz 1 (Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 12.10.2008 **Time: 20**Minutes **M.M. = 20** (10 %)

Name:_____ ***Id No:***_____

1. What is the principle of operation of a transformer?

2. Why do we use iron core in a transformer?

3. List four applications of transformers.

4. Why are the auto transformers not safe for supplying a LV from a HV source?

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Quiz 1 (Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 12.10.2008 **Time: 20**Minutes **M.M. = 20** (10 %)

5. Write down the name of the instrument Transformers known to you.

6. Mention the factors on which hysteresis loss depends?

7. Which connection is best suited for 3 phase, 4 wire service in case of 3 phase transformers?

8. The maximum flux density in the core of a 250/3000 V, 50 hz single phase transformer is 1.2 Wb/m2. If the emf/turn is 8 V, calculate primary and secondary turns?

9. Calculate area of the core in case of problem no 8?

10. The main purpose of performing OC test on a transformer is to measure its _____.

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Quiz 2 (Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 23.10.2008 **Time: 20**Minutes **M.M. = 10** (10 %)

Name:_____ Id. No. _____

1. A DC motor is still used in industrial applications because it
   (i) is cheap
   (ii) is simple in construction
   (iii) provides fine speed control
   (iv) none of the above

2. Carbon brushes are preferable to copper brushes because
   (i) they have longer life
   (ii) they reduce armature reaction
   (iii) they have lower resistance
   (iv) they reduce sparking

3. the mechanical power developed in a Dc motor is maximum when back emf is equal to
   (i) Twice the applied voltage
   (ii) Half of the applied voltage
   (iii) One third of the applied voltage
   (iv) None of the above

4. A DC motor runs at 1725 rpm at full load and 1775 rpm at no load. The speed regulation is
   (i) 4.7 %
   (ii) 2.9 %
   (iii) 7.6 %
   (iv) 1.5 %

5. The speed of a DC motor can be controlled by changing
   (i) its flux
   (ii) armature circuit resistance
   (iii) applied voltage
   (iv) all of the above

6. For the same rating, a DC machine has _____ an AC machine

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Quiz 2 (Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 23.10.2008 **Time:** 20Minutes **M.M. = 10** (10 %)

(i) the same weight as

(ii) more weight than

(iii) les weight than

(iv) none of the above

7. The field winding of a DC shunt machine usually carries _____ of the rated current of the machine.

(i) 2 to 5 %

(ii) 15 to 20 %

(iii) More than 20 %

(iv) Less than 0.5 %

8. DC machines which are subjected to abrupt changes of load are provided with

(i) Interpole windings

(ii) Compensating windings

(iii) Equalizers

(iv) Copper brushes

9. Why is the resistance of the field winding of DC shunt generator kept below critical filed resistance?

10. Why a DC series motor used to start heavy loads?

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Quiz 3(Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 29.11.2008 Time: 20Minutes **M.M. = 10** (10 %)

Name:_____ Id. No. _____

Q1. The stator of a 3 Ø Induction Motor produces:
(1) Steady Magnetic Field
(2) Rotating Magnetic Field
(3) Alternating Magnetic Field
(4) No Magnetic Field

Q2. The air gap between stator and rotor of a 3 Ø Induction Motor ranges from:
(1) 2 - 4 cm
(2) 0.4 – 4 mm
(3) 1 – 2 cm
(4) 4 – 6 cm

Q3. The relation among synchronous speed Ns, rotor speed N and the slip s is:
(1) N= (s-1)Ns
(2) N= (1-s)Ns
(3) N= (1+s)Ns
(4) N = s.Ns

Q4. The full load slip of a 3 Ø Induction Motor ranges from:
(1) 10 – 20%
(2) 20 – 30%
(3) 2 – 5 %
(4) None

Q5. The torque characteristics of a 3 Ø Induction is similar to that of _____
(1) DC Series Motor
(2) DC Shunt motor
(3) DC Differentially compounded motor
(4) DC cumulatively compounded motor

Q6. The starting torque of a 3 Ø Induction Motor is _____ supply voltage.
(1) independent of

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Quiz 3(Closed Book)

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 29.11.2008 **Time:** 20Minutes **M.M. = 10** (10 %)

(2) directly proportional to

(3) directly proportional to the square of

(4) None

Q7. If Ns and N are the speed of rotating field and rotor respectively, the rotor Input/ rotor output is equal to:

(1) N/Ns

(2) Ns/N

(3) Ns-N

(4) N-Ns

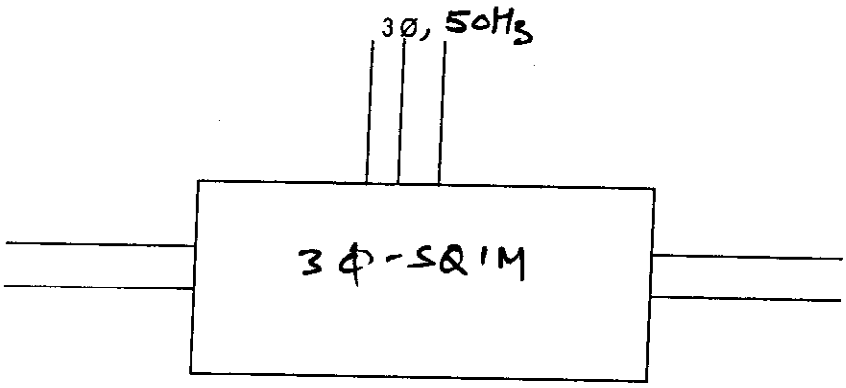
Q8. When the rotor of the 3 Ø Induction Motor is blocked, the slip is :

(1) Zero

(2) ½

(3) 1/10

(4) One



Q9. In the fig, the rotor frequency is _____ when the machine is at standstill.

Q10. If one of the lines in the same fig is interchanged:

(1) Flux speed decreases

(2) Flux speed increases

(3) Flux speed remains same

(4) None

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Comprehensive Examination

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 24.12.2008 **Time: 03 hrs** **M.M. = 60** (30 %)

- ***Attempt all Questions, maintain the serial order.***
- ***Assume missing data, if any.***

Q1. (a) Two shunt generators operating in parallel deliver a total current of 250 A. one of the generator is rated 50 kW and other 100 kW. The voltage rating of both machines is 500 V and has regulations 6% (smaller) and 4%. Assuming linear characteristics, determine the current delivered by each machine and the terminal voltage. [3 + 3]

(b) A 220 V shunt motor with an armature resistance of 0.5 ohm is excited to give constant main field. At full load, the motor runs at 500 rpm and takes an armature current of 30 A. If a resistance of 1 ohm is placed in the armature circuit, find the speed at full load torque and also find the stalling torque. [3 +3]

Q2. (a) Draw the phasor diagram of a practical transformer connected to an inductive load. Discuss the importance of shifting the impedance in the transformers. [3 +3]

(b) Calculate the percentage voltage regulation of a transformer in which the percentage resistance drops is 5% when the power factor is 0.8 lagging, unity and 0.8 leading. [3x2]

Q3. (a) A 6 pole, 50 Hz, 3 phase induction motor runs at 960 rpm when the torque on the shaft is 200 N-m. If the stator losses are 1500W and friction/windage losses are 500 W, find the rotor cu loss and efficiency of the motor. [2 x3]

(b) A 3 phase, star connected, 400 V, 50 Hz, 4 pole induction motor has the following per phase parameters referred to the stator:
R_1 = 0.15 ohm, X_1=0.45 ohm, R_2' = 0.12 ohm, X_2' = 0.45 ohm, X_m = 28.5 ohm
Calculate the stator current and power factor when the motor is operated at rated voltage and frequency with slip 4%. [2 x3]

Q4. (a) Derive the EMF equation of an alternator. Find the no of conductors in series per phase required for the armature of a 3 phase, 50 Hz, 10 pole alternator. The winding is star connected to give a line voltage of 11 kV. The flux per pole is 0.16Wb. Assume Kp=1& Kd = 0.96. [2 x3]

(b) A 3 phase, 10 KVA, 400V, 50 Hz star connected alternator supplies the rated load of 0.8 pf lagging. If the armature resistance is 0.5 ohm/phase and synchronous reactance is 10 ohm/phase, find the voltage regulation and power angle. [3+3]

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Comprehensive Examination

Course No.: INSTR C 371 **Course Title:** Electromechanical Energy Conversion

Date: 24.12.2008 **Time: 03 hrs** **M.M. = 60** (30 %)

Q5. (a) A 3 phase, 6 MW, 4000V, 180 rpm, 50 Hz synchronous motor has per phase synchronous reactance of 1.2 ohm. At full load, the torque angle is 20 degree elect. If the generated back emf per phase is 2400 V, calculate the mechanical power developed. What will be the maximum mechanical power developed? [3+3]

(b) Write technical note on the following: [2 x3]
(i) Double cage induction machines
(ii) Rotating magnetic field from two phase supply