

BITS, PILANI – DUBAI
Academic City, Dubai

Semester I 2009 – 2010
III Year (EIE)-CDC

Comprehensive Examination

Course No.: INSTR C 371

Course Title: Electromechanical Energy Conversion

Date: 27.12.2009

Time: 03 hrs

M.M. = 60 (30 %)

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

Q1.

- A. During starting of a Synchronous Motor, when should the rotor excitation be applied? [3]
- B. How does the behavior of Synchronous Motor differ from that of a 3 Phase Induction Motor? [3]
- C. A 2000 V, 3 phase, star connected synchronous motor has resistance and synchronous reactance per phase of 0.2 ohm and 1.9 ohm respectively. Calculate the generated (back) e m f per phase with an input of 800 kW at pf 0.8 lagging. [4]

Q2.

- A. What are the advantages and disadvantages of 3 phase transformers over 3 single phase bank of transformers? [4]
- B. A single phase transformer has 1000 turns on the primary and 200 turns on the secondary. The no load current is 3 A at pf of 0.2 lagging. Calculate the primary current and power factor when the secondary current is 280 A at a pf of 0.8 pf lagging. Draw the phasor diagram also while solving. [6]

Q3.

- A. Why is a differentially compounded motor rarely used? [2]
- B. What are the stray load losses? [2]
- C. A 50 kW, 440V shunt generator having an armature circuit resistance including inter pole winding of 0.15 ohm at normal working temperature was run as a shunt motor on no load at rated voltage and speed. The total current drawn by the motor was 5 A including shunt field current of 1.5 A. Calculate the efficiency of the shunt generator at $3/4^{\text{th}}$ full load. [6]

Q4.

- A. The ratio of maximum torque to full load torque in a 3 phase Induction Motor is 2.5. Calculate the ratio of starting torque to full load torque for direct on line starting. The rotor resistance is 0.5 ohm/phase and rotor standstill reactance is 5 ohm/phase. [4]
- B. A 3 phase, star connected, 400 V, 50 Hz, 4 pole Induction Motor has the following per phase parameters referred to stator:
 $R_1 = 0.15 \text{ Ohm}$; $X_1 = 0.45 \text{ Ohm}$; $R_2' = 0.12 \text{ ohm}$; $X_2' = 0.45 \text{ Ohm}$; $X_m = 28.5 \text{ Ohm}$
Calculate the stator current and power factor when the motor is operated at rated voltage and frequency with 4 % slip. [6]

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Q5.

- A. A 4 pole, 250 W, 115 V, 60 Hz capacitor start induction motor takes full load line current of 5.3 A while running at 1760 rpm. If the full load efficiency of the motor is 64 %, find the Motor slip, power factor and full load torque. [6]
- B. Explain double field revolving theory in case of single phase Induction Motors. [4]

Q6.

- A. Calculate the value of the distribution factor for a 3-phase winding of a 4-pole alternator having 36 slots. [4]
- B. A 1000 kVA, 2300 V, 3 phase star connected alternator has a resistance of 0.309 ohm/phase and a synchronous reactance of 3.31 ohm/phase. Calculate the change of line voltage when the rated output of 1000kVA at 0.8 lagging pf is switched off. The speed and excitation current remain unchanged. [6]

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Semester I 2009 – 2010

III Year (EIE)-CDC

Test -2 (Open Book)

Course No.: INSTR C 371

Course Title: Electromechanical Energy Conversion

Date: 10.12.2009

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? [2+ 2]
- Q2. A 4 pole, 3 ϕ , 50 Hz induction motor has a star connected rotor. The rotor has a resistance of 0.1 ohm per phase and standstill reactance of 2 ohm per phase. The induced emf between the slip rings is 100 V. if the full load speed is 1460 rpm, calculate:
- | | | |
|-------|--|-----|
| (i) | the slip | [1] |
| (ii) | the induced emf in the rotor in each phase | [1] |
| (iii) | rotor reactance per phase | [1] |
| (iv) | rotor current and rotor power factor | [1] |
- Assume slip rings are short circuited.*
- Q3. (A) What is the difference between Power Transformers and Distribution Transformers? [2]
- (B) A 3 HP, 3 ϕ , 50 Hz induction motor with full load efficiency and power factor of 0.83 and 0.8 respectively has a short circuit current of 3.5 times the full load current. Estimate the line current at the instant of starting the motor from a 500 V supply by means of a star delta switch. Ignore the magnetizing current. [2]
- Q4. A shunt motor fed from a 400 V DC supply takes an armature current of 100A when running at 800 rpm. If the total torque developed remains unchanged, find the speed at which the motor will run if the flux is increased to 120% of its original value and a resistance of 0.8 ohm is connected in series with the armature. The armature resistance is 0.2 ohm. [4]
- Q5. 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. [4]

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Academic City, Dubai

Semester I 2009 – 2010
 III Year (EIE)-CDC - EIE

Test -1 (Closed Book)

Course No.: ^{INSTR}EEEC 371

Course Title: Electromechanical Energy Conversion

Date: 18.10.2009

Time: 50Minutes

M.M. = 30 (15 %)

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

Q1. What are the main applications of auto transformers? The primary and secondary voltages of an auto transformer are 230 V and 75 V respectively. Calculate the currents in the different parts of the winding when load current is 200 A. Also calculate the saving of copper. [1+2+2]

Q2. A single phase, 100 kVA, 2000/200 V, two winding transformer is converted into an auto transformer as shown in fig 1 such that more than 2000 V is obtained at the secondary. The portion 'ab' is the 200 V winding and portion 'bc' is the 2000 V winding. Find the kVA rating as auto transformer. [5]

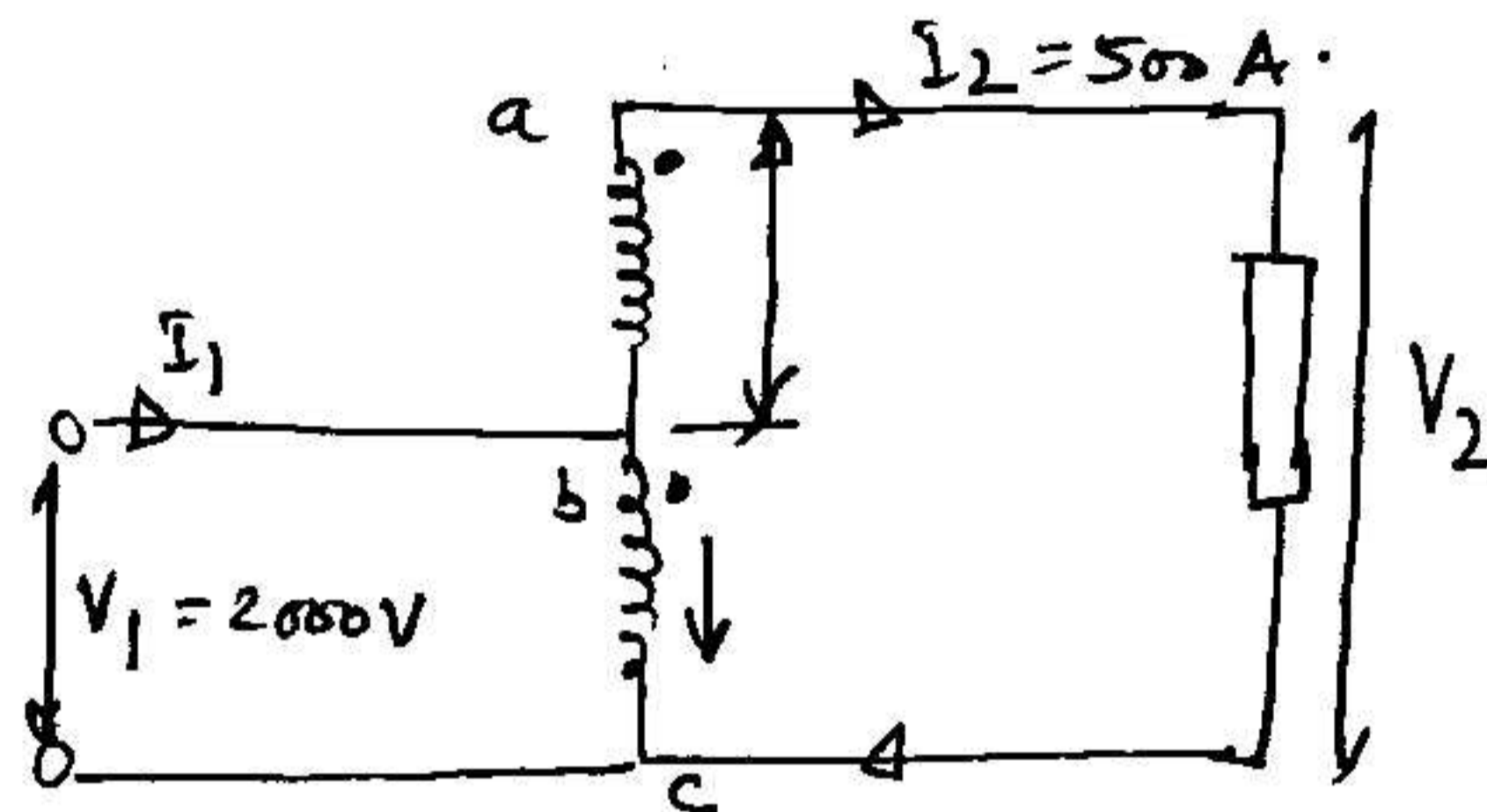


fig 1

Q3. What are the conditions for the satisfactory parallel operation of transformers?
 Two single phase Transformers A and B rated at 250 kVA each are operated in parallel on both sides. Impedances for both A and B are $(1 + j6)$ ohm and $(1.2 + j408)$ ohm respectively. Find the load shared by each when the total load is 500 kVA at 0.8 pf lagging. [2+3]

Q4. A separately excited DC generator when running at 1200 rpm supplies 200 A at 125 V to a circuit of constant resistance. What will be the load current when the speed is dropped to 1000 rpm if the field current is unaltered? Armature resistance is 0.04 ohm and total drop at brushes is 2 V. [5]

Q5. A 4500/16000 V, 1500 KVA, 50 Hz transformer has the following parameters:
 $R_1 = 0.03$ ohm $R_2 = 0.44$ ohm $R_0 = 1688$ ohm
 $X_1 = 0.092$ ohm $X_2 = 1.34$ ohm $X_0 = 256$ ohm
 The transformer is supplying full load at a power factor of 0.8 lagging. Draw the exact equivalent circuit and find the input current. [5]

Q6. An 8 pole wave wound DC generator has 480 armature conductors. The armature current is 200A. find the armature reaction demagnetizing and cross magnetizing AT per poles if (i) brushes are on GNA (ii) brushes are shifted 6 degree electrical from GNA [2+3].

Name: _____

Id. No. _____

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Semester I 2009 – 2010
III Year (EIE)-CDC

Quiz 2(Closed Book)

Course No.: INSTR C 371

Course Title: Electromechanical Energy Conversion

Date: 18.11.2009

Time: 20Minutes

M.M. = 10 (5 %)

- *Assume suitable data, if needed.*

1. How many types of electric braking are employed in DC motors? Write the names only.
2. Write down the emf equation of a DC machine and elaborate the symbols used.
(As generator)
3. A 220 V DC shunt motor runs at 500 rpm, when the armature current is 50 A. Calculate the speed if the torque is doubled, if armature resistance is 0.2 ohm?
 - a. 576 rpm
 - b. 476 rpm
 - c. 367 rpm
 - d. 345 rpm
4. A 240 V DC series motor takes 40 A when giving its rated output at 1500 rpm. Its resistance is 0.3 ohm. The resistance to be added to obtain rated torque at 1000 rpm :
 - a. 2 ohm
 - b. 2.1 ohm
 - c. 1.9 ohm
 - d. 1 ohm
5. Write down any five parts of a DC machine.

6. The stator of a 3 \emptyset Induction Motor produces:
- (1) Steady Magnetic Field
 - (2) Rotating Magnetic Field
 - (3) Alternating Magnetic Field
 - (4) No Magnetic Field
7. The air gap between stator and rotor of a 3 \emptyset Induction Motor ranges from:
- (1) 2 - 4 cm
 - (2) 0.4 - 4 mm
 - (3) 1 - 2 cm
 - (4) 4 - 6 cm
8. The relation among synchronous speed N_s , rotor speed N and the slip s is:
- (1) $N = (s-1)N_s$
 - (2) $N = (1-s)N_s$
 - (3) $N = (1+s)N_s$
 - (4) $N = s.N_s$
9. Define Cogging in Induction Motors.
10. The frequency of the emf in the stator of a 4 pole SQIM is 50 Hz and that in the rotor is 1.5 Hz. What is the slip and at what speed is the motor is running?

BITS, PILANI – DUBAI
FIRST SEMESTER 2009 – 2010
THIRD YEAR-EIE

Course Code: INSTR C371
Course Title: EMEC
Duration: 20 minutes

Date: 30.09.09
Max Marks: 10
Weightage: 5%

Name:	ID No:
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Instructions: 1. Attempt all questions. 2. Encircle or Tick the correct answer.

1. An emf of 8 volts is induced in a coil of inductance 2H. The rate of change of current must be:
 - a. 16 A/s
 - b. 2 A/s
 - c. 0.25 A/s
 - d. 4 A/s

2. In an iron core coil, the iron core is removed, so that the coil becomes an air cored coil. The inductance of coil will:
 - a. increase
 - b. decrease
 - c. may increase or decrease
 - d. remain the same

3. A 50 KVA, single phase, 230/2000V transformer is fed at 230 V and is supplying 50 KVA load at 0.8 pf lagging. The output voltage will be:
 - a. 2000 V
 - b. > 2000 V
 - c. < 2000 V
 - d. 2002.20 V

4. It is necessary that magnetic coupling of a transformer is close. This is done to ensure:
 - a. high efficiency
 - b. good regulation
 - c. both a & b
 - d. good regulation and high power factor

5. A 200/400 ratio transformer has a secondary winding resistance of 0.5 ohm. The total resistance referred to primary should be about:
- ≥ 0.25 ohm
 - > 0.5 ohm
 - 1 ohm
 - 2 ohm
6. An auto transformer results in saving of material if:
- turns ratio is high
 - turns ratio is low
 - rating is high
 - rating is low
7. An auto transformer is used to step down voltage V_1 to V_2 . An open circuit develops in the winding. The maximum voltage across the load may become :
- $V_1 + V_2$
 - $V_1 - V_2$
 - $2V_1$
 - V_1
8. An open circuit test is conducted on a 100/500 V transformer. The 500 V winding is open circuited and 100 V is applied to the other winding. The input power is 200 W. If the open circuit test is repeated with 100V winding open circuited and 500V applied to the other winding, the input power would be:
- 200W
 - 1000W
 - 40W
 - 8W
9. One primary and one secondary terminal of a two winding transformer are connected to an ohm meter. The reading of ohm meter will be:
- zero
 - infinity
 - zero or infinity
 - equal to winding resistance
10. Which of the following combinations of 3 phase transformers can operate successfully in parallel?
- Delta-Wye and Delta-Wye
 - Wye-Delta and Delta-Wye
 - Delta-Delta and Delta-Wye
 - Wye-Delta and Delta-Delta