

BITS, Pilani- Dubai Campus  
Knowledge Village, Dubai  
First Semester 2004-2005  
III Year EEE & EI

EEE UC371/INSTR UC371- Electromechanical Energy Conversion

First -Test

Date of Test 3<sup>rd</sup> October 2004,

Time 50 Minutes

Maximum Marks 20

Answer all Questions

Q1 Write the conditions required for the satisfactory and successful operation of transformers connected in parallel. (5)

Q2 A 3-Phase transformer bank consisting of three 1 phase transformers is used to step down the voltage of a 3 phase 6600V transmission line. If the primary line current is 10 A, calculate the secondary line voltage, line current and output kVA for the Star/Delta connection. The turns ratio is 12. Neglect losses. (7)

Q3 Figure 1 shows a Scott-connected transformer supplied from 11 kV, 3 phase, 50 Hz mains. Secondaries, series connected as shown, supply 1000 A at a voltage of 141.4 to a resistive load. The phase sequence of three phase supply is ABC.

(a) Calculate the turn ratio of Teaser transformer.

(b) Calculate the line current  $I_B$  and its phase angle w.r.t the voltage of phase A to neutral on the 3-phase side. (2+6)

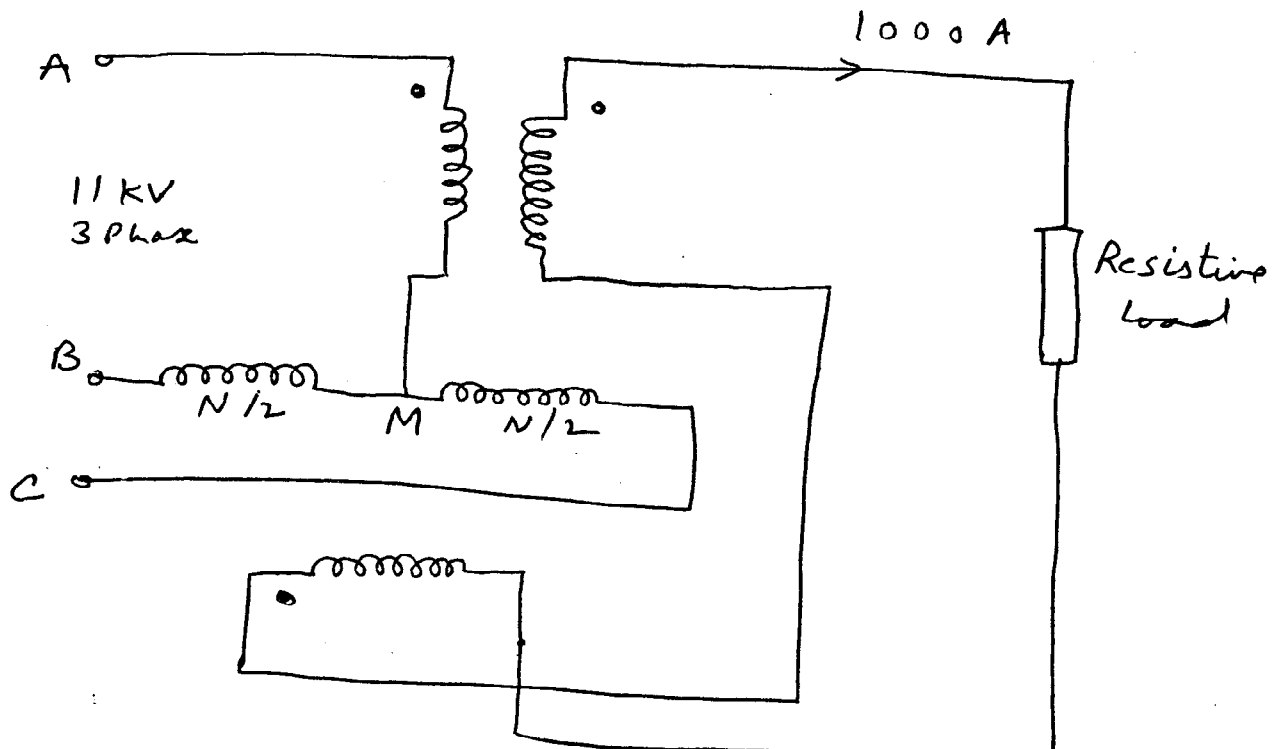


Figure 1

**BITS, Pilani- Dubai Campus**

**Knowledge Village, Dubai**

**First Semester 2004-2005**

**III Year EEE &EI**

**EEE UC371/INSTR UC371- Electromechanical Energy Conversion**

**Second -Test**

**Date of Test 28 November 2004,**

**Time 50 Minutes**

**Maximum Marks 20**

**Answer all Questions**

**Q1 What are the purpose and location of the following?**

- i) An interpole or commutating winding.**
- ii) A compensating winding.**
- iii) A series field winding.**

**(6)**

**Q2 A d c shunt motor is being operated from 300 V mains. Its no load speed is 1200 rpm. When fully loaded, it delivers a torque of 400 N m and its speed drops to 1100 rpm. Find its speed and power output when delivering the same torque if operated with an armature voltage of 600 V. Excitation is assumed unchanged.**

**(6)**

**Q3 Discuss how the circle diagram is drawn for the analysis of induction motor. Draw a neat sketch of circle diagram with free hand and show how different parameter like motor input, fixed losses, Stator copper loss, Rotor copper loss, efficiency and Power factor can be obtained with the help of a circle diagram.**

**(8)**

Name.....

Roll No.....

**BITS Pilani-Dubai Campus, Knowledge Village, Dubai**  
**First Semester, III Year (EEE&EI) 2004-2005**

## **Comprehensive Exams (Closed Book)**

**EEE UC371 / INSTRU UC371 (Electromechanical Energy Conversion)**

**Max Marks 60**

**Time 3 Hours**

**Answer any five Questions. Each question carries equal marks.**

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**Q1 a) Explain with the help of connection and vector diagrams how a 2 phase supply can be obtained from a three phase supply. (6)**

**b) Two single transformers are connected in parallel to supply a load having a resistance of 10 Ohm and reactance of 5 Ohm. The effective resistance and reactance of Transformer A referred to secondary are 0.1 Ohm and 1.2 ohms and the corresponding values for transformer B are 0.16 Ohm and 1.5 Ohm. The no load emf of transformer A is 2200 V and that of B is 2100V. Determine**

- i) Circulating current on no load and**
- ii) Current delivered by transformer A.**

**(6)**

**Q2 a) A three phase induction motor has a 4 pole, star connected stator winding and runs on 50 Hz with 400 V between lines. The rotor resistance and standstill reactance per phase are 0.4 ohm and 3.6 ohm respectively. The ratio of rotor to stator turns is 0.67. Calculate**

- i) The gross torque at 4% slip**
- ii) The gross mechanical power at 4 % slip and**
- iii) Maximum Torque**

**Neglect stator impedance.**

**(6)**

**b) State the effects of increasing rotor resistance on starting currents, starting torque and maximum torque of an induction motor. Why at all starters are necessary for starting the three phase induction motor? What are the various types of starters used for squirrel cage induction motor? Discuss any one method in detail.**

**(6)**

**Q3 a) Explain the followings**

- i) Why only two brushes are needed on wave windings, regardless of the number of poles.**
- ii) Why armature circuit is usually selected for reversal of rotation in spite of the fact that field circuit carries less current than armature circuit in case of dc machine.**

**(6)**

b) A 3 Kw series motor runs normally at 800 rpm on a 240 V supply taking 16A, the field coils are all connected in series. Estimate the speed and current taken by the motor if the coils are reconnected in two parallel groups of two in series. The load torque increases as the square of the speed. Assume that the flux is directly proportional to the current and ignore losses. (6)

Q4 a) Classify the different types of Electrical Machine according to their speed and write their applications too. (4)

b) Explain the purpose of using damper windings in synchronous machines. Also discuss hunting of synchronous machine. (4)

c) Three single phase transformers are delta connected and are supplying a line current of 200A. Determine the current in each transformer. If one unit is faulty and removed what will be the capacity of the new set, if the current in each transformer remains the same? (4)

Q5 a) Prove that maximum mechanical power out put of a synchronous motor is given by

$$P_{m(out)max} = -(E_f^2/Z_s^2) Ra + (V_t E_f / Z_s) \quad (6)$$

b) With the help of phasor diagram show the effect of varying excitation of synchronous motor under constant load. (6)

Q6 a) Explain why a single phase single winding induction motor produces no starting torque? Discuss double revolving field theory of single phase induction motor. What are the methods of starting single phase induction motor? Discuss any one method in detail. (6)

b) A 2000V, 3 phases, 4 pole star connected synchronous motor runs at 1500 rpm. The excitation is constant and corresponding to an open circuit voltage of 2000V. The resistance is negligible in comparison with synchronous reactance of 3.5ohm/phase. For an armature current of 200 A determine

- i) Power factor
- ii) Power input and
- iii) Torque developed.

Draw the Phasor diagram too.

Assume armature current lagging behind the supply voltage. (6)