Reg. No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION –MAY 2016

SUBJECT: ANALYSIS AND CONTROL OF ELECTROMAGNETIC DEVICES (EE 242)

(BRANCH: E&E/IP/ MECHANICAL)

23RD MAY, 2016

Time: 3 Hours **Max. Marks: 100**

✓ **Answer ANY FIVE full Questions.**

1A. Mention the properties of an ideal transformer **(04)**

1B. With a neat sketch draw and explain the Y/Δ starter of a 3 phase induction motor **(06)**

1C. A 15 kVA transformer is loaded as follows

12 hours – 2 kW at PF of 0.5

6 hours – 12 kW at PF of 0.8

6 hours – 18 kW at PF of 0.9

Find all day efficiency. Assume Iron loss = full load copper loss = 300 W. **(10)**

2A. Starting from the approximate equivalent circuit derive the torque equation & explain the torque / slip characteristics of 3 phase induction motor. **(06)**

2B. A 2000 V, 3 phase, star connected synchronous motor has an effective resistance & synchronous reactance of 0.2 Ω and 2.2 Ω per phase respectively. The input is 800 kW at normal voltage and electromotive force is 2500 V. Calculate line current and power factor. **(10)**

2C. Distinguish between core type and shell type transformers **(04)**

3A. Determine R_c, X_m, R_{eq}, X_{eq} referred to primary of a 4 kVA, 200/400 V, 50 Hz transformer with the following results

O.C Test 200 V, 0.7 A, 70 W (LV Side)

S.C Test 15 V, 10 A, 80 W (HV Side)

Find the secondary terminal voltage and efficiency at full load 0.8 PF lag. **(10)**

3B. Distinguish between squirrel cage and slip ring rotor. **(03)**

3C. A 3 phase 20 hp, 500 V, 50 Hz, 6 Pole induction motor runs at 950 RPM, with a power factor of 0.86, The Mechanical losses total 1 hp. Calculate,

a) Slip b) Rotor copper loss

c) Input of stator losses amount to 1500 W d) Line current

e) Rotor frequency **(07)**

4A. A 10 pole, 50 Hz, slip ring induction motor runs at 576 RPM on full load. The rotor resistance per phase is 0.25 Ω. Assuming a constant load torque, determine the additional resistance per phase in the rotor to reduce the speed to 480 RPM. **(06)**

4B. Derive the condition for zero voltage regulation & maximum voltage regulation. **(04)**

4C. A 500 V, 50 Hz, 3 Phase circuit takes 20 A at a lagging PF of 0.8. A synchronous motor is used to make the overall PF 0.95 lag.
Calculate the kVA input to motor and its power factor when driving a load of 10 hp. The motor has an efficiency of 80 %. **(10)**

5A. An 11 kV, 3 Phase, star - connected synchronous motor takes 200 A from supply at unity PF.
The induced EMF is increased by 25 %, find the current and power factor. Find the current and power factor if EMF is decreased by 25 %. Neglect resistance and synchronous reactance is 8Ω. **(14)**

5B. Draw and explain the phasor diagram of a transformer supplying inductive load. **(06)**

6A. Explain any two methods of staring synchronous motor. **(06)**

6B. Determine iron loss and full load copper loss of a 1 kVA, 50 Hz, 200/400 V transformer.
The efficiency is 0.88 both at 50 % of full load and 131 % of full load. Assume load PF to be unity. **(08)**

6C. The rotor resistance & reactance per phase of a 4 pole, 50 Hz, 3 phase induction motor are 0.025 Ω and 0.12 Ω respectively.
Find the value of external rotor resistance to get three fourth of maximum torque at starting. **(06)**

7A. Derive equations for power input & power output of a synchronous motor, in terms of E, V & Z_s. Also find the condition for maximum input and maximum output. **(12)**

7B. A 3 hp, 500 V induction motor with efficiency and PF of 0.83 and 0.8 respectively, has a short circuit current of 3.5 times full load current. Full load slip = 0.05. Estimate the line current at starting using Y/Δ starter. Also find the starting torque in terms of full load torque. **(08)**

8A. Derive the EMF equation of a transformer **(02)**

8B. A Single phase 50 Hz core type transformer has square cores of 20 cm side. The flux density in core is 1 Wb/m^2. Find the number of turns in two windings designed for 3000/220 V ratio. Stacking factor =0.9. **(06)**

8C. A 3 phase induction motor has 4 pole, star connected stator winding & runs on 220 V, 50 Hz supply. The rotor resistance is 0.1 Ω and rotor reactance 0.9 Ω. The ratio of stator to rotor turns is 1.75. The full load slip is 5%. Calculate for this load

a) The torque b) hp

Find also

c) Maximum torque d) Speed at maximum torque

e) Starting torque f) draw the torque / slip curve **(12)**