Reg. No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION - OCT. / NOV. 2017

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

(BRANCH: E&E/ MECHANICAL)

Tuesday, 07 November 2017

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

✓ **Answer ANY FIVE Questions.**

1A. A 4 kVA, 200/400 V, single phase transformer gave the following test results
O.C Test 200V, 0.8 A, 70 W (LV Side)
S.C Test 20V, 10 A, 60 W (HV Side)
Determine the secondary terminal voltage at full load and power factors of 0.8 lag , 0.8 lead and UPF. Also find the efficiency at
(i) $\frac{1}{2}$ load 0.9 PF lag (ii) full load 0.8 PF lead

1B. A 2500 V, 3 phase, star connected synchronous motor has a reactance of 5 Ω resistance of 0.5 Ω. The motor takes an input of 1000 kW and excitation EMF of 3600 V. Find the line current and PF. **(10+10)**

2A. A 50 kVA transformer has full load copper loss of 750 W and core loss of 600 W. Determine the all day efficiency when the load during the day is as follows:
6 hours– 5 kW at PF 0.6
12 hours – 40 kW at at PF 0.8
6 hours – 30 kW at at PF 0.85

2B. The full load torque of a 3 phase, 50 Hz, 4 pole 1410 rpm induction motor is 50.52 Nm. Find the starting torque if the maximum torque is developed at 1200 rpm

2C. Compare squirrel cage and slip ring rotors. **(8+8+4)**

3A. A star connected 440 V, 50 Hz induction motor takes a line current of 40 A at a lagging PF of 0.8. A synchronous motor is used to make the PF 0.95. Find the rating of synchronous motor.

3B. Draw and explain the torque / slip characteristics of a 3 Phase induction motor and prove that maximum torque is independent of rotor resistance. What is the significance of starting torque?

3C. The rotor of a 4 pole, 50 Hz, induction motor has a resistance of 0.25 Ω per phase and runs at 1440 rpm on full load. Find the external resistance to be added in the rotor to lower the speed to 1200 rpm, Assume constant load torque. **(6+8+6)**

4A. An 11 kV, 3 Phase, synchronous motor takes 200 A at unity PF. Find the stator current and power factor if the excitation is
i) increased by 25 % ii) lowered by 25 %
Synchronous reactance is 10 Ω.

4B. Derive the condition for maximum efficiency of a transformer

4C. With a neat sketch explain star – delta starter. **(10+4+6)**

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

a) torque b) hp output

c) maximum torque d) speed at maximum torque.

5B. What are the properties of an ideal transformer?

5C. Draw and explain the phasor diagram of a transformer supplying unity PF load. **(10+4+6)**

6A. Prove that the speed of rotating magnetic field is inversely proportional to number of poles.

6B. A 6 Pole, 550 V, 50 Hz, 3 phase induction motor develops 30 hp including mechanical losses of 2 hp at a speed of 950 RPM, the power factor is 0.88. Calculate,

a) Slip

b) Rotor copper loss

c) Input of stator losses are 2000 W

d) Line current

e) Rotor frequency

6C. Distinguish between core type and shell type transformers **(6+10+4)**

7A. 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 130 % of full load.
Assume load PF to be unity.

7B. Derive equations for power input & power output of a synchronous motor. Prove that power input – power output is the copper loss in the staror. **(8+12)**

8A. Describe any two methods of staring synchronous motor.

8B. Derive the EMF equation of a transformer

8C. 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 for a voltage ratio of 3000/220 V. Assume Stacking factor =0.9.

8D. Determine the percentage tapping required on an autotransformer to start an induction motor such that line current is limited to twice the full load current. Short circuit current is 4 times the full load current. Full load slip = 0.05, find the ratio of starting torque to full load torque. **(5+3+6+6)**