Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING) MAKEUP EXAMINATIONS, DECEMBER 2019

ELECTRICAL MACHINES-I [ELE 2154]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 28, December 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Draw and explain phasor diagram of a practical transformer supplying lagging load indicating all currents, voltage drops, induced emfs, supply voltage and load voltage. ***(03)***

1B. A 100 kVA, 11000 / 240 V, 50 Hz, single phase transformer has its leakage impedance of (10 + j 7) Ω with respect to HV side. The maximum efficiency is found to occur when load is 65% of full load. Determine:

(i) Full load voltage regulation for a load power factor of 0.8 leading

(ii) Iron loss

(iii) Maximum efficiency for a load power factor of 0.8 lagging. ***(03)***

1C. The efficiency of 800 kVA transformer at unity power factor is 98 % both at full load and half-full load. The transformer operates on the following duty cycle:

625 kVA, 0.8 pf lagging for 6 hours;
700 KW, 0.9 pf lagging for 4 hours;
300 KW, 200 kVAR0.95 pf lagging for 4 hours;
No Load for remaining period.

Calculate:

(i) Iron loss and full load copper loss in kW.

(ii) All-day efficiency. ***(04)***

2A. Draw the connection diagram of a 3 phase star-delta transformer. Obtain ratio of secondary line current to that of primary line current in terms of transformation ratio K defined as secondary phase voltage to primary phase voltage. ***(03)***

2B. Sketch a step down auto transformer and hence obtain expressions for conductively and inductively transferred power in kVA in terms of load voltage V_2 and load current I_2. ***(03)***

2C. Two single phase transformers rated at 25 kVA and 60 kVA respectively are connected in parallel to supply a load of 70 kVA at 0.8 pf lagging. The equivalent impedances referred to secondary are (0.1 + j 0.4) Ω and (0.05 + j 0.3) Ω. Calculate kVA load shared by each transformer and their percentage load in terms of rated load. ***(04)***

3A. Show that when a 3 phase supply is given to a balanced stator winding of a 3 phase induction motor, results in a magnetic field of constant magnitude and rotates at synchronous speed. Draw relevant phasor diagram. ***(04)***

3B. A 4 pole, 50 Hz, 3-phase slip ring induction motor has rotor resistance of 0.4 Ω per phase and inductive reactance of 4 Ω per phase at standstill conditions. Rotor induced emf at standstill condition is 80 Volts per phase. Calculate:

(i) Starting and maximum torques
(ii) Gross torque and power when running with a slip of 4%. ***(04)***

3C. "Mechanical losses of an induction motor is treated as constant losses". Justify the statement with relevant reasons. ***(02)***

4A. A 440 V, 50 Hz, 4-pole, 3 phase induction motor has a shaft power of 80 kW when running at a speed of 1440 rpm. The mechanical and iron loss each equals 3 kW. Stator copper loss at this load is equal to rotor copper loss. Calculate:

(i) Efficiency of Induction Motor
(ii) Line current drawn at a power factor of 0.8 lagging. ***(03)***

4B. A 3 phase, 6 pole, 50 Hz slip induction motor has its rotor impedance of (1 + j 2.8) Ω per phase at standstill conditions. It develops full load torque at a speed of 960 rpm. It is desired to reduce speed to 900 rpm to get the same torque. Calculate external resistance per phase required to be connected with rotor winding through slip rings. ***(04)***

4C. A 230 V, 50 Hz single phase capacitor start induction motor has its main and starting winding impedances of (3 + j 4) Ω and (5+ j 2) Ω at standstill conditions. Calculate the value of capacitance required in series with starting winding such that starting winding current leads main winding current by 90^{o}. ***(03)***

5A. Explain the functions of the following in DC generator:
(i) Magnetic pole body (ii) Yoke (iii) Commutator ***(03)***

5B. A DC generator has the following reading when tested for open circuit characteristic at rated speed.

E_g in Volt	5	100	145	165	175	180
I_f in Amp	0	1	2	3	4	5

Plot OCC and hence determine:

(i) critical field resistance
(ii) Maximum generated voltage when connected as shunt generator with shunt field resistance of 40 Ω
(iii) Shunt field resistance required to generate a voltage of 160 V ***(04)***

5C. A DC generator has 400 armature conductors with 4 poles. The flux per pole is 0.03 Wb. It is required to generate a voltage of 400 V. Determine the speed at which it runs when the armature winding is (i) lap connected (ii) wave connected. ***(03)***