Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

GRADE IMPROVEMENT EXAMINATIONS, AUGUST 2021

ELECTRICAL MACHINERY - II [ELE 2251]

REVISED CREDIT SYSTEM

Time: 2 Hours **Date: 11 August 2021** **Max. Marks: 40**

Instructions to Candidates:

- Answer **any four** full questions.
- Missing data may be suitably assumed.

1A. Hopkinson's test was conducted on two identical DC machines. It gave the following results for full load:

Line voltage is 220 V, field currents of motor & generator are 0.3 A & 0.45 A. Armature currents of motor & generator are 25 A & 19.5A, respectively. Calculate the efficiency of generator if the armature resistance of each machine is 0.45 Ω. ***(05)***

1B. DC series motors are never used in applications where the load may be thrown off. Why? Substantiate your answer with the help of suitable characteristics. Compare the characteristics with those of DC shunt motor. ***(05)***

2A. A 250 V DC shunt motor has an armature resistance of 0.6 Ω and a field resistance of 250 Ω. When driving a constant torque load at 650 rpm, the armature takes 20 A. If it is required to raise the speed from 650 rpm to 850 rpm, what resistance must be inserted in the shunt field circuit? Assume linear magnetization characteristics. ***(05)***

2B A 400 V, 68 A DC shunt motor takes 8 % of full load current at no load. Armature reaction weakens the flux by 2 % from no load to full load. Armature resistance is 0.2 Ω, field resistance is 200 Ω and brush contact resistance is 0.02 Ω/brush. Calculate the ratio of full load speed to no load speed. ***(05)***

3A. A 3-phase, 50 Hz, 1000 rpm, star connected alternator has 72 armature slots with 6 conductors per slot and the coil span is 10 slots. The average airgap flux per pole is 0.26Wb. Calculate the distribution and pitch factors of the winding, number of turns per phase and line value of emf induced. ***(06)***

3B. Explain the significance of slip test in Synchronous machines. ***(04)***

4A A 60 kVA, 381.05 V, 50 Hz, Y - connected alternator has an effective resistance of $0.016\,\Omega$ and armature related self-inductance of $0.23\,mH$. With the help of accurate phasor diagrams and related analysis, determine the induced voltage in the armature delivers rated current at a load power factor of 0.7 leading. ***(05)***

4B. (i) State the conditions to be satisfied for successful synchronisation of an alternator with infinite busbars. Also mention the techniques through which, these conditions are ensured to have been met.

(ii) The stator of a 3 – phase alternator has nine slots per pole and carries a balanced 3 – phase, double - layer winding. The coils are short pitched and the coil pitch is seven slots. Find the distribution factor and pitch factor. ***(05)***

5A. 3-phase, star connected alternator is rated 1,600 kVA, 13.5 kV. Its per-phase effective armature resistance & synchronous reactance are 1 & 40 respectively. *a)* Calculate the percentage voltage regulation for a load of 1,250 kW at 0.8 pf lagging.

b) Draw the phasor diagram for the given load. ***(05)***

5B. What is the effect of load power factor on the armature reaction in an alternator?

A 1500 kVA, 6600 V, 3 – phase, Y – connected alternator with a resistance of $0.4\,\Omega/phase$ and synchronous reactance of $6\Omega/phase$ delivers a full – load current at a power factor 0.8 (lagging) and normal rated voltage. Estimate the terminal voltage (line – line) for the same excitation and load current at 0.8 p.f. (leading). ***(05)***

6A A 220 V, 8 hp DC series motor is mechanically coupled to a fan and draws 30 A and runs at 400 rpm with no external resistance connected to armature. The torque required by the fan is proportional to square of the speed. R_a = 0.8 Ω and R_{field} = 0.6 Ω. Neglect armature reaction and rotational losses.

(a) Determine the power delivered to the fan and torque developed by the motor.

(b) If the speed is to be reduced to 300 rpm by inserting a resistance in the armature circuit, determine its value and the power delivered to the fan. ***(05)***

6B Using relevant phasor diagram, discuss the behaviour of a cylindrical rotor synchronous motor supplying a constant load but operating under varying excitation conditions. ***(05)***