Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKEUP EXAMINATIONS, JAN 2016

SUBJECT: ELECTRICAL MACHINERY - II [ELE 204]

REVISED CREDIT SYSTEM

Time: 3 Hours | 14, January 2016 | MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.
- Graph sheets shall be supplied, if required.

1A. What are the advantages of stationary armature type of alternator over that of stationary field type alternator? ***2***

1B. Discuss the effect of load power factor on armature reaction of a synchronous generator with the aid of emf and mmf diagrams. ***3***

1C. A 4 MVA, 11 kV, 3-phase star connected alternator with a resistance of 0.3 Ω and reactance of 2.5 Ω per phase, delivers full load current at 0.8 pf lagging and normal terminal voltage to an infinite bus. Determine the excitation emf and load angle.
For the same power output, if the excitation is increased by 15%, estimate the new current and power factor. ***5***

2A. A 3 phase, 50 Hz, 1000 rpm, alternator has 108 slots. The armature winding is lap connected with a coil span of 160^{o}. Calculate
(i) pitch and distribution factors for fundamental, 3^{rd} harmonic and 7^{th} harmonic
(ii) order of harmonic with zero pitch factor ***3***

2B. A 3 phase, 6600 V, 50 Hz star connected alternator gave the following readings during open circuit test:

Field current in Amp	3.2	5.0	7.5	10.0	14.0
Open Circuit Phase voltage in Volt	1790	2830	3800	4330	4760

A field current of 3.2 A circulated rated armature current of 500 A during short circuit test. Given the armature resistance as 0.2 Ω per phase, calculate full load voltage regulation at 0.8 pf lagging by MMF method. ***7***

3A. What are the essential conditions to be satisfied for successful synchronization of incoming 3 phase alternator with bus bars? ***2***

3B. The governor characteristics of two alternators A and B are as follows:
A: No load – 52.5 Hz, Full load of 800 kW – 49 Hz
B: No load – 52.5 Hz, Full load of 700 kW – 50 Hz
Calculate the share of load from each machine to supply a total load of 600 kW and the common frequency. ***3***

3C. Two 3 phase, 50 Hz, star connected synchronous generators connected in parallel supply a common load of impedance (8+j6) Ω per phase. The excitation emf of the machines are (4937.6+j0) and (5899–j1.55) volts per phase respectively. The synchronous impedances are (0.5+j10) Ω and (0.4+j12) Ω per phase respectively.
Determine (i) common terminal voltage and (ii) the current and power factor of each machine. ***5***

4A. A 3 phase, 50 Hz, 400 V, 6 pole, star connected synchronous motor has a per-phase resistance and synchronous impedance of 0.5 Ω and 4 Ω respectively. It takes a current of 60 A at 0.9 pf leading with a certain field current. If the load torque is decreased until the line current is 45 A, the field current remaining unchanged, find the gross torque developed and the new power factor. ***6***

4B. A 3 phase, 50 Hz, 6.6 kV, 1000 rpm star connected synchronous motor has a synchronous reactance of 10 Ω per phase with negligible resistance. For certain excitation the power input is 900 kW and induced emf is 5100 V per phase. Calculate (i) torque angle (ii) line current (iii) power factor (iv) Synchronizing power for a mechanical displacement of 0.6^0 ***4***

5A. Why a synchronous motor is not self-starting? Explain the working principle of using damper windings for starting synchronous motor. ***3***

5B. A 1000 kVA, 3 phase, 480 V, 50 Hz star connected salient pole alternator has its direct and quadrature axes reactance of 0.1 Ω and 0.075 Ω per phase respectively with negligible armature resistance. When it is delivering full load to an infinite bus, calculate % voltage regulation (i) at 0.8 pf lagging (ii) at unity pf. ***4***

5C. An industrial plant is supplied with 875 kVA of electrical power at 0.8 pf lagging from a 3 phase, 50 Hz, 11kV substation. A synchronous motor of rating 100 kVA operating at a leading pf of 0.6 is added during expansion.. Calculate the new kVA supplied and overall pf of the plant. ***3***

6A. Design the core diameter, gross axial length, net iron length, armature peripheral speed of 500 KVA, 6.6 kV, 12 Pole, 500 rpm, 3 phase star connected alternator using the following parameters:
Average air gap flux density = 0.6 Wb/m^2; Amp-conductor/m = 30000;
Axial length = 65 % of Pole pitch; Winding factor = 0.955 ***4***

6B. A 25 KVA, 6600/400 V, 50 Hz, 3 phase, delta/star, 2-stepped core type transformer has the following preliminary data:
Emf per turn = 2.25; Maximum flux density in core = 1.1 Tesla; Current density = 2.3 A/mm^2; Window space factor = 0.3; Yoke cross sectional area is 10 % more than that of Core; Window height/Window width = 3.5;
Design (i) no. of turns and cross section of LV and HV windings, (ii) core and yoke dimensions ***6***