Kafrelsheikh University
Faculty of Engineering
Final Exam of 2nd semester-2016-2017
Department of Electrical Engineering
Subject: **Electrical Machine 4 (S.M.)** course code: EPM4224 Full Mark: 90 Marks
Year: Fourth Electrical Power (R.2007) Number of pages: 2 Time allowed: 3 hours
Exam Date: 22/5/2017

Attempt to solve all questions

Q1: (15 Marks)

a) Mention the uses of damper windings in a synchronous machine?

b) The stator of a 3-phase, 16-pole alternator has 144 slots and there are 4 conductors per slot connected in two layers and the conductors of each phase are connected in series. If the speed of the alternator is 375 r.p.m., calculate the e.m.f. inducted per phase. Resultant flux in the air-gap is 5×10^{-2} webers per pole sinusoidally distributed. Assume the coil span as 150° electrical..

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Q2: (15 Marks)

a) Name the various methods for predetermining the voltage regulation of 3-phase Alternator.

b) A synchronous generator 10 kV, 220 V 50 Hz, 3-phase, 1200 rpm, Y-connected has an effective resistance of o.4 Ω, and synchronous reactance of 5 Ω. The field winding resistance is 4.5 Ω. When the generator operates at the full load and 0.8 pf (lag.) the field winding current of 5 A. the rotational loss is 500 W. determine (i) the generator efficiency. (ii) The prime mover torque.

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Q3: (15 Marks)

a) Explain the phasor diagram of a loaded alternator on (*i*) Lagging pf, (*ii*) Leading pf, (*iii*) Unity pf.

b) A three-phase, 350 kVA, 3300 V, 60 Hz, 6- pole, Y-connected synchronous machine, with a cylindrical rotor type and all losses can be neglected. Its X_s is 10 Ω.

i. When the machine operates as a generator delivering full-load at rated voltage and with a lagging pf of 0.9, construct the circle diagram and hence determine the excitation voltage and the load angle.

ii. With the excitation voltage adjusted to the same value as the terminal voltage, find the pf and efficiency when the machine is running as a generator delivering 80 A at rated voltage.

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Q4: (15 Marks)

A 2300-V, three phase, 60 Hz, star-connected cylindrical synchronous motor has a synchronous reactance of 11 Ω per phase. When it delivers 200 hp, the efficiency is

found to be 90% exclusive of field loss, and the power-angle is 15 electrical degrees as measured by a stroboscope. Neglect ohmic resistance and determine:

(a) the induced excitation per phase.

(b) the line current

(c) the power factor

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Q5: (15 Marks)

A 22 KV, 3 phase star-connected turbo- alternator with a synchronous impedance of 1.4 Ω/phase is delivering 240 MW at unity p.f. to a 22 KV grid. If the excitation is increased by 25%, then the turbine power is increased till the machine delivers 280 MW. Calculate the new current and power factor.

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Q6: (15 Marks)

a) Explain clearly what is meant by synchronous impedance of an alternator and how it can be determined experimentally. How does the value of regulation as calculated by synchronous impedance method compared with that obtained from an actual load test and why.

b) Two identical 2 MVA alternators operate in parallel. The governor of the first machine is such that the frequency drops uniformly from 50 Hz on no-load to 47.5 Hz on full-load. The corresponding uniform drop of the second machine is 50 Hz to 48 Hz. How will they share a load of 3 MW.

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With my best wishes
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