



UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 6 Examination in Engineering: November 2014

Module Number: EE6320

Module Name: Electrical Machines and Drives

[Two Hours]

[Answer all questions, each question carries 7.5 marks]

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- Q1 a) Explain why short pitch windings are preferred over full pitch windings?
[1 Mark]
- b) Define and state the expressions for,
i) pitch factor
ii) distribution factor
[2 Marks]
- c) In a three-phase, star connected alternator, there are two coil sides per slot and 16 turns per coil. Armature has 288 slots on its periphery. When driven at 250 r.p.m., it produces 6600 V between the lines at 50 Hz. The pitch of the coil is two slots less than the pole pitch. Calculate the flux per pole of the machine.
[4.5 Marks]
- Q2 a) i) Discuss the necessity of parallel operation of transformers.
ii) State the conditions for satisfactory parallel operation of three-phase transformers.
[3 Marks]
- b) Two single-phase transformers (transformer A and transformer B) are connected in parallel to a load of $(2+1.5j) \Omega$. The equivalent impedances of the transformer A, referred to the secondary is $Z_A = (0.15+0.5j) \Omega$ and the equivalent impedance of the transformer B, referred to the secondary is $Z_B = (0.1+0.6j) \Omega$. No-load secondary terminal voltages of the two transformers are $E_A = 207 \angle 0^\circ$ V and $E_B = 205 \angle 0^\circ$ V. Find the power output and the power factor of each transformer.
[4.5 Marks]
- Q3 a) i) What are the advantages of a bank of three-phase transformers over a single three-phase transformer unit?
ii) State the different forms of connections used in three-phase transformer banks with their applications.
[3 Marks]

- b) Three single-phase, 100 kVA, 6600/1100 V transformers are delta connected on the primary and star connected on the secondary to provide electric power to a residential area. The primary resistance per phase is 1.8Ω and secondary resistance per phase is 0.025Ω . Assuming the iron loss as 15 kW, determine the efficiency when the secondary is supplying the full load at 0.8 power factor.

[4.5 Marks]

- Q4 a) i) What is the necessity of parallel operation of generators?
ii) How does an increase in excitation of a synchronous generator which is connected to an infinite bus bar, affects its operation?
iii) How does the change in prime mover input to a synchronous generator which is connected to an infinite bus, affects its operation?

[3 Marks]

- b) G_1 and G_2 are two 500 kVA synchronous generators operate in parallel to supply the following loads.

1. 250 kW at 0.9 power factor lagging
2. 300 kW at 0.75 power factor lagging
3. 150 kW at 0.8 power factor lagging

G_1 generator supplies 100 kW at 0.8 power factor lagging.

- i) Calculate the real and reactive power supplied by the two generators.
- ii) Calculate the power factor of the G_2 generator.

[4.5 Marks]