UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 6 Examination in Engineering: October 2015

Module Number: EE6320   Module Name: Electrical Machines and Drives (O/C)

[Two Hours]

[Answer **all questions**, each question carries **7.5 marks**]

Q1 a) Explain why the double layer windings are preferred compared with the single layer windings.

[1 Mark]

b) Define and state the expressions for,
   i) pitch factor
   ii) distribution factor

[2 Marks]

c) Design and draw a developed winding table for a three phase, double layer, 4-poles and 48 slots machine. Assume that the coils are short pitched by 1 slot.

[1.5 Marks]

d) A three phase, six poles and 50 Hz alternator has 12 slots per pole and 4 conductors per slot. The winding is 5/6 short pitched and the flux per pole is 1.5 Wb. The armature coils are connected in series with star connection. Calculate the induced electro motive force (e.m.f.) per phase.

[3 Marks]

Q2 a) i) Explain the necessity of parallel operation of transformers.

   ii) Explain in brief, the necessary conditions that are required for reliable parallel operation of transformers.

[3 Marks]

b) Two single phase transformers are connected in parallel to supply a load. If the transformers have equal voltage ratios, determine the load division between the two transformers.

[2 Marks]

c) A load of 450 kVA at 0.8 p.f. lagging is to be shared by two three phase transformers with equal ratings. The equivalent impedances of the transformers referred to the secondary are (1.5 + 5 j) and (1.5 + 4.5 j) respectively. Calculate the load shared by each transformer.

[2.5 Marks]

Q3 a) i) Three phase transformer banks can be used to transform the three phase voltages to appropriate voltage levels. Explain how the three phase voltage transformation can be accomplished using only two single phase transformers.

ii) "In three phase transformers primary and secondary windings are infrequently connected in Y-Y combination". Comment on this statement.

iii) List the advantages and disadvantages of autotransformers compared to two winding transformers.

[4 Marks]

b) A three-phase transformer bank has a delta connected primary and a star connected secondary working on 50 Hz supply. The line voltage on primary and secondary are 400 V and 6.6 kV respectively. The line current on the primary side is 8 A and secondary side has a balanced load of 0.6 p.f. lagging. Calculate the output of the transformer and the line current on the secondary side.

[3.5 Marks]

Q4 a) i) What is meant by synchronization of a generator?

ii) Briefly explain the three light bulb method used in synchronization of generators.

iii) Consider two generators with similar generating capacities which are operating in parallel. Explain how the power sharing of these two generators can be adjusted independent of the system frequency?

[3 Marks]

b) Two identical 2000 kVA synchronous generators are operating in parallel. The first machine has a uniform frequency drop from 50 Hz on no-load to 48 Hz on full-load. The corresponding uniform frequency drop of the second machine is 50 Hz to 47. 5 Hz.

i) How will the two machines share a load of 3000 kW?

ii) What is the maximum load at unity power factor that can be delivered without overloading any of the machines?

[4.5 Marks]