

UNIVERSITY OF ENERGY AND NATURAL RESOURCE
SCHOOL OF ENGINEERING
COMPUTER ENGINEERING
ELNG 108 ELECTRICAL MACHINES
 Second Semester mid Exams *APRIL 2016*

Attempt ALL Questions. TIME: 50mins

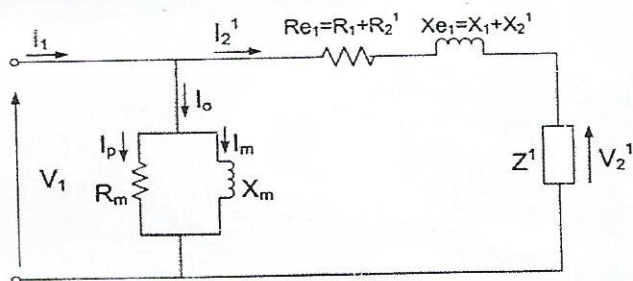
Q1. An 8 pole DC shunt generator with 778 wave connected armature conductors and running at 1000 rpm supplies a load of 12.5Ω resistance at a terminal voltage of 250V. The armature resistance is 0.24Ω and the field resistance is 250Ω . Determine:

- a. the armature current;
- b. The induced emf;
- c. The flux per pole.

[10 marks]

Q2. A transformer is rated 10 kVA, 60Hz. The parameters for the approximate equivalent circuit shown below are $R_m = 80k\Omega$, $X_m = 35k\Omega$, $R_{e1} = 8.4\Omega$, $X_{e1} = 13.7 \Omega$, $N_1=350$ and $N_2=50$. The rated secondary full load current is 10A at 0.8 lagging PF. If the applied voltage to the primary is 2500V, determine the secondary terminal voltage. What is the input power factor?

[10 marks]



Q3. A short shunt compound generator delivers a load current of 30A at 220V and has armature, series and shunt field resistances of 0.05, 0.30 and 200 ohm respectively. Calculate the induced emf and the armature current. Allow 1.0 V per brush for contact drop **[5 marks]**

Q4. A DC series motor takes 40A at 220V and runs at 800rpm. If the armature and series field resistances are 0.2Ω and 0.1Ω respectively and the iron and friction losses are 0.5kW, find the torque developed in the armature. What will be the output of the motor? **[10 marks]**

SECTION C – Answer question one and any other two questions. DURATION: 1hr: 30mins

16. (a) (i) With the aid of a diagram, explain the torque speed characteristics of a DC induction motor. [2 marks]
(ii) What is commutation in DC MACHINES? [2 marks]
- (b) (i) Briefly explain the principle of operation of electrical transformers [3 marks]
(ii) State three types of losses associated with a practical transformer [3 marks]
- (c) An 8 pole DC shunt generator with 778 wave connected armature conductors and running at 1000 rpm supplies a load of $12.5\ \Omega$ resistance at a terminal voltage of 250V. The armature resistance is $0.24\ \Omega$ and the field resistance is $250\ \Omega$. Determine:
(i) The armature current; [2 marks]
(ii) The induced emf; [2 marks]
(iii) The flux per pole [2 marks]
- (d) A DC series motor takes 30A at 220V and runs at 800rpm. If the armature and series field resistances are $0.2\ \Omega$ and $0.1\ \Omega$ respectively and the iron and friction losses are 0.5kW, find the torque developed in the armature. [4 marks]
17. (a) State three methods of achieving speed control in a DC motor. [3 marks]
- (b) A short shunt compound wound generator running at 16.67rps supplies 11kW at a terminal voltage of 220V. The resistances of the armature, shunt and series field windings are $0.05\ \Omega$, $110\ \Omega$, and $0.06\ \Omega$ respectively. The overall efficiency is 81.5%. Determine
(i) The total copper loss [4 marks]
(ii) The iron and friction losses [3 marks]
18. (a)(i) Briefly explain why the starting current of DC Motors is high [3 marks]
(ii) Suggest two innovative ways of reducing the starting current. [2 marks]
- (b) A 30kW, 400V shunt motor has an armature resistance of $0.15\ \Omega$.
(i) Calculate the value of a series resistor which will limit the starting current to 240A. [3 marks]
(ii) Determine the current the motor will take if started directly on line [2 marks]
19. (a) Define Slip of an induction machine [2 marks]
- (b) Why is lap wound DC machine suitable for high current, low voltage applications? [3 marks]
- (c) A transformer is rated 10 kVA, 60Hz. The parameters for the approximate equivalent circuit shown below are $R_m = 80k\ \Omega$, $X_m = 35k\ \Omega$, $R_{e1} = 8.4\ \Omega$, $X_{e1} = 13.7\ \Omega$, $N_1 = 350$ and $N_2 = 50$. Determine the voltage to be applied to the primary to obtain the rated current in the secondary of 41.67A when the secondary terminal voltage is 240V. The load power factor is 0.8 lagging [5 marks]