EXAMINATIONS – December 2016
Main Examination

Duration	: 2 H00
Max.Marks	: 70
Number of Questions	: 4
Number of pages	: 3

Examiner	: Dr. Chitra Venugopal
Moderator	: Dr. Remy Tiako

Instructions:

- ➢ Answer all questions
- ➢ No notes of any forms are allowed into the examinations
- ➢ Scientific calculator with erased memory is allowed

QUESTION 1: LINE COMMUTATED CONVERTERS

A single phase fully controlled bridge converter is used for regulating the DC output voltage. The input to the converter is 230V, 50Hz and it supplies continuous current of 4A to a RL load. The converter uses thyristor switches and the firing angle of the switches is maintained at $\pi/3$.

    a.   Derive equations for average output voltage   (4 Marks)

    b.   Calculate the average value of output voltage   (2 Marks)

    c.   Active and reactive power supplied to the load   (4 Marks)

    d.   Calculate the value of load resistance   (2 Marks)

    e.   If one of the SCR in the negative group is damaged and gets open circuited,

         i.   Derive equation for the average output voltage   (4 Marks)

        ii.   Calculate the value of average output voltage and output current. Assume the firing angle remains the same.   (4 Marks)

QUESTION 2: DC MOTOR DRIVE CIRCUITS

A separately excited dc motor is driven by a single phase full converter in the armature circuit and in the field circuit. The armature and field converters are supplied by the same supply voltage of 230V, 50Hz. The armature converter delay angle is $55°$ and the field converter delay angle is $45°$. The dc motor armature and field resistance values are 0.5Ω and 100Ω respectively. The motor voltage constant is 1.2V/A rad/sec. The motor armature current is 20A. Neglect the viscous friction and no load losses. Calculate

    a.   The speed in rpm   (11 Marks)

    b.   Torque developed   (3 Marks)

    c.   The total input power   (2 Marks)

    d.   If the polarity of the motor back emf is reversed, calculate the delay angle of armature circuit converter so as to maintain the armature current constant at the same level.   (4 Marks)

QUESTION 3: DC CHOPPERS

A solar panel supplies power to charge a 24V battery using a DC chopper operating at a switching frequency of 20kHz. During the day time the output from the solar panel varies between 8-16V. Consider all the components used in the chopper are ideal.

    a.   Design a suitable chopper which can successfully run this application   (2 Marks)

    b.   Derive the equation for output voltage and output current considering the converter is a lossless converter   (6 Marks)

    c.   Determine the minimum and maximum duty cycle required to obtain the specified output voltage   (2 Marks)

    d.   Determine the input current values if the required output power is 5W   (5 Marks)

e. Determine the minimum value of L that can keep the converter operating in a continuous conduction mode   (5 Marks)

QUESTION 4: AC VOLTAGE CONTROLLERS

In a light dimmer application, a single phase full wave voltage controller circuit with back to back thyristor switch is used. The supply voltage is 230V, 50Hz. The load resistance value is 5Ω and the thyristors are triggered at an angle($\alpha_1=\alpha_2$) of $\pi/2$. Determine the

    a. RMS value of load current   (2 Marks)

    b. Load power   (2 Marks)

    c. Input power factor   (2 Marks)

    d. The average value of thyristor current   (2 Marks)

    e. RMS value if thyristor current   (1 Marks)

    f. Calculate the maximum di/dt value in the thyristor   (1 Marks)