Menoufia University
Faculty of Engineering
Shebin El-Kom
Department of Electrical Engineering
Academic Year 2019/2020
Spring Semester, Final Exam

Level: M. Sc. Preparatory Studies
Course: Design of Power Electronics Circuits (ELE611)
Date: 09/08/2020
Time Allowed: Three Hours
Total Marks: 100

Answer the Following Five Questions:

Question (1) **(20 Marks)**

A series circuit consists of an A.C. supply 220V, 50 Hz, a switch, an inductor 0.2 H and a resistor 75 ohm. When the switch is closed at zero time, carry out the following;

i) **derive** an expression for circuit current.

ii) **determine**; (a) The extinction angle. (b) The average current. (c) The rms current.
(c) The power consumed by the load and input power factor.

Question (2) **(20 Marks)**

A single-phase fully-controlled thyristor converter feeding an *RL* load connected in series with a back emf *E*. Circuit data and load parameters are: $V = 220$ V, $f = 50$ Hz, $R = 1.5\ \Omega$, $L = 20$ mH and $E = 12$ V. For a trigger angle $\alpha = 60°$, carry out the following;

i) **Derive** an expression for the load current.

ii) **Determine** (a) the average thyristor current. (b) the rms thyristor current.
(c) the rms output current. (d) the average load current.
(e) the critical delay angle α_c.

Question (3) **(20 Marks)**

A type A dc-chopper is feeding an *RL* load connected in series with a back emf *E*. Source voltage $V = 220$ V, chopping period $T = 2$ ms, on period $= 1.0$ ms, load circuit parameters: $R = 5\ \Omega$, $L = 15$ mH and $E = 12$ V.

(a) Find whether load current is continuous or not.

(b) Determine the value of average output current.

(c) Determine the maximum and minimum values of steady state output current.

(d) Sketch the time variations of gate signal i_g, load voltage v_o, load current i_o, thyristor current i_T freewheeling diode current i_{fd} and voltage across thyristor v_T.

Question (4) **(20 Marks)**

(i) Derive expressions required to determine the filter parameters of an *LC* filter connected to the output terminals of a two-pulse single-phase rectifier feeding a resistive load.

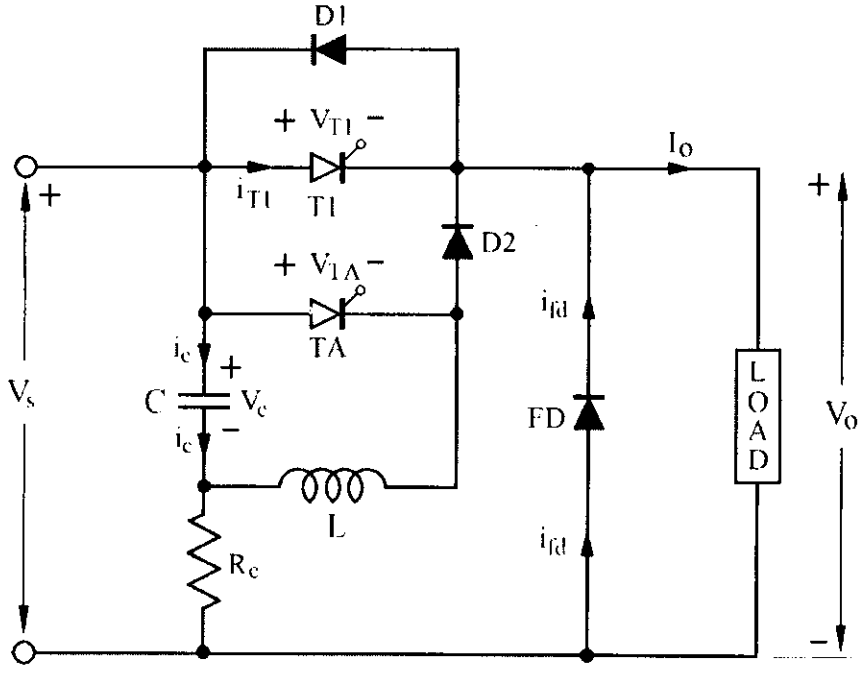
(ii) A single-phase two-pulse diode rectifier has input supply of 230 V, 50 Hz and a load resistance $R = 100\ \Omega$ and load inductance $L_L = 10$ mH. An *L-C* filter is to be used on the output side so as to reduce the output voltage ripple to 5%. Design the LC filter and determine the rms value of ripple voltage.

Question (5) **(20 Marks)**

For the forced commutated thyristor circuit shown in the below figure:

i) Derive mathematical expressions for the design of commutation parameters.

ii) If the source voltage is 230 V dc and turn-off time of the main thyristor is 40 μ.sec. Determine the values of L and C for a load current of 500 A. Give any assumptions required for successful and safe operation. Also determine the peak values of capacitor voltage and commutation current.



End of Exam Questions – Good Luck