جامعة المنوفية

Menoufiya University
Faculty of Engineering
Department of Electrical Engineering

Course: Power Electronics (1)- (ELE 616) *Date : 3/6/2017*
Time : 3-Hour *Marks : 100*

Post Graduate Exam (M.sc)

Answer the following questions:

Question (1) *(25-Mark)*

1.1) ***A*** **230 V, 960 rpm, 20 A, separately excited dc motor has armature circuit resistance and inductance of 1.2Ω and 50 m H respectively. The motor is controlled by a single-phase full-controlled rectifier with source voltage of 230 V, 50 Hz. Calculate no load speeds, and speeds and developed torques on the boundary between continuous and discontinuous conductions for** $\alpha = 45^0, and 135^0$.

1.2) ***A*** **single-phase full converter is connected to a 220 V, 50 Hz supply. The load current I_a can be assumed to be continuous and its ripple content is negligible.**

(a) Express the input current in a Fourier series; determine the harmonic factor of input current HF, displacement factor DF, and input power factor PF.

(b) If the delay angle is $\alpha = 60^0$, calculate V_{dc}, V_{rms}, HF, DF, and PF.

Question (2) *(25-Mark)*

2.1) ***A*** **three-phase full converter is supplied from a Y-connected 220 V, 50 Hz supply. The average output voltage is 180 V. The load current is 60 A and has negligible ripple.**

(a) Derive an expression for reduction of output voltage due to commutation.

(b) Calculate the percentage reduction of output voltage due to commutation if the inductance per phase is 0.5 mH. Draw the waveforms for the output voltage V_o.

2.2) ***A*** **single-phase full converter is operated with symmetrical angle control. The load current with an average value of I_a is continuous, where the ripple content is negligible.**

(a) Express the input current of the converter in Fourier series, and determine the harmonic factor HF of the input current, displacement factor DF, and input power factor PF.

(b) If the conduction angle is $\beta = 60^0$ and the peak input voltage is $V_m = 169.8$V, calculate V_{dc} V_{rms}, HF, and PF.

Question (3) *(25-Mark)*

3.1) A single-phase full-wave controller supplies an RL load. The input rms voltage is V=220 V, 50 Hz. The load is such that L=0.008 H and R=2.513Ω. The delay angles of thyristors are equal: $\alpha_1 = \alpha_2 = \frac{\pi}{3}$. Determine:

P.T.O.

(a) The conduction angle of thyristor, δ;
(b) The rms output voltage, V_o;
(c) The rms thyristor current, I_R;
(d) The rms output current, I_o;
(e) The average current of a thyristor, I_A;
(f) The input power factor PF.

(You can use the curves of figures 2and3).

3.2) *A* single-phase/ single-phase cycloconverter is supplying from 220V, 50 Hz source. The load resistance is 2.5 Ω and load inductance is L=20 mH. The frequency of output voltage is 20 Hz. If the delay angles are generated by comparing a cosine signal at source frequency with a sinusoidal reference signal at output frequency. Determine:

1-The rms output voltage;
2-The rms current of each thyristor;
3-The input power factor PF.

Question (4) *(25-Mark)*

4.1) Explain with aid of sketches the operation of the Buck-Boost converter of Fig. (1), assuming continuous load current $I_a=I_A$.

4.2) The input voltage of Buck-Boost converter in Fig.(1), V_s=12 V. The duty cycle K=0.25 and the switching frequency is 25 kHz. The inductance, L =150 μH and filter capacitance is C_2 =220 μF. The energy transfer capacitance C_1 =200 μF and inductance L_1 =200 μH. The average load current is I_a 1.125 A.

Determine the :

(a) Average output voltage, V_a;
(b) Peak-to-peak output voltage ripple ΔV_c;
(c) Peak-to-peak ripple current of inductor ΔI; and
(d) Peak current of the transistor, I_p.

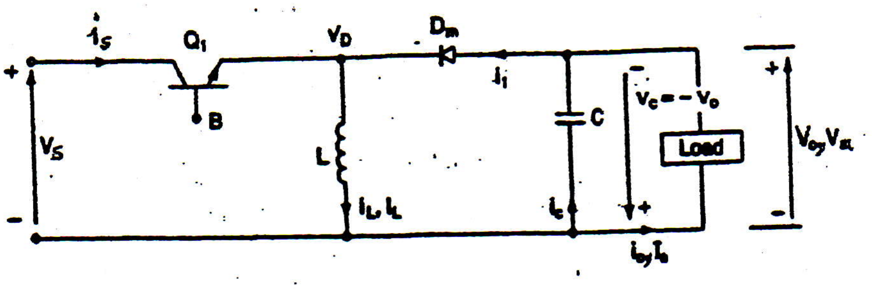

Figure (1) Buck-boost converter

Good Luck
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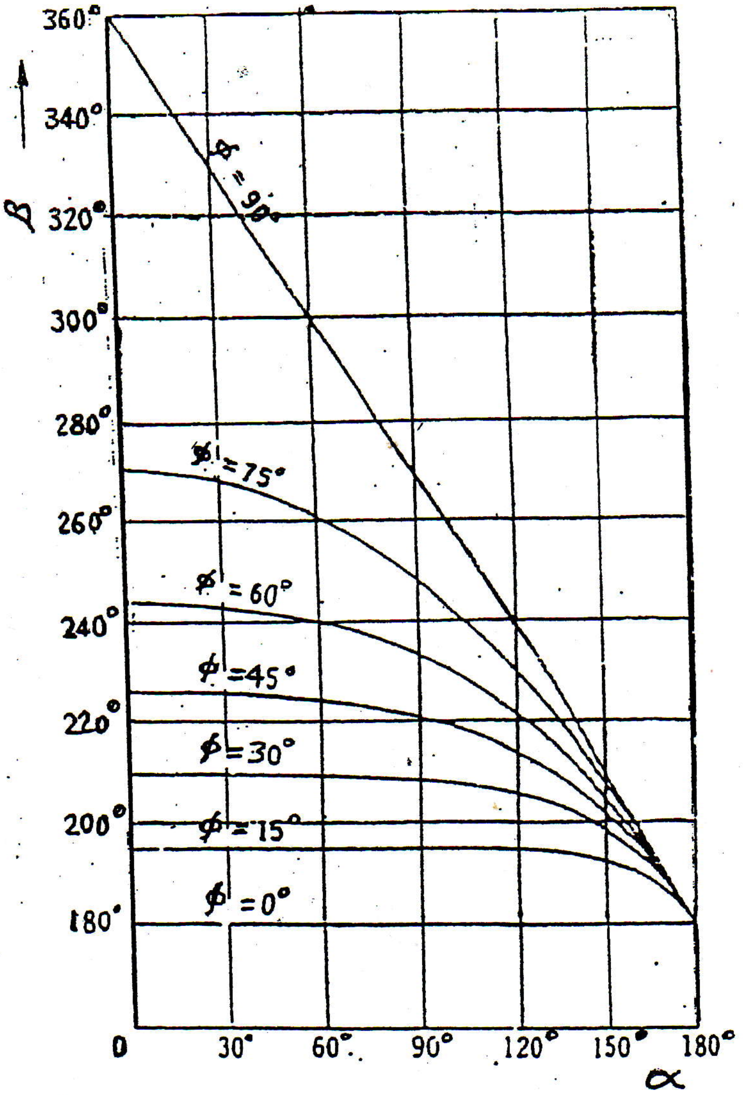

Figure (2)Relation between firing angle (α) and extinction angle (β) for various load angle (φ).

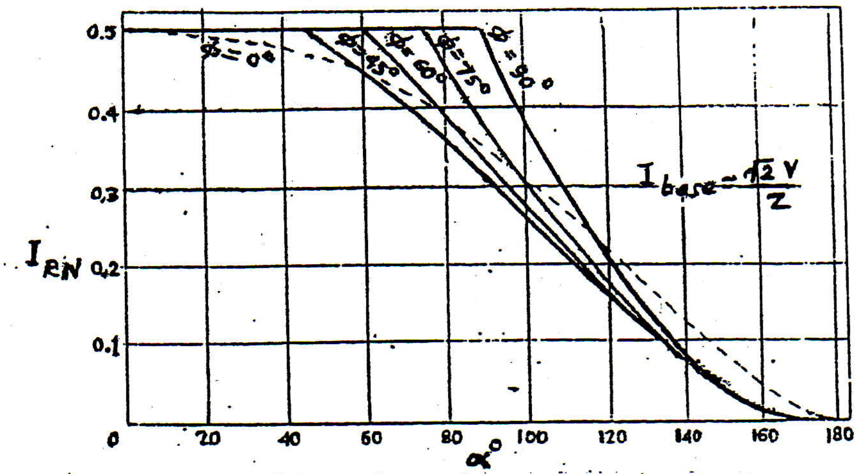

Figure (3) Normalized rms value of the thyristor current (I_{RN}) versus firing angle (α) for various load angle (φ).

Good Luck

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