

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014****Subject code: 1720709****Date: 23-06-2014****Subject Name: Advanced Power Converters****Time: 02:30 pm - 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Critically evaluate the operation of series loaded resonant (SLR) half-bridge DC-DC converter when operating with (i) $\omega_s < \frac{1}{2}\omega_0$ and (ii) $\omega_0 < \omega_s$ where ω_0 is the resonant frequency and ω_s is the switching frequency of the converter. **07**
- (b)** Draw the circuit configuration of Y/Z-1 configuration. If the number of turns of the primary winding is N_1 derive the necessary equations to determine the number of turns of other windings of these transformer. **07**
- Q.2 (a)** With appropriate waveforms and analysis, show how the harmonic cancellation can be achieved in a 12 pulse converter. **07**
- (b)** For the circuit given in Fig.1, $V_d = 42V$, $V_o = 14V$, Output power = 50W, $C_r = 50nF$, and $L_r = 2.5\mu H$. Assume that the inductor L_f maintains the constant output current and the switch and diode are ideal. Determine the switching frequency. **07**

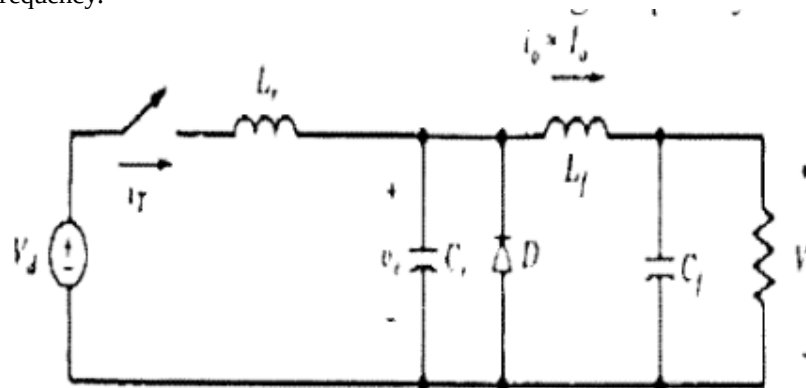


Fig. 1

Fig. 1
OR

- (b) With neat waveforms explain how the zero voltage switching is achieved in the converter shown below in Fig. 2. 07

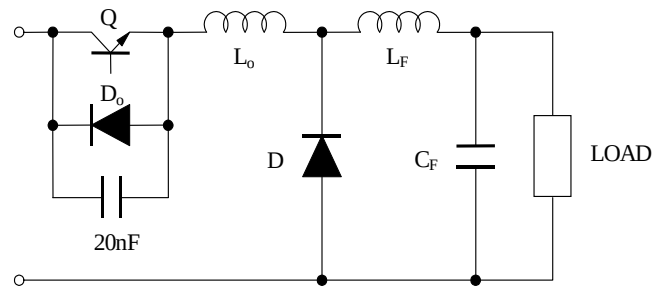


Fig.2

- Q.3 (a) Derive the equation for an inductor current in a series resonating circuit having a constant current type load connected across a capacitor. 07
- (b) State the two basic rules to be observed for operating the switches of a Matrix converter and hence, group the possible switching state combinations of a 3-phase Matrix converter. Also, discuss the significance of LC filter in context to the converter. 07

OR

- Q.3 (a) Discuss the different steps involved in the 4-step commutation of matrix converter. Clearly explain how the safe commutation from one phase to another phase is ensured by detecting the sign of the output current. 07
- (b) A 5-level CHB multi-level inverter is controlled by in-phase disposition, level shifted, carrier based PWM technique. For any one phase, draw the waveforms for the carrier waveform (frequency modulation index = 6), reference signal, gate signals, individual H-cell's output and output phase voltage waveform. 07

- Q.4 (a) With relevant analysis, obtain the magnitude and orientation for NPN, OPN, and POP vectors. Also, draw the entire space vector diagram for this inverter. Clearly mark the magnitudes of the vectors on the diagram. 07
- (b) List and explain the design criteria for the space vector control scheme used for Diode Clamped Multilevel inverter from the view point of achieving minimum switching losses and minimum deviation in neutral point voltage. 07

OR

- Q.4 (a) Write a brief note on the control of converters of HVDC transmission system. 07
- (b) Why is it essential to have a power electronic converter as an interface between a load and a PV array? Discuss the features that the power electronics converter must possess. 07
- Q.5 (a) With suitable block diagram discuss the control scheme for Doubly Fed Induction Generator based wind energy generation system. 07
- (b) Compare SVC, STATCOM and the passive filters in terms of their capability as shunt compensating device to match average and instantaneous reactive power required by the load. 07

OR

- Q.5 (a) Comment on the number of switches, capacitors, diodes (besides diodes connected in anti-parallel with the switches) and sources for 5-level three-phase CHB, NPC and Flying capacitor multilevel inverters. 07
- (b) Show the block diagram of HVDC transmission system and discuss the significance of each block. 07
