Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER 2012

Subject code: 1720709 **Date: 02-01-2013**

Subject Name: Advanced Power Converters

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

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

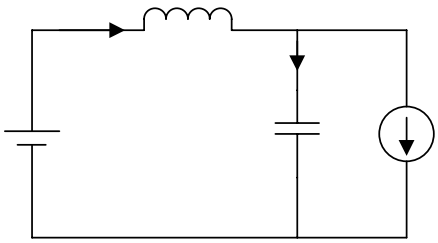
Q.1 **(a)** Discuss the significance of a phase shifting transformer for a multi-pulse converter application. With detailed mathematical analysis for any one appropriate phase shifting transformer configuration explain how a phase shift of -15° can be obtained. **07**

(b) Explain in brief why resonant converters are needed? Also, draw the switching loci (characteristics representing current through switch v/s. voltage across switch) for the switch when operating under following conditions (i) with snubber circuit (ii) with ZCS and ZVS and (iii) when snubber or ZCS/ZVS is not employed. **07**

Q.2 **(a)** Explain the operation of series loaded resonant (SLR) half-bridge DC-DC converter when operating with the condition $\frac{1}{2}\omega_0 < \omega_S < \omega_0$. **07**

(b) Derive the following equation for series-resonant circuit with a capacitor-parallel load where I_{L0} and V_{c0} are initial conditions (values at t = 0) for inductor current and capacitor voltage, respectively. **07**

$$i_L(t) = I_o + (I_{Lo} - I_o)\cos\omega_o(t - t_o) + \frac{V_d - V_{co}}{Z_o}\sin\omega_o(t - t_o)$$



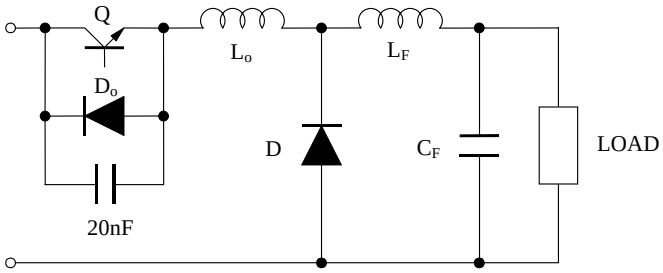
OR

(b) The Zero Voltage Switching (ZVS) forward converter shown below works with a range of load currents from 5A to 15A. The supply voltage is 40V and the load voltage is 20V. You may assume that the output filter inductor current is smooth. **07**

(i) Determine the value of L_O if it is chosen so that ZVS is just possible at the minimum load current.

(ii) Calculate the converter operating frequency when operating at 5A output.

(iii) Calculate the peak voltage across the transistor when operating at maximum load current.



Q.3	**(a)**	What do you mean by instantaneous reactive power? How can the instantaneous reactive power need of a load be compensated using a power converter? Show the detailed scheme alongwith brief description of the scheme.	**07**
	(b)	Why does one require bi-directional switches for a matrix converter? How can such bi-directional switches be obtained? Also, critically evaluate/compare these bi-directional switches.	**07**
		OR	
Q.3	**(a)**	In context to a Matrix converter write a brief note on the safe commutation techniques.	**07**
	(b)	Compare the various multi-level converter configurations in terms of the number of components (i.e. number of switches, diodes, capacitors, sources etc.) utilized.	**07**
Q.4	**(a)**	Draw the space vector diagram for a 3-level NPC (diode clamped) inverter. Also, list the switching sequence to generate the reference vector located in different regions of sector 1.	**07**
	(b)	Draw a one line diagram of an HVDC transmission system for interconnecting two ac systems. Also explain the functions of each component involved in it.	**07**
		OR	
Q.4	**(a)**	Write a brief note on UPQC.	**07**
Q.4	**(b)**	Write a brief note on 5-level NPC/H-bridge inverter.	**07**
Q.5	**(a)**	Write a brief note on control of HVDC receiving and transmission terminals.	**07**
	(b)	Distinguish between mechanical and electrical tracking in relation to Photovoltaic System and hence, discuss any one MPPT method electrical tracking.	**07**
		OR	
Q.5	**(a)**	Explain the principle of level and phase shifted PWM strategies for cascaded multi-level inverter and critically evaluate these control strategies in terms of their advantages and disadvantages.	**07**
	(b)	Discuss in brief the factors that lead to the deviation in neutral point voltage of an NPC converter. Also, discuss the control scheme for minimizing this deviation.	**07**

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