Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**ME SEMESTER II EXAMINATION – SUMMER 2017**

**Subject Code: 2720709** **Date: 29/ 05 /2017**

**Subject Name: Advanced Power Converters**

**Time:02:30 PM to 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)** With neat diagram and waveforms, explain the operation of series loaded resonant half -bridge DC-DC converter in discontinuous conduction mode. What will be the effect on the output current if the load is changed? **07**

**(b)** Classify different control schemes for MLI. Explain IPD carrier based modulation scheme for controlling 5-level cascaded H bridge inverter with relevant waveforms.

**Q.2** **(a)** What does one mean by multi-pulse converter? What are its advantages? With appropriate block-diagram explain how a 24 pulse converter can be obtained. Clearly indicate the type of phase shifting transformer used with the corresponding phase shift. **07**

**(b)** The ZVS switched resonant BUCK converter has an input voltage of 12V and supplies a resistive load with current of 3A. The values of resonant inductor $L_r$ and resonant capacitor $C_r$ are 2 µH and 79 nF, respectively. The switching frequency $f_s$ is 200kHz. The output inductor and capacitor are 10 mH and 100 µF, respectively. Determine (a) the average output voltage, $V_o$ (b) the duration for which the resonant capacitor is charged linearly and (c) the peak voltage across the resonant capacitor. **07**

**OR**

**(b)** Discuss in brief the significance of Y/Z transformers in context to the multi-pulse converters and derive the necessary equations for a Y/Z-1 configuration that helps to determine the number of turns to achieve the desired phase shift. **07**

**Q.3** **(a)** 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**

**(b)** With neat waveforms discuss the operation of ZCS Resonant Switched Buck Converter. **07**

**OR**

**Q.3** **(a)** Write a brief note on any one control technique used to operate a 3-phase Matrix converter. **07**

**(b)** Suggest a suitable transformer configuration to eliminate harmonics below 10th order in the input line current for a HVDC transmission. Also, derive an equation for primary current of transformer. **07**

**Q.4** **(a)** Draw space vector diagram for three-level NPC MLI. Explain the seven segment switching scheme considering reference vector located in region-4 of sector-I. **07**

**(b)** Draw the circuit diagram of cascaded H-bridge Multilevel Inverter considering two H-bridge with unequal DC voltage. How many maximum levels are possible? Mention the switching table for obtaining different levels. **07**

**OR**

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|---|---|---|---|
| **Q.4** | **(a)** | 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** |
| | **(b)** | Draw the circuit configuration for 5-level CHB multilevel inverter. Specify the voltage levels and corresponding switching table. Comment on the number of switches and diodes (besides the anti-parallel diodes to the switches) for NPC inverter against that of CHB multilevel inverter. Also comment on the number of carrier and modulating signals required for these inverters when operating with level shifted carrier based PWM. | **07** |
| **Q.5** | **(a)** | Explain the need of MPPT in PV system. Explain Perturb and Observe Algorithm using Boost converter as MPP Tracker. | **07** |
| | **(b)** | Classify and compare different grid connected PV inverter configurations. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | With the help of relevant characteristics, discuss in brief the need of MPPT control of a Wind Energy Conversion System. | **07** |
| | **(b)** | Write a brief note on STATCOM and explain how it differs from SVC. | **07** |

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