Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– I (OLD course)• EXAMINATION – SUMMER 2015

Subject Code: 710702 **Date:12/05/2015**

Subject Name: Advanced Power Electronics

Time: 10:30 am to 1:00 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)** Draw and explain static *V-I* characteristics and transfer characteristics of Power MOSFET. **07**

(b) Draw the circuit of buck converter and explain its working in DCM when operating with constant input voltage V_d. Also derive the expression, **07**

$$\frac{V_0}{V_d} = \frac{D^2}{D^2 + \frac{1}{4}\left(\frac{I_o}{I_{LB,max}}\right)}$$

Q.2 **(a)** With neat diagram and necessary waveforms, explain the working of Ļuk converter. Derive the expression for output voltage. **07**

(b) (i) Compare SMPS with linear voltage regulator. **07**

(ii) Forward converter and DC-DC bridge converters (half-bridge or full bridge) are in-fact isolated buck converter. Which of these topologies is better? Justify your answer.

OR

(b) With necessary discussions and derivation justify the following statement: **07**

ñWhile operating with modulation index less than or equal to 1, output voltage of SVPWM is about 15% higher than that operating with SPWMò.

Q.3 **(a)** With neat waveforms explain the operation of 3-phase bridge inverter having 150° conduction mode control. Discuss how it incorporates the features of both 180° and 120° conduction modes. **07**

(b) With relevant waveforms and circuit, explain the operation of 3-phase bi-directional (full wave) AC voltage controller operating with firing angle Ŭ = 120° and feeding star connected resistive load. **07**

OR

Q.3 **(a)** In a 1-phase ASCI, with load L, SCRs T_3 and T_4 are conducting a constant current I = 10A. If T_1 and T_2 are turned on at t = 0s to force commutate T_3 and T_4; find the time required for the load current to fall to zero. Load L = 10 εH and commutating capacitance C = 6 εF. Find also the total commutation interval and the circuit turn off time for each SCR. **07**

(b) Write a brief note on selective harmonic elimination technique. **07**

Q.4 **(a)** A single-phase H-bridge inverter is triggered using a sine PWM control strategy. If amplitude modulation index is adjusted to unity and if frequency modulation index = 11 (eleven), show the harmonic spectrums for the output voltage for following cases: (i) Unipolar PWM and (ii) Bipolar PWM. **07**

(b) Write a brief note on the factors that decide the quality of output voltage in a Cyclo-converter. **07**

OR

Q.4	**(a)**	Draw the circuit for 3-phase to 1-phase cyclo-converter and discuss its principle of operation in brief.	**07**
	(b)	Draw and explain a gate driver circuit for firing a MOSFET operating at low speed/low-switching frequency.	**07**
Q.5	**(a)**	Comment on how to achieve the four quadrant operation with conventional VSI. How is CSI superior to VSI in this aspect?	**07**
	(b)	What does one mean by óArea Productô?. List the steps involved in obtaining óArea-Productô for high frequency transformer used with forward converter.	**07**

OR

Q.5	**(a)**	A single-phase AC voltage controller (having two anti-parallel connected SCRs) is feeding an R-L load having a load power factor angle ū . If the SCRs are triggered at a firing angle Ŭ < ū , sketch the waveforms for output voltage and current for following cases: (i) if a single pulse with pulse width slightly more than thyristor turn off time) is used for firing (ii) if pulse train is used for triggering SCRs.	**07**
	(b)	State the important differences in the functioning and design of transformers and inductors used for DC-DC converters. Also list the steps involved in the design of inductor of DC-DC converters.	**07**

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