



SF-7763

B. E. - IV (E) (Sem. - VIII) Examination

May/June - 2011

**Advanced Power Electronics
(Elective)**

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दर्शावेक निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 4 (E) (SEM. - 8)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="ADVANCED POWER ELECTRONICS"/>	<input type="text" value="Student's Signature"/>
Subject Code No. : <input type="text" value="7"/> <input type="text" value="7"/> <input type="text" value="6"/> <input type="text" value="3"/>	
Section No. (1, 2,.....) : <input type="text" value="1&2"/>	

- (2) Attempt all questions.
- (3) Answer to the two sections must be written in separate answer books.
- (4) Any type of calculator can be used.
- (5) Figures to the right indicate marks.

Section - I

- 1 Answer in one or two sentences. Each question carries one mark. (10)
- (a) How can the ripple in the output voltage of the dc-dc converter be minimized?
 - (b) State the factors which decide the continuous or discontinuous mode of operation for the converters.
 - (c) Mention the purpose(s) of using a transformer in a flyback type of SMPS.
 - (d) What is ESR ? What is its effect in dc-dc converter ?
 - (e) In which class can one categorize the push-pull converter: (a) with unidirectional excitation or (b) with bi-directional excitation ?
 - (f) Mention the range of firing angle for which the thyristor controlled inductor can work as a variable inductor.
 - (g) From practical considerations, what is the firing angle range for a converter (rectifier terminal) of a HVDC transmission system ?
 - (h) Why thyristor controlled inductors can not provide instantaneous VAR regulation ?
 - (i) Draw a current sink type load.
 - (j) Comment on the power factor of current sink type load with a voltage source.
- 2 (a) A Cuk converter is to supply a load of 10 A at 150 V from a dc source of 50 V. Estimate the required values of each component if the switching frequency is 25 kHz. Make calculations based on the following assumptions. (6)
- Peak to peak ripple current in L_1 and $L_2 = 1$ A.
Peak to peak ripple voltage in $C_1 = 10$ V.
Peak to peak ripple voltage in $C_2 = 1$ V.

- (b) Discuss the method to achieve the voltage regulation in case of SMPS with multiple outputs. Also briefly explain how the dynamic cross regulation can be improved. (4)

3 **Attempt any three from the following.** (18)

- (a) 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.
- (b) Write a brief note on heat sink design for power semiconductor switches.
- (c) Distinguish between Online UPS and Standby UPS. Also with a one line diagram, explain the working of Online UPS.
- (d) The input voltage for forward converter is 160 V. The converter transformer has 120 turns in primary. Switching frequency is 50 kHz. Duty cycle is 25 %. Feedback winding has 120 turns. Determine following
- (i) Maximum blocking voltage of the static switch.
 - (ii) Waveform of voltage across primary winding
 - (iii) Waveform of voltage across feedback winding.
- (e) (i) Draw a circuit diagram that is capable of accepting 115 V AC or 230 V AC input and gives same DC output voltage. (Detailed explanation is not required. But figure should clearly indicate under what conditions/arrangements the circuit works with 115 V). (2 marks)
- (ii) List the various methods to provide protection against inrush current in SMPS during the turn-on and explain any one in brief (4 marks)

- 4 (a) What is Power Factor Pre-Regulator (PFP)? Which dc-dc converter is very commonly used as a PFP? Explain the control scheme to operate this PFP to achieve unity power factor. (6)
- (b) An inductive load is supplied from a single phase, 230 V, 50 Hz ac supply. The load current varies between the two extreme limits 4 A and 6-j12 A. A thyristor controlled reactor (TCR) is installed to compensate for the reactive power, thus making the power factor equal to unity for a load current of 4-j4 A. Find the firing angle for this unity power factor operation. (6)

OR

- 4 (a) What is an Active Filter ? Explain in brief about various active filter and their applications. (7)
- (b) An HVDC transmission system is rated at 250 MW, ± 250 kV and the converter uses 12-pulse converter arrangement. Determine the RMS current and peak reverse voltage of each thyristor. (5)

Section – II

- 5 (a) Draw block diagram of closed speed control of DC motor and explain only the significance of the inner current control loop of the block diagram. (5)
- (b) The speed of a 100 kW, 1000 rpm, separately excited DC motor is controlled by a 3 phase full converter. The specifications of the converter are 460 V, 300 A. The input to the converter is a 3-phase, 415 V, 50 Hz ac supply. Determine
- (i) Firing angle of the converter and the power factor at the rated speed.
 - (ii) Firing angle and the power factor at the 10 % of rated speed.
 - (iii) Active and reactive power drawn from the system at the rated speed.

- 6 (a) Draw the equivalent circuit of MCT and explain its operation. (6)
 (b) Write a brief note on Power Integrated Circuits. (6)

OR

- 6 (a) Draw and explain the I-V characteristics of Power BJT. Also explain the working and significance of monolithic darlington connected BJT pairs. Discuss the need for additional diodes with it. (7)
 (b) What are cascade drive circuits? Discuss one such circuit. (5)

7 **Attempt any three from the following** (18)

- (a) Explain the speed control of dc shunt motor operating with step-down chopper. Clearly show the discontinuous and continuous mode operation on the speed-torque curve at various duty ratios.
- (b) A Y connected squirrel cage induction motor has following ratings and parameters 440V, 50 Hz, 4 pole, 1370 rpm, $R_s = 2 \Omega$, $R_r' = 3 \Omega$, $X_s = X_r' = 3.5 \Omega$. Motor is controlled by VSI at constant V/f ratio. Inverter allows frequency variation from 10 to 50 Hz. For regenerative braking of induction motor drive. Determine
 (i) Speed for frequency of 30 Hz. And 80 % of full load torque.
 (ii) Frequency for a speed of 1000 rpm and full load torque.
 Torque for a frequency of 40 Hz and speed of 1300 rpm.
- (c) A three phase, 400 V, 50 Hz, 4 pole, 1450 rpm, star connected squirrel cage Induction Motor has the following parameters per phase when referred to the stator.
 $R_s = 0.11 \Omega$, $R_r' = 0.09 \Omega$, $X_s = 0.4 \Omega$, $X_r' = 0.6 \Omega$ and $X_m = 12 \Omega$.
 The motor is controlled by a six-step inverter. The dc input to the inverter is provided by a six pulse, fully controlled rectifier.
 (i) Find the firing angle for the rectifier to get the rated fundamental voltage across the motor. The rectifier is fed by an ac source of 400 V, 50 Hz.
 (ii) If the machine is operated by constant flux then determine, the inverter frequency at 560 rpm and rated torque while operating with V/f control.
- (d) Discuss the effects of non-sinusoidal excitation (occurring due to the presence of high frequency components in the inverter output voltage) on the performance of an Induction motor.
- (e) (i) List the disadvantages of the static slip power recovery scheme.
 (ii) Why a transformer is essential in a static slip power recovery scheme ?
 (iii) Why stator voltage control is suitable for speed control of induction motors in fan and pump drives.
- (f) Write a brief note on the Load Commutated Inverter Drive used for a Synchronous motor.

8 **Answer the following in one or two sentences.**

- (a) Which good features of MOSFET and BJT are found in an IGBT ? (1 mark)
 (b) Name a self-controlled (fully controlled) device and briefly explain why it is known as self-controlled. (2 mark)
 (c) What is a blanking circuit ? Where is it needed ? (2 mark)
 (d) What is the advantage of having a bipolar driver amplifier in place of a unipolar driver ? (1 mark)
 (e) Which device suffers from secondary breakdown problem ? (1 mark)
 (f) Can MOSFET be used for rectification application ? Why ? (1 mark)
 (g) What is the purpose of using a delay block at the input (i.e. in the path of the speed command) while achieving the speed control of an Induction motor ? (2 mark)