M.Tech. Electrical Power System (CBCS Pattern) Semester - II

PEPS21 - Advanced Power Electronics

P. Pages : 3 **GUG/S/23/11021**

Time : Three Hours * 1 2 5 1 * Max. Marks : 70

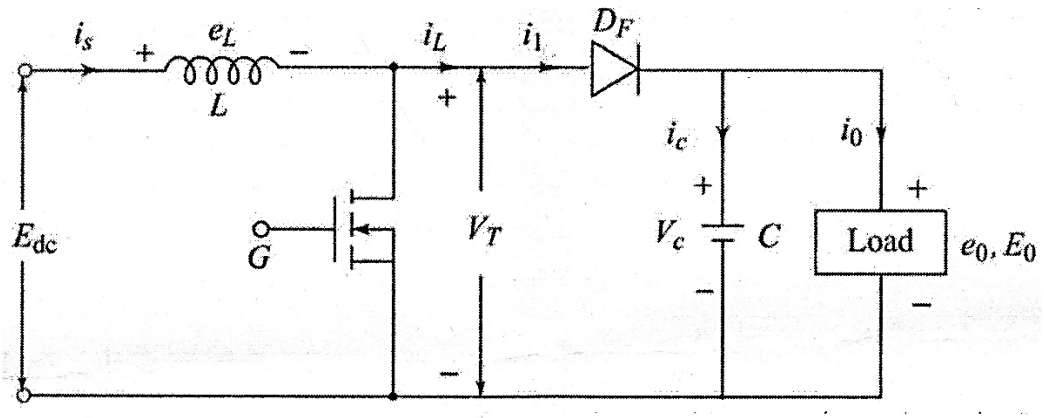
Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Discuss the reaction, mechanism wherever necessary.
7. Answer **any five** questions as per internal given choice.
8. Use of non-programmable calculator is permitted.

1. a) Derive the expressions for peak-to-peak ripple current of inductor and peak-to-peak ripple voltage of capacitor in terms of circuit components, supply voltage, frequency and duty-ratio, for a Buck converter. **7**

b) With the help of neat structural diagram and suitable waveforms, explain the operation of insulated-gate BJT. (IGBT). **7**

OR

2. a) **7**



Consider the boost converter of fig. The input voltage to this converter is 8V. The average output voltage $E_0 = 16V$ and the average load current $I_0 = 0.5A$. The switching frequency is 30kHz. If $L = 160\mu H$ and $C = 380\mu F$. Compute (a) the duty-cycle α; (b) the ripple current of inductor, ΔI; (c) the peak current of inductor, I_2, and (d) the ripple voltage of filter capacitor, ΔV_c.

b) Compare SCR, Power BJT, MOSFET and IGBT on the basis of following parameters: **7**

i) Operating frequency ii) Trigger circuit

iii) Drop iv) Snubbers

v) V-I rating vi) Applications

3. a) There are two types of dc-dc converters, which are non-isolated and isolated converter. List out THREE (3) examples of non-isolated and THREE (3) examples of isolated converter. **7**

b) What are the advantages of isolated dc-dc converters? **7**

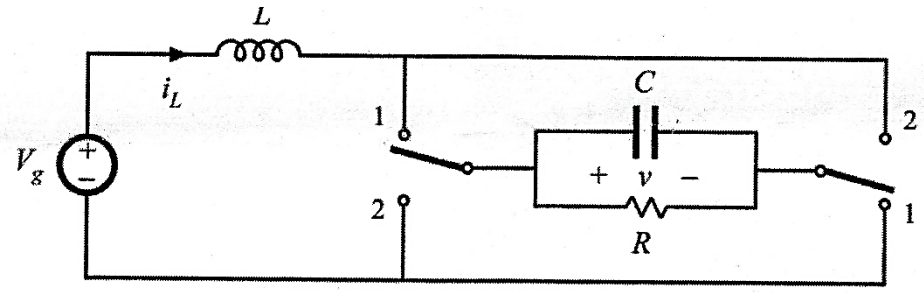
OR

4. a) An isolated buck or forward converters has 150 turns in primary winding and 120 turns in the secondary winding. The dc input voltage is 160V. Find the duration and the voltage across the primary and feedback windings during on and off periods. The converter operates at 25% duty ratio and 25kHz. The number of turns of feedback winding, $N_f = 180$. **7**

b) With the help of neat structural diagram and suitable waveforms, explain the operation of isolated push pull converter. **7**

5. a) Construct a complete small-signal equivalent circuit model for the Cuk converter. **7**

b) **7**



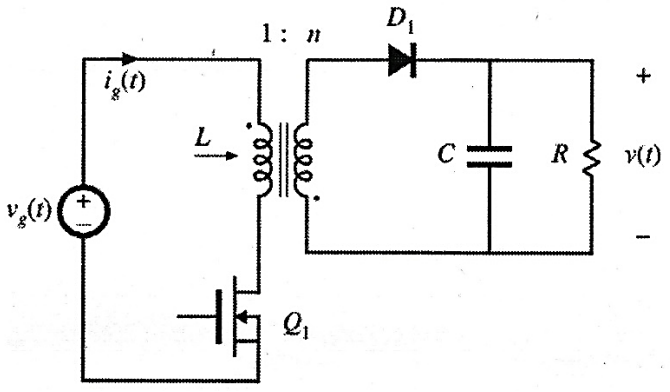
The ideal current-fed bridge converter of Fig. operates in the continuous conduction mode.

a) Determine the nonlinear averaged equations of this converter.
b) Perturb and linearize, to determine the small-signal ac equations.
c) Construct a small-signal ac equivalent circuit model for this converter.

OR

6. a) Derive the small-signal dynamic equations that model the ideal Cuk converter. **7**

b) **7**



Construct a complete small-signal ac equivalent circuit model for the flyback converter shown in Fig. operating in continuous conduction mode. The transformer contains magnetizing inductance L, referred to the primary. In addition, the transformer exhibits significant core loss, which can be modeled by a resistor R_C in parallel with the primary winding. All other elements are ideal. You may use any valid method to solve this problem. Your model should correctly predict variations in $i_e(t)$.

7.	a)	Draw and explain briefly the operation of resonant dc link inverter.	**7**
	b)	Explain the operation of ZCS converter with diagram and waveforms.	**7**

OR

8.	a)	With the help of neat circuit diagram and waveforms, explain the operation of full-bridge series resonant inverters with bidirectional switches.	**7**
	b)	What is a quasi-resonant converter? Differentiate briefly between resonant and quasi-resonant converter.	**7**
9.	a)	Explain parallel resonant converter in discontinuous conduction mode.	**7**
	b)	Draw and explain the various types of zero current switch topology.	**7**

OR

10.	a)	Draw and explain the various versions of zero-voltage switch topology.	**7**
	b)	With the help of neat circuit diagram and associated waveforms, explain the operation for full-wave mode of ZCS resonant buck converter.	**7**

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