Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.TECH (EE-(O))/SEM-2/PEM-201/2013

2013

POWER ELECTRONICS – II

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. $5 \times 14 = 70$

1. a) With the help of circuit diagram, mathematical expressions and necessary waveforms explain the operation of a single phase AC voltage controller with inductive load.

   b) A 1-ph. full-wave AC voltage controller supplies and R-L load with $R = 2 \cdot 5\ \Omega$ and $L = 6 \cdot 5$ mH, $a = 90°$, $V_{L\text{-}L} = 400$ volts, 50 Hz. Determine V_{orms}, input *PF* for, 75° and 120°. Find conduction angle of switch. V_{orms}, rms values switch current and output current, which average current, inptu *pf*. 7 + 7

2. a) With the help of circuit and necessary waveforms explain the operation of a 3-ph cycloconverter.

   b) The input voltage of a single phase to single phase cycloconverter is 230 V at 50 Hz. Load is R = 15 ohms and L = 47 mH. Output frequency : 16·66 Hz, α_p = 120° and converters operates as semiconverters. Determine V_{orms} , thyristor rms current, input PF and draw the output voltage wave-forms. 5 + 9

3. Write short notes on any *two* of the following : 7 + 7

   a) Stepped modulation and harmonic injection modulation in inverter.

   b) Space vector modulation

   c) Cascaded multilevel inverter

   d) Matrix converter.

4. What do you mean by resonant inverter ? Justify the use of ZVS and ZCS resonant inverter. Explain the operation with proper circuit diagram, expressions and waveforms of a ZCS resonant inverter. 2 + 3 + 9

5. With the power circuit and the different waveforms of control circuit, develop the detailed control electronics of a practical 3-phase cycloconverter and explain the operation in detail.

6. a) Draw the circuit of half bridge resonant inverter controlled with pulse phase modulation and explain its operation mechanism with proper waveforms.

   b) Develop the system modeling of a grid connected voltage Source Inverter. 7 + 7

7. a) Discuss in detail the modeling of a three leg sine wave inverter.

b) Make a model and simulate a single phase voltage controlled VSI in MATLAB.

8. a) Explain the operation of a phase shifted PWM converter and make a circuit model of it.

b) Develop a PSPICE program of a 1-ph full wave A.C. voltage controller. 7 + 7

9. a) With the help of circuit and necessary waveforms explain the operation of a boost inverter.

b) A 3-ph 50 Hz bridge inverter with $V_s = 220$ V, supplies a balanced Y-connected load with $R = 5\ \Omega$ and $L = 23$ mH. Find (i) expression of $v_{ab}(t)$ and $i_a(t)$ in fourier series, (ii) r.m.s. line voltage, r.m.s. phase voltage, fundamental r.m.s. line voltage, fundamental r.m.s. phase voltage. THD, DF, HF of LOH, DF of LOH, P_o, avg. and r.m.s. value of switch current. (assume 180° conduction) 6 + 8

10. a) Explain any two methods for harmonic reductions in inverter.

b) A 1-ph, 50 Hz bridge inverter with $V_s = 220$ V, supplies a load with $R = 10\ \Omega$ and $L = 31{\cdot}5$ mH, $C = 112\ \mu$F. Find (i) expression of $i_o(t)$ in fourier series, (ii) fundamental r.m.s. THD of load current, P_{oI}, P_o, avg. of supply current, peak and r.m.s. value of switch current, conduction time of switches and diodes. 6 + 8