UNIVERSITI SAINS MALAYSIA

Semester I Examination
Academic Session 2008/2009

November 2008

EEE 542 – INDUSTRIAL POWER ELECTRONICS

Time : 3 hours

INSTRUCTION TO CANDIDATE:

Please ensure that this examination paper contains **FOUR (4)** printed pages and
SIX (6) questions before answering.

Answer **FIVE (5)** questions.

Distribution of marks for each question is given accordingly.

All questions must be answered in English.

S1.   Design single-phase full rectifier 2 quadrant with R and L load. Determine:

   (i)   Skecth the output voltage waveform for $\alpha=90^0$

   (ii)   Determine the circuit's efficiency at $\alpha=90^0$

   (iii)   Value of α if $V_{dc}/V_m =0.6$

   (iv)   What is the maximum efficiency of the circuit?

                                                                                      (100%)

S2.   Design three-phase full converter, with highly inductive load from three-phase supply, $V_S=208V$ and f=50Hz.

   (i)   Sketch the output voltage waveform for $\alpha=60^0$
   (ii)   Determine the value of V_{dc} and V_{rms} at $\alpha=60^0$
   (iii)   The maximum efficiency of the circuit
   (iv)   What is the advantage of this circuit compared to half wave rectifier?

                                                                                      (100%)

S3.   (a)   Explain in brief the principle operation of an ac controller transformer tap.

                                                                                      (30%)

       (b)   For three-phase full wave ac controller Y connected R load:

              (i)   Draw the complete design of the system
              (ii)   Determine the output waveforms for $\alpha=60^0$ at load C
              (iii)   The rms output voltage the controller in term of α.

                                                                                      (70%)

S4. (a) What are the performance parameters of inverter circuit?

(20%)

(b) Explain in detail the operation of a single-phase bridge inverter with inductive load from a dc source:

(i) Sketch the complete design
(ii) The output voltage and current waveforms
(iii) The rms output voltage

(40%)

(c) For question 3(b), if the circuit has an RLC with R=10Ω, L=30mH, C=100μF, f_o=50 Hz and dc input voltage V_s=240 V. Express the instantaneous load current in Fourier series.

(40%)

S5. Explain how a 3 phase inverter is constructed from a single dc supply. Describe in detail the concept apply in your design. Based on the 180^0 conduction, derive the expression for the instantaneous line to line voltage V_{ab} in a Fourier series.

(100%)

S6. (a) What are the advantages and disadvantages of a Boost regulator?

(20%)

(b)   Referring to buck-boost regulators:

     (i)   Draw the complete circuit diagram.

     (ii)   Explain in brief the circuit operation.

     (iii)   Sketch the waveform of the regulators.

     (iv)   Prove that this regulator can provides an voltage output that may be less than or greater than the input voltage.

     (v)   Derive the equations for I_{min} and I_{max}.

(60%)

(c)   State the critical condition for continuous inductor current in this regulator.

(20%)

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