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# UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 2008/2009

November 2008

## EEE 542 – INDUSTRIAL POWER ELECTRONICS

Duration: 3 hours

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Please check that this examination paper consists of FOUR pages of printed material before you begin the examination.

This paper contains SIX questions.

**Instructions:** Answer **FIVE (5)** questions.

Answer to any question must start on a new page.

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) Sketch the output voltage waveform for  $\alpha=90^\circ$
- (ii) Determine the circuit's efficiency at  $\alpha=90^\circ$
- (iii) Value of  $\alpha$  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  $\alpha=60^\circ$
- (ii) Determine the value of  $V_{dc}$  and  $V_{rms}$  at  $\alpha=60^\circ$
- (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  $\alpha=60^\circ$  at load C
- (iii) The rms output voltage the controller in term of  $\alpha$ .

(70%)

...3/-

- 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  $R=10\Omega$ ,  $L=30\text{mH}$ ,  $C=100\mu\text{F}$ ,  $f_o=50\text{ Hz}$  and dc input voltage  $V_s=240\text{ V}$ . 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  $180^\circ$  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%)