



**UTHM**  
Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2019/2020**

COURSE NAME : POWER ELECTRONIC CONVERTERS  
COURSE CODE : BNE 33603  
PROGRAMME CODE : BNE  
EXAMINATION DATE : DECEMBER 2019 / JANUARY 2020  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER ALL QUESTIONS

**TERBUKA**

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

- Q1** (a) (i) Power electronic switches are categorized into three types, which are: uncontrolled, semi-controlled and fully controlled. Describe in brief the characteristic for each category (3 marks)
- (ii) Sketch the V-I characteristic curve of SCR and label completely (5 marks)
- (b) **Figure Q1(b)** shows the control signal, voltage and current of power electronic switch that is operated at 25 kHz.  $V_d$  is the voltage across the switch during off-state and  $I_o$  is the current flows through the switch during on-state. The switch has the voltage fall time,  $t_{fv}$  of 50 ns. The power dissipated during on-state is 3 W and the total average power dissipated is 9.75 W. If the current flowing through the switch is 4 A during ON signal, determine;
- (i) the turn-on interval time,  $t_{on}$ , of the switch (3 marks)
- (ii) the average switching power loss (3 marks)
- (iii) the current rise time,  $t_{ri}$ , if the turn-off crossover interval  $t_{c(off)} = 300$  ns (6 marks)
- Q2** A single phase full-wave controlled rectifier has a resistive load of  $R = 12.5 \Omega$ , the voltage at the primary transformer is 240 V with ratio 2:1, and the firing angle of thyristor is  $30^\circ$
- (a) Draw the circuit explain in this question. (3 marks)
- (b) Derive and find the average output voltage. (7 marks)
- (c) Estimate the average load current (2 marks)
- (d) Calculate average output power (2 marks)
- (e) Determine the new firing angle,  $\alpha$ , if the rectifier is connected to the load which consumes 50 % less than maximum possible average output voltage. (6 marks)

TERBUKA

- Q3** (a) List **THREE (3)** types of PWM switching method of inverter (3 marks)
- (b) A square-wave single phase, full-bridge inverter supplies a RLC series load with resistor  $9 \Omega$ , inductor  $50.93 \text{ mH}$  and capacitor  $455 \mu\text{F}$ . The fundamental output inverter current is  $10 \text{ A}$ . The inverter is operates at the frequency of  $50 \text{ Hz}$ .
- (i) Estimate DC source of the inverter. (6 marks)
- (ii) Calculate the RMS output voltage. (2 marks)
- (iii) Express the instantaneous load current up to  $7^{\text{th}}$  harmonic. (9 marks)
- Q4** (a) List **TWO (2)** types of DC-DC converters and draw their circuits. (6 marks)
- (b) A buck-boost converter circuit has a DC input voltage source of  $V_i$ . Assume all the components are ideal. Derive the expression of inductor ripple current during ON-state and OFF-state. (6 marks)
- I Referring to the converter in **Figure Q4(b)**, power absorbed due to resistor,  $R$  is  $51.2 \text{ W}$  at switching frequency of  $100 \text{ kHz}$ , determine the following parameters:
- (i) The duty cycle (2 marks)
- (ii) Load resistor,  $R$  (3 marks)
- (iii) The minimum value of the inductor to provide continuous current mode (CCM) operation (3 marks)

TERBUKA

**Q5** A single-phase full-wave AC voltage regulator as shown in **Figure Q5** has a resistive load of  $R = 6 \Omega$  and the input supply voltage  $V_s = 240 \text{ V}$  (rms), frequency is 50 Hz. The delay angle of thyristors is  $\alpha = \pi/3$

- (a) Sketch waveform of output voltage at load (4 marks)
- (b) Derive the RMS output voltage  $V_o$ , (5 marks)
- (c) Determine the RMS output voltage  $V_o$ , (4 marks)
- (d) Determine the RMS output current  $i_o$ , (3 marks)
- (e) State the peak value of the output voltage waveform and the current output waveform at load terminal (4 marks)

TERBUKA

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2019/2020

PROGRAMME CODE : BNE

COURSE NAME : POWER ELECTRONIC CONVERTERS

COURSE CODE : BNE 33603

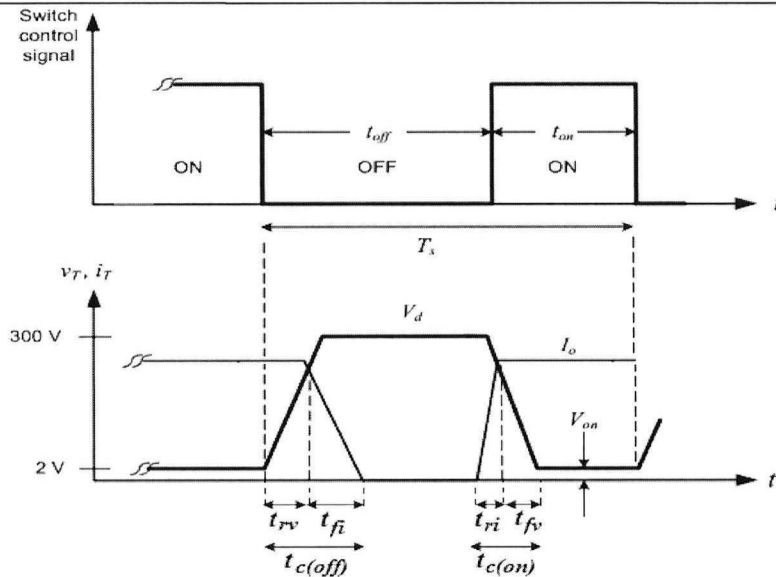


Figure Q1(b)

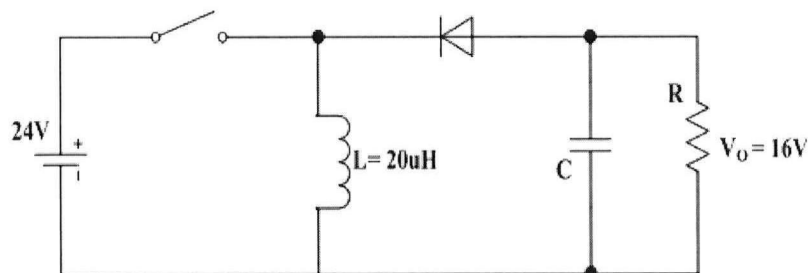


Figure Q4(b)

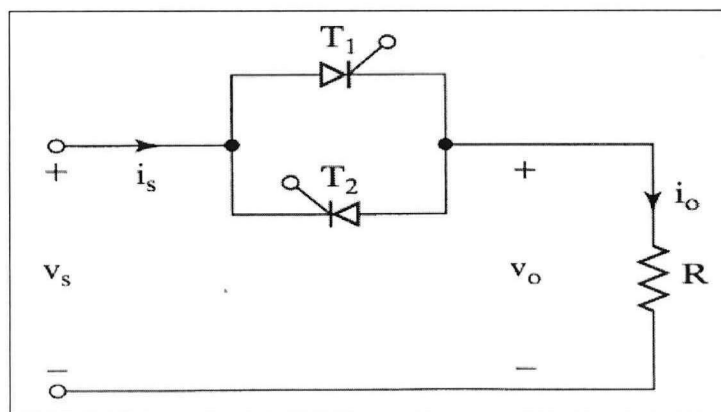


Figure Q5

TERBUKA