

LIB

M.E. (ETRX) Sem II

18/12/09

Con 5471-09.

Power ETRX

BB-6164

(4 Hours)

[ Total Marks : 100

**N.B.:** (1) Question No. 1 is **compulsory**. From remaining **six** questions solve any **four** questions.

- (2) **Figures** to the **right** indicate **full** marks.  
 (3) Draw **neat** sketches/waveforms wherever **necessary**.  
 (4) Assume suitable **additional** data if **necessary**.

1. Answer any **five** of the following :—

- (a) Compare IGBT and SCR.  
 (b) Explain effect of source inductance on converter circuit operation considering rectifier mode and inverter mode.  
 (c) Why 'Snubber circuit' is necessary in SCR circuits.  
 (d) Draw Torque-speed characteristics of squirrel cage induction motor driven by v/f control. Explain constant torque and constant power regions.  
 (e) Explain why soft start and soft stop are required in some motor drive application.

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2. (a) Draw a circuit diagram for a three phase bidirectional delta connected controller. Sketch relevant waveforms and derive an expression for r.m.s. value of output voltage when feeding a resistive load.

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(b) A cycloconverter is operating from 415 V, 50 Hz three phase system. It is driving a three phase reversible drive consisting of squirrel cage motor in a range of 5 Hz to 15 Hz using constant torque control. The load power factor is 0.9 and input displacement factor is 0.75. Calculate—

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- (i) Range of variation of triggering angle of the cycloconverter  
 (ii) Highest value of power factor and corresponding firing angle.

3. (a) Describe by means of suitable diagram the operation of a D.C. series motor chopper drive in regenerative braking mode. Derive the expression for maximum regenerating speed under the assumption of continuous ripple free current.

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(b) A D.C. series motor chopper drive is operating in regenerating mode. The d.c. supply voltage is 600 V the armature resistance is 0.03 ohms and the field resistance is 0.05 ohms. The back emf constant is  $K_v = 12$  mV/A-rad/sec. The average armature current is maintained constant at 350 A. The armature current is continuous and has negligible ripple. If the duty cycle of the ripple is 50%, determine the regenerated power and operating speed.

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4. (a) Derive the expression for loss of average voltage in a 3 phase full controlled rectifier due to commutation over lapping.

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(b) A three phase semiconverter is operated from a 220 V, 50 Hz Y connected supply. The load current is continuous and can be assumed to be ripple-free. The average load current is 150 A and commutating inductance is 0.5 mH. Determine the angle of overlap if the delay angle is  $\pi/6$ .

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[ TURN OVER



5. (a) Draw the circuit and state the design procedure for impulse commuted chopper. **10**  
Derive an expression for average minimum and maximum output voltage.
- (b) A chopper is fed from 220 volts dc and peakload current is 400 Amp. (For **10**  
the chopper the data given is :
- Chopper frequency = 250 Hz  
Commutating capacitance = 60  $\mu$ F (micro-Farad)  
Commutating Inductance = 20  $\mu$ H(micro-Henry)
- For the above chopper determine :
- (i) Circuit turn-off time ( $t_q$ )  
(ii) Minimum and Maximum average output voltage.
6. (a) Draw a diagram depicting a circuit model of IGBT. Which important **10**  
characteristics and of which basic devices are combined in fabricating this  
device ?
- (b) Draw and explain rheostatic breaking of separately excited DC motor. **10**
7. Write short notes on any **two** of the following :— **20**
- (a) Speed control of static Kramer drive.  
(b) Vectors control of ac induction motor.  
(c) Power factor improvement techniques in converter.