M.E. Sem 2 (Rev.) Etrx. Power Electronics 15/12/08

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Con. 5545–08. (REVISED COURSE) BB–8342

(4 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**. Solve any **four** questions from remaining questions.
(2) Draw **neat** sketches/waveforms wherever **necessary**.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume **suitable** data if **necessary**.

1. Answer any **five** of the following :– **20**
   (a) Explain what is 'second breakdown' in power transistors and how it limits rating of the device in switching inductive loads.
   (b) Compare IGBT and SCR.
   (c) In which slip power recovery scheme it is possible to operate a.c. motor above synchronous speed ? Draw the block diagram of the scheme.
   (d) Explain $\frac{dv}{dt}$ rating of SCR and explain reasons of its importance.
   (e) Draw two circuit diagrams which provide isolation between the control circuit and power circuit and explain the importance of isolation in practical application.
   (f) Compare Voltage source inverters and Current source inverters.

2. (a) Draw the circuit diagram of 1ϕ semiconverter with 'RL' load. Draw the waveforms for firing angle (α) 45°. Derive an expression of output voltage, output current and power factor. **10**
   (b) The 1ϕ full converter is fed from 230 V, 50 Hz supply mains. If delay angle is $\pi/3$, calculate : **10**
   (i) Output dc voltage (ii) Output rms voltage
   (iii) Harmonic factor (iv) Displacement factor
   (v) Power factor.
   for ripplefree continuous load current. If delay angle changes of $2\pi/3$ what will be the effect on the circuit operation ? Elaborate with waveforms.

3. (a) Draw the circuit and state the design procedure for impulse commuted chopper. Derive an expression for average minimum and maximum output voltage. **10**
   (b) A chopper is fed from 220 volts dc and peakload current is 400 Amp. For the chopper the data given is : **10**
   Chopper frequency 250 Hz.
   Commutating Capacitance 60 (micro–Farad) μF
   Commutating inductance 20 (micro–Henry) μH
   For the above chopper determine :
   (i) Circuit turn-off time (t_q)
   (ii) Minimum and maximum average output voltage.

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4. (a) Draw a schematic diagram for a single phase to single phase cyclo-converter. Explain the generation of giving pulses, so as to achieve minimum harmonic contents in the output. **10**

   (b) The input voltage to a cycloconverter is 120 V, 60 Hz. The load resistance is 5 ohms and the load inductance is 40 mH. The frequency of the output voltage is 20 Hz. If the converters are operated as semiconverters and the delay angle is $\frac{2\pi}{3}$, determine : **10**

   (i) RMS value of the output voltage
   (ii) RMS current of each thyristors
   (iii) Input power factor.

5. (a) Draw and explain three phase bridge voltage source inverters and explain its modes 120° and 180°. **10**

   (b) A series inverter circuit has an inductor of 10 mH, a capacitor of 47 μF connected in series with a load resistance 5 ohms. Determine : **10**

   (i) Resonating frequency (ii) Time period of oscillation.

6. (a) Draw a closed loop speed control scheme for a d.c. drive employing a separately excited d.c. motor, where in constant torque constant power characteristic is obtained. Explain how a change over takes place from constant torque operation to constant power operation. Also explain how to incorporate a feature of adjustability of speed at which such a change over would take place. **10**

   (b) A separately excited d.c. motor has following ratings and specifications : **10**

   Power – 20 HP
   Armature voltages – 300 V
   Speed – 1800 RPM
   Armature resistance – 0·35 ohms
   Field resistance – 250 ohms
   Motor voltage constant – K_v = 1·15 V/A-rad/sec.

   The motor is controlled by a three phase full convertor supplied from 208 V, 50 Hz Y connected supply. The field current is also controlled by a three phase full converter and is set to a maximum permissible value. The armature and field currents canbe assumed to be continuous and ripple-free. Viscous friction and no load losses may be neglected. If the motor is feeding rated power at rated speed, determine the speed regulation from no load to full load. Assume no load current is 10% of the rated value.

7. Write short notes on :– **20**

   (a) Speed control of static Kramer drive
   (b) Vector control of ac induction motor
   (c) Power factor improvement techniques in converter.
