

Power Electronics

P3-upq-Feb.-13KL-120 A4 E

Con. 9006-13.

BB-7522

(4 Hours)

[Total Marks : 100

N.B. :(1) Question No. 1 is compulsory.

(2) Solve any **four** questions out of remaining **six** questions.(3) **Figures** to the **right** indicate **full** marks.(4) Assume **suitable** data if **required** but justify the **same**.

1. Answer the following :—

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- (a) Explain the terms soft recovery and abrupt recovery in power diodes. Draw relevant waveforms. State advantages of using soft recovery diodes over abrupt recovery diodes in some applications.
- (b) What is the necessity of isolation circuit between the control circuit and power circuit ? Draw two circuits which provides isolation.
- (c) Can semiconverter be operated in inverter mode ? Give reasons for your answer.
- (d) Explain the second break down in power transistors and how it limits the ratings of device in switching inductive loads.
- (e) Explain the importance of $\frac{dv}{dt}$ and $\frac{di}{dt}$ ratings of SCR.

2. (a) Explain how a full converter can be used to drive separately excited dc motor in motoring mode and how the converter can be used to electrically brake the motor using generator mode with relevant waveforms. Give range of firing angle delays in both the cases. 10

(b) A single phase full converter is supplied with 250 V, 50 Hz supply. The load current is continuous and ripple free. If the source inductance is 0.5mH and the load current is 75 amps. Determine angle of overlap (μ) for firing angle delay 10

$$(\alpha) = \frac{\pi}{4}$$

3. (a) Explain the principle of vector field oriented control for induction motor. 10

(b) A 3-phase 11.2 kW, 1750rpm, 460 V, 60 Hz, four pole Y connected induction motor has the following parameters $R_s = 0.66\Omega$, $R_r' = 0.38\Omega$,

$X_s = 1.14\Omega$, $X_r' = 1.71\Omega$ and $X_m = 33.2\Omega$. The motor is controlled by varying both the voltage and frequency. The volts / Hertz ratio, which corresponds to the rated voltage and rated frequency is maintained constant.

- (i) Calculate the max torque T_m and the corresponding speed ω_n for 60 and 30 Hz.
(ii) Repeat (i) if R_s is negligible.

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4. Discuss why a 3-phase to single phase cyclo-converter requires positive and negative group phase controlled converters. Under what conditions the group work as inverters or rectifiers ? How should the firing angles of the two converters be controlled?
5. (a) Draw and explain three phase bridge voltage source inverters and explain its modes 120° and 180° .
(b) A series inverter circuit has an inductor of 10 mH, a capacitor of $47\mu\text{f}$ connected in series with a load resistance of 5 Ohms. Determine (i) Resonating frequency (ii) Time period of oscillation.
6. (a) Draw the circuit and state the design procedure for impulse commutated chopper.
(b) Explain the effect of source inductance on performance of single phase full converter operating in (i) rectifier mode and in (ii) inverter mode. Draw relevant waveforms and give expressions of input / output voltages in both cases.
7. Write short notes on the following :—
 - (a) LASCR
 - (b) Current source inverter
 - (c) Permanent magnet stepper motor
 - (d) MCT.
