Total No. of Questions—12]                    [Total No. of Printed Pages—6

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**[5057]-65**

S.E. (E&TC Engineering) (First Semester) EXAMINATION, 2016

**POWER DEVICES AND MACHINES**

**(2008 PATTERN)**

**Time : Three Hours**                              **Maximum Marks : 100**

**N.B.** :— (i)    Answers to the two sections should be written in separate answer-books.

(ii)   Neat diagrams and waveforms must be drawn wherever necessary.

(iii)  Figures to the right indicate full marks.

(iv)   Use of non-programmable calculator is allowed.

(v)    Assume suitable data, if necessary.

**SECTION I**

1.    (a)    Compare power MOSFET with IGBT ?                    [5]

(b)    Explain construction and steady state characteristics of power BJT.                    [7]

(c)    The reverse recovery time of a power diode is 5 μs and rate of fall of diode current is 80 A/μs. If softness factor is 0.5, determine :                    [6]

(i)    $t_a$ & $t_b$

(ii)   Peak inverse current ($I_{RR}$)

(iii)  Storage charge ($Q_{RR}$)

P.T.O.

*Or*

**2.** (*a*)  Compare power MOSFET with power BJT.  [5]

(*b*)  What is latch up in IGBT ? Explain causes and remedies for latch up.  [7]

(*c*)  Draw and explain Gate Drive Circuit for IGBTT.  [6]

**3.** (*a*)  Draw two transistor analogy of SCR ? Derive an expression for its anode current $I_A$ ?  [6]

(*b*)  The gate triggering circuit of a SCR has a source voltage of 15 V and the gate cathode characteristics has a straight line slope of 130. If gate power dissipation is 0.5 W, calculate :  [6]

(*i*)  Triggering voltage

(*ii*)  Triggering current

(*iii*)  Gate series resistance.

(*c*)  Compare SCR with GTO ?  [4]

*Or*

**4.** (*a*)  Compare SCR with TRIAC ?  [5]

(*b*)  Explain construction and steady state characteristics of SCR.  [6]

(*c*)  Draw and explain synchronized UJT triggering circuit for SCR with waveforms.  [5]

**5.** (*a*) Explain single phase fully controlled rectifier for R-L load with various modes of operations and waveforms. Also derive expressions for average output voltage and rms output voltage. [10]

(*b*) A single phase semi-converter is operated from 120 V, 50 Hz AC supply. The load resistance is 10 Ω. If the average output voltage is 25% of the maximum possible average output voltage, determine : [6]

(*i*) Firing angle

(*ii*) Average output current

(*iii*) rms output current.

*Or*

**6.** (*a*) A single phase full wave ac voltage controller has a resistive load of R = 10 Ω and the input voltage is $V_s$ = 230 V (rms), 50 Hz. The delay angles of thyristors T1 and T2 are equal : α1 = α2 = π/3. Determine : [6]

(*i*) the rms output voltage and current

(*ii*) the input PF

(*iii*) rms current of each SCR.

(*b*) Draw and explain single phase full wave AC voltage controller for R load and derive an expression for its output voltage. Also draw the following waveforms : [10]

(*i*) gate pulses

(*ii*)   output voltage

(*iii*)  output current

(*iv*)  voltage across SCR1

(*v*)   voltage across SCR2.

## SECTION II

**7.** (*a*)  What is a DC chopper ? Explain different control techniques in DC chopper. [7]

(*b*)  A step down DC chopper has a resistive load of R = 15 Ω and input voltage $V_s$ = 200 V. When the chopper remains ON, its voltage drop is 2.5 V. The chopper frequency is 1 kHz. If the duty cycle is 50%, determine : [6]

(*i*)   Average and rms output voltages

(*ii*)  Chopper efficiency.

(*c*)  Explain with block schematic working of Off-line UPS. [5]

*Or*

**8.** (*a*)  Single phase full bridge inverter has a resistive load of R = 3 Ω, dc input voltage is 50 V. Calculate : [4]

(*i*)   rms o/p voltage at the fundamental frequency E1

(*ii*)  Output power P0.

(*b*) Explain $1 - \Phi$ bridge inverter for R-L load with circuit and waveforms. Derive expression o/p rms voltage. [8]

(*c*) Explain step up chopper with circuit ? Show that : [6]

$$V_0 = \frac{V_S}{(1 - D)}.$$

**9.** (*a*) Explain construction, torque-speed and torque-current characteristics for dc shunt motor. [10]

(*b*) A 4-pole, lap wound DC motor has 500 conductors. Its speed is 1000 rpm. The flux per pole is 20 mWb. It is connected to 200 V dc supply, armature resistance is 0.8 Ω. Find : [6]

(*i*) Back e.m.f.

(*ii*) Armature current

(*iii*) Torque developed.

*Or*

**10.** (*a*) Explain torque-speed characteristics of 3-phase induction motor. [8]

(*b*) Explain construction, working and characteristics of ac servomotor. [8]

**11.** (*a*) Draw and explain various types of 3-phase transformer connection along with relation between phase and line voltages and currents. [8]

(*b*) State various protection methods for motors ? Explain field failure protection method for dc motor in detail. [8]

<div align="center">*Or*</div>

**12.** (*a*) Explain construction, working and characteristics of BLDC motor. [8]

(*b*) What are types of stepper motor ? Explain any *one* type with construction and working in detail. [8]