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18EC36

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020

Power Electronics and Instrumentation

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Name the power semiconductor devices along their circuit symbols and maximum Ratings. (04 Marks)
- b. Explain the operation of SCR, in terms of two transistor model and derive anode current and gate currents relation. Discuss how a small gate current can trigger the device into conduction. (08 Marks)
- c. The latching current of a thyristor circuit is 60m Amp. The duration of the firing pulse is 50μsec. Given $V_s = 100V$, $R = 20\Omega$ and $L = 0.5H$ are connected in series.
 - i) Derive the expression for circuit current $i(t)$
 - ii) Draw variation of current $i(t)$ with reference to time
 - iii) Will the thyristor device get turned ON? (08 Marks)

OR

- 2 a. Enumerate the applications of power electronics. (04 Marks)
- b. Explain the operation of self commutation by resonating load [class A] with relevant circuit and waveforms. (08 Marks)
- c. What are the gate triggering schemes? Explain with circuit diagram and wave forms, now RC triggering circuit turns ON (triggers) SCRs. (08 Marks)

Module-2

- 3 a. Explain the control strategies used to operate choppers. (06 Marks)
- b. Explain with the help of neat circuit diagram and waveforms, the operation of a single phase half wave controlled rectifiers with resistive load. Derive an expression for the :
 - i) Average load voltage
 - ii) RMS load voltage. (08 Marks)
- c. For the ideal type A [step down] chopper circuit, following conditions are given : $V = 220V$, Duty cycle = 0.3, Chopping frequency $f = 500Hz$, $R = 1\Omega$, $L = 3mH$ and $E_b = 23$ volts. Determine the following :
 - i) Minimum value of output current (load)
 - ii) Maximum value of output current (load)
 - iii) Average output (load) current. (06 Marks)

OR

- 4 a. Explain the effect of free wheeling diode used in controlled rectifiers. (04 Marks)
- b. With the circuit diagram and circuit waveforms, explain the principle of operation of step-up chopper. (08 Marks)
- c. A single phase fully controlled bridge rectifier is feeding to a RL load, to obtain a regulated DC output voltage. The RMS value of the AC voltage is 230V, at 50Hz and the firing angle is maintained at $\pi/3$, so that the load current is 4Amp.
 - i) Calculate the DC average output voltage
 - ii) Active power and reactive power input
 - iii) Assuming the load resistance remains the same, determine DC average output voltage. If a freewheeling diode is used at output with all the conditions remains same. (08 Marks)

Module-3

- 5 a. Define the terms : i) instrument ii) Accuracy iii) Absolute error iv) Relative errors? (04 Marks)
- b. Explain the operation of single – phase half bridge inverter connected to RL load, with the help of circuit and waveforms. (08 Marks)
- c. A basic D' arsonval movement with a null scale deflection of 2mA and having an internal resistance of 50Ω is available. It is to be converted into a 0–10V, 0–1000V, 0–100V and 0–250V multi range voltmeter. Determine the value of resistance to extend? (08 Marks)

OR

- 6 a. What are inverters? Classify the inverters according to commutation and connections? (04 Marks)
- b. What are the static errors? Explain them in detail with examples. (08 Marks)
- c. A single phase half bridge inverter, has resistive load of $R = 3\Omega$ and DC input voltage $V_{dc} = 50$ volts. Calculate :
 i) RMS output voltage at fundamental frequency
 ii) The output power (P_0)
 iii) The average and peak current of each thyristor
 iv) The peak – reverse blocking voltage of each thyristor. (08 Marks)

Module-4

- 7 a. Explain how a simple AC bridge circuit operates and derive an expression for the unknown parameters. (04 Marks)
- b. With the aid of diagram, explain the working of unbalanced wheat stone bridge and derive for a galvanometer current expression. (08 Marks)
- c. Explain the principle of operation of digital time measurement with basic block diagram. (08 Marks)

OR

- 8 a. What are the advantages of digital instruments over analog instruments? (04 Marks)
- b. Determine the equivalent parallel resistance and capacitance that causes a Wein's bridge to null condition with the following values : $R_1 = 3.1K\Omega$, $C_1 = 5.2\mu F$, $R_2 = 55K\Omega$, $R_4 = 100K\Omega$, $f = 2.5KHz$. Derive the balanced expressions. (08 Marks)
- c. With neat block diagram, explain the operating principle of a Ramp type DVM. (08 Marks)

Module-5

- 9 a. Define transducers. What are advantages of electrical transducers? (04 Marks)
- b. Explain instrumentation Amplifier using transducer bridge with the help of circuit diagram. (08 Marks)
- c. Explain with neat diagram the PLC structure. (08 Marks)

OR

- 10 a. What are features of instrumentation Amplifiers? How it differs from the ordinary opAmp. (04 Marks)
- b. Describe the operation of resistive position transducer with constructional diagram and typical circuit used. (08 Marks)
- c. With the aid of Bridge circuit, explain the working of resistance thermometer. Mention limitations of it. (08 Marks)