Roll No.

PRESIDENCY UNIVERSITY
BENGALURU

<u>SCHOOL OF ENGINEERING</u>

MAKE UP EXAMINATION

Make up Exam: January 2023   **Date**: 23 Jan 2023

Course Code: EEE 214   **Time**: 9:30AM-12:30PM

Course Name: Power Electronics   **Max Marks**: 100

Program & Sem: B.Tech & VI   **Weightage**: 50%

Instructions:

(i)   Read the question properly and answer accordingly.
(ii)   Question paper consists of 3 parts.
(iii)   Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries Two marks   (10Qx2M=20M)

1. A power converter is designed for battery operated vehicle which is intended to feed the power back to the source during braking operation. Suggest the suitable semiconductor device which is suitable in the power converter

                                                    (C.O.NO 1) [Knowledge]

    a. SCR   b. IGBT   c. GTO   d. LASCR

2. In a cement industry, three phase inverter is controlled by a three phase AC Voltage controller. Phase controlled technique has been used to control the power converter. Suggest the suitable semiconductor switching device in the design of the converter

                                                    (C.O.NO 1) [Knowledge]

    a. MOSFET   b. SCR   c. IGBT   d. IGCT

3. A single phase fully controlled converter is fed from single phase 230V,50Hz supply system. Compute the maximum average output voltage of the converter?
                                                    (C.O.NO 2) [Knowledge]
    a. 207.10V   b.540.8V   c.420.7V   d.231V

4. If the input supply frequency is 60Hz. The ripple frequency of average DC output voltage of three phase fully controlled rectifier is _____

(C.O.NO 2) [Knowledge]

a. 360Hz   b. 300 Hz   c 50Hz   d. 150Hz

5. In PV panel integration, a boost converter is used to step up the dc voltage, the range of duty cycle is _____

(C.O.NO 3) [Knowledge]

a. 0 to 1   b.1 to infinity   c.0 to .5   d.1 to 1.5

6. In a single phase PV grid interfacing, A step up DC-DC converter is used and the input voltage of the converter is 200V. The turn on time and total time period of the converter are 100micro sec 200micro sec respectively. The average DC output voltage of the converter, if the turn on time is reduced to four times is _____

(C.O.NO 3) [Knowledge]

7. A single phase half wave AC voltage controller is connected electric heater of 1kW and controlled by using phase control technique. Compute the minimum value of rms output voltage, if the supply voltage is single phase 230V,50Hz supply?

(C.O.NO 4) [Knowledge]

a. 102.6V   b. 12.6V   c.0V   d.162.6V

8. An induction heater is controlled by a single phase fullwave AC voltage controller is connected to heat the metal piece. The specifications of the source are single phase 230V, 50Hz, AC supply and load is 3kW. The average value of thyristor current is _____

(C.O.NO 4) [Knowledge]

9. In a single phase half bridge inverter, the supply voltage is 220V DC. The rms value of output voltage is _____

(C.O.NO 5) [Knowledge]

a. 440V   b. 220V   c. 110V   d. 55V

10. A domestic fan is controlled by 800VA inverter. Assume the inverter is controlled by single phase half bridge and full bridge inverter separately. Comment on %THD in both the cases   (C.O.NO 5) [Knowledge]

a. Full bridge is more   b.equal   c.Half bridge is more   d. Cannot be determined

Part B[Thought Provoking Questions]

Answer all the Questions. Each question carries Twenty marks.   (2Qx20M=40M)

11. IRFZ44N n-channel enhancement MOSFET is used in a dc motor control circuit is shown in Fig.1. The PWM technique is used to vary the gate to source voltage of MOSFET to control the speed of a dc motor.   A voltage of 1.5V has applied across gate – to – source voltage (VGS), at this condition, the drain current is 25 μA and the speed of the motor is zero. The data sheet of the MOSFET is presented in Fig.2.
    a) Identify the reasons for the zero speed of the motor and mention the steps for the trouble shooting.
    b) If a MOSFET has a threshold voltage of 2 V, V_{GS} under saturation is 4.5V, at this condition, the drain current is observed to be 2A. Neglecting the channel width modulation effect and assuming that the MOSFET is operating at saturation, Compute the drain current for an applied VGS of 5.5V and 7.0V. Comment on the magnitude of drain current.

(C.O.NO 1) [Comprehension]

Fig.1 dc motor controller with n-channel MOSFET as a switching device.

12. Assume the domestic inverter of rating 800VA is controlled by single phase half bridge and single phase full bridge inverters. The input dc Voltage of the inverter is 220V dc. While operation, it is observed that single phase half bridge inverter is producing more humming noise and generating more heat too.
    i.   Identify the reason for the noise(4M)
    ii.   Assume the required data and compute the rms value of fundamental output voltage of the single phase half bridge inverter(6M)
    iii. Compute the power loss due to 5th order harmonics, if the load is 50 ohms(6M)
    iv.   Identify the control parameters to vary the rms value of single phase full bridge inverter.(4M)   (C.O.NO 5) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries Twenty marks.   (2Qx20M=40M)

13. A battery operated vehicle is controlled by a chopper and is connected to separately excited DC motor. The battery pack is made up of Li-Ion of voltage 400V DC. The motor specifications are 700V, 950 rpm, 30A and Armature resistance of 0.05 ohms. It is required to operate in first quadrant of speed and torque plane.
    - i)   Suggest the type of chopper (4M)
    - ii)   Compute the value of duty cycle to operate at rated torque and speed. (8M)
    - iii)   Assume the required data and control the motor at different torque and speed conditions. Comment on the variation of Duty cycle.(8M)

(C.O.NO 3) [Comprehension]

14. A fan manufacturing company has produced Type A fan as per the Bureau of Indian Standards (BIS) norms, i.e IS: 374-1992. Type A fan regulator shall be capable of reducing the fan speed at least 30% of the rated speed and test results are presented Fig. 2

(C.O.NO 4) [Comprehension]

DATA SHEETS

Type A fan tested on a standard regulator
Case 1: Supply voltage = 220V

Regulator Number	Voltage V_r Volts	Current Amps	Power Watts	Voltage V_c Volts	Speed RPM
1	81	0.100	0.81	200.000	132
2	112	0.150	16.80	181.000	187
3	131	0.180	23.58	164.000	219
4	150	0.210	31.50	143.000	247
5	220	0.250	55.00	0.044	315

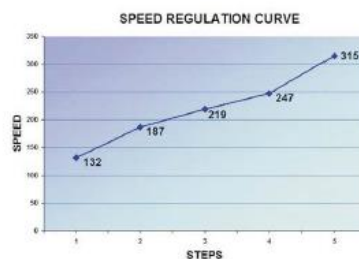SPEED REGULATION CURVE

Fig. 2 Test results on a standard regulator

- i)   Suggest the suitable AC Voltage controller for the control **(4M)**
- ii)   Chose the data which is required and suggest the firing angles at 4 and 5 positions(12M)
- iii)   Comment on variation of firing angle at different positions(4M**)**