Modified

CBCS SCHEME

USN | | | | | | | | | | |

18EC36

Third Semester B.E. Degree Examination, Feb./Mar. 2022
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. Mention the different types of power electronic converters. Explain the significance, functions and applications of them. **(07 Marks)**

b. Explain the static Anode-Cathode characteristics of SCR with circuit diagram and V-I characteristics. **(08 Marks)**

c. Explain the basic operation of the unijunction transistor with basic UJT structure, UJT symbol and equivalent circuit. **(05 Marks)**

OR

2 a. Mention the applications of power electronics in various sectors. **(07 Marks)**

b. The latching current of a thyristor circuit is 50mA. The duration of the firing pulse is 50μs. Will the thyristor get fired? **(05 Marks)**

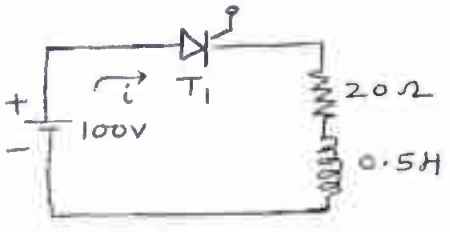


Fig.Q.2(b)

c. Explain the operation of the resistance firing circuit with associated voltage waveforms. Derive the relevant expressions. **(08 Marks)**

Module-2

3 a. Explain the operation of the single phase half wave controlled rectifier with resistive load using circuit and waveforms. **(10 Marks)**

b. Give basic chopper classification with different chopper configurations. **(05 Marks)**

c. A dc chopper circuit connected to a 100V dc source supplies an inductive load having 40mH in series with a resistance of 5Ω. A freewheeling diode is placed across the load. The load current varies between the limits of 10A and 12A. Determine the time ratio of the chopper. **(05 Marks)**

OR

4 a. Explain the effect of freewheeling diode with half wave controlled rectifier circuit and waveforms using inductive load. **(10 Marks)**

b. Explain the operation of step-up/down choppers with suitable circuit. Derive the relevant expression. **(07 Marks)**

c. A step-up chopper is used to deliver load voltage of 500V from a 220V dc source. If the blocking period of the thyristor is 80μs. Compute the required pulse-width. **(03 Marks)**

Module-3

5 a. Explain the operation of the single phase half bridge inverter with RL load. Draw the relevant circuit and waveforms. **(10 Marks)**

b. Explain the operation of the isolated forward converter with suitable circuit diagram and relevant waveforms. Mention the advantages and disadvantages. **(10 Marks)**

OR

6 a. Explain the types of errors in measurements. **(07 Marks)**

b. Explain the operation of the multirange voltmeter with normal circuit and with multipliers connected in series string circuit. **(07 Marks)**

c. A 1mA meter movement having an internal resistance of 100Ω is used to convert into a multirange ammeter having the range 0-10mA, 0-20mA, and 0-30mA. Determine the value of the shunt resistance required. **(06 Marks)**

Module-4

7 a. Explain the operation of dual slope integrating type DVM with basic principles and suitable block-diagram. **(08 Marks)**

b. With suitable block diagram, explain the operation of measurement of time briefly. **(07 Marks)**

c. A capacitance comparison bridge is used to measure a capacitive impedance at a frequency of 2kHz. This bridge constants at balance are $c_3 = 100\mu F$, $R_1 = 10K\Omega$, $R_2 = 50K\Omega$, $R_3 = 100K\Omega$. Find the equivalent series circuit of the unknown capacitance. **(05 Marks)**

OR

8 a. With suitable block diagram and table explain the operation of successive approximation DVM. **(08 Marks)**

b. With suitable block diagram approach explain the operation of the digital frequency meter. **(07 Marks)**

c. Find the equivalent parallel resistance and capacitance that causes a Wien bridge to null with the following component values $R_1 = 3.1K\Omega$, $C_1 = 5.2\mu F$, $R_2 = 25K\Omega$, $f = 2.5kHz$, $R_4 = 100K\Omega$. **(05 Marks)**

Module-5

9 a. Explain the operation of the resistive position transducer with construction and electrical equivalent circuit. **(07 Marks)**

b. In the differential instrumentation amplifier using transducer bridge, $R_1 = 2.2K$, $R_F = 10K$, $R_A = R_B = R_C = 120K$, $E = +5V$ and op-amp supply voltage = ±15V, the transducer is a transistor with the following specifications. $R_T = 120K$ at a reference temperature of 25°C. Temperature coefficient of resistance = -1K/°C. Determine the output voltage at 0°C and 100°C. **(06 Marks)**

c. Explain the PLC structure with block diagram. And also explain the PLC operation with PLC operation diagram. **(07 Marks)**

OR

10 a. Explain the operation of the LVDT with construction, various core positions of it, and variation of output voltage vss displacement. **(10 Marks)**

b. What is the significance of analog weight scale? Using strain gauge bridge circuit for analog weight scale explain its operation briefly. **(05 Marks)**

c. With Bell circuit diagram, explain the operation of the Programmable Logic Controller (PLC) relays. **(05 Marks)**

* * * * *

Regarding Modification of Scheme and Solutions 18EC36 and 18EC32

"Manjunatha P" <manjup.jnnce@gmail.com>

May 26, 2022 2:02 PM

To: boe@vtu.ac.in

Dear Sir,

As per the query from the evaluation center, there are no issues in the subject Power Electronics and Instrumentation 18EC36 and also There are no issues in the Question paper for the subject 18EC32 Network Theory, but the following correction is considered in its scheme for Q 1 b). The same is attached. This is for your kind information.

—
Dr. Manjunatha. P
B.E. ,M.E. ,Ph.D IIT Bombay, Mumbai
Professor & Head
Department of Electronics & Communication Engineering
JNN College of Engineering, Shimoga
Karnataka 577204
Mob No: 09964378365
Personal home page http://jnnce-ece-manjunath.weebly.com/

"APPROVED"
Registrar (Evaluation)
Visvesvaraya Technological University
BELAGAVI - 590018

Comments from BoE of ECE/ETE Board for the following subjects towards Scheme and solution

Dear Sir,

#	Code	Subject Name	Comments from BoE ECE/ETE
1.	18EC36	Power Electronics and Instrumentation	As per the scrutiny from BoE members, There are no issues in Question paper and its scheme is correct.
2.	18EC32	Network Theory	As per the scrutiny from BoE members, There are no issues in Question paper but the following correction is considered in its scheme for Q 1 b). The same is attached.

Hence the same may be considered for the further process

With regards

Dr. Manjunatha
Chairman BoE for ECE/ETE
Professor & Dean Academics JNN College of Engineering
Shimoga

"APPROVED"
Registrar (Evaluation)
Visvesvaraya Technological University
BELAGAVI - 590018

Visvesvaraya Technological University
Belagavi, Karnataka - 590 018

190918EC3613918

Signature of Scrutinizer

Scheme & Solution

Subject Title : Power Electronics & Instrumentation Subject Code : 18EC36

Question Number	Solution	Marks Allocated
	Module-1	
1 a)	i) Ac to Dc converters ii) choppers iii) Inverters iv) cyclo converters v) Ac regulators.	(2)
	significance, function and applications of each one	(5) 7
b)	circuit diagram	(1)
	V-I charcterstics	(3) 8
	Explanation	(4)
c)	Basic UJT Structure	(1)
	UJT symbol	(1)
	UJT equivalent circuit	(1)
	Explanation	(2) 5
	-OR-	
2 a)	Sectorwise Applications in PE : i) Home appliances ② Gaming and entertainment ③ commertial ④ Aerospace ⑤ Automotive ⑥ Industrial ⑦ medical ⑧ Security ⑨ Telecommunications ⑩ Transportation ⑪ Utility systems 1 sector × 1 marks (at least 7 sectors)	(7) 7
b)	As the SCR is triggered, the current will rise exponentially in the inductive circuit.	
	$i(t) = \frac{V}{R}(1 - e^{-t/\tau})$ where $\tau = L/R = \frac{0.5}{20} = 0.025s$	(2)
	$i(t) = \frac{100}{20}(1 - e^{-t/0.025})$	5
	At $t = 50\mu s$, $i(50\mu s) = 5(1 - e^{-50\times10^{-6}/0.025}) = 0.99mA$	(3)
	$\therefore$ SCR will not get fired	
c)	Resistance firing circuit	(2)
	associated Voltage w/fs	(2)
	Explanation with expressions	(4) 8

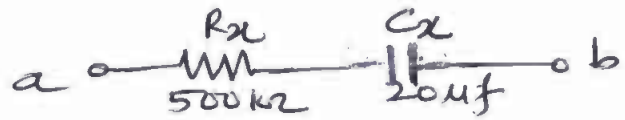
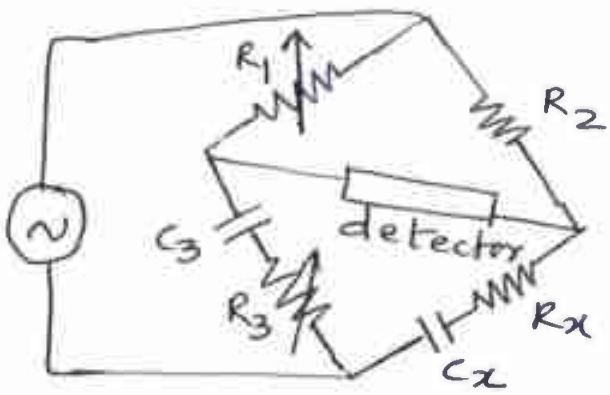
Subject Title : Power Electronics & Instrumentation Subject Code : 18EC36

Question Number	Solution	Marks Allocated
	Module-2	
3 a)	circuit diagram of 1φ HW controlled rectifier with resistive Load	(2)
	Waveforms	(3)
	Explanation	(5)
		10
b)	class A chopper class B —"— class C —"— class D —"— class E —"— } configuration and Explanation	(5)
		5
c)	The average value of the load current = $\frac{I_1+I_2}{2}=\frac{11+12}{2}$ = 11A	(1)
	The minimum value of load current = $\frac{100}{5}$ = 20A.	(1)
	Average value of the voltage = E_{av} = 100 × 11/20 = 55V	(1)
	$T_{on}/T_{on}+T_{OFF} = E_{av}/E_{dc} = 55/100 = 0.55$	(1)
	$\therefore T_{ON} = 0.55(T_{ON}+T_{OFF})$ ie $T_{ON}/T_{OFF} = 0.55/0.45 = 1.222$	(1)
		5
	— OR —	
4 a)	Half wave controlled rectifier with a freewheeling diode	(2)
	Waveforms	(3)
	Explanation	(5)
		10
b)	Step-up/Down chopper circuit	(2)
	Explanation with derivation	(5)
		7
c)	$E_o = E_{dc}(T_{ON}+T_{OFF})/T_{OFF}$	(1)
	$500 = 220(T_{ON}+80\times10^{-6})/80\times10^{-6}$	
	$\therefore T_{ON} = 101.6\times10^{-6} = 101.6\,\mu sec$	(2)
		3
	Module-3	
5 a)	ckt diagram	(2)
	waveforms	(3)
	Explanation	(5)
		10
b)	circuit diagram	(3)
	Waveforms	(3)
	Explanation	(4)
		10

Subject Title : Power Electronics & Instrumentation Subject Code : 18EC36

Question Number	Solution	Marks Allocated
	— OR —	
6 a)	Explanation on Gross error	(2)
	Systematic errors	(1)
	Instrumental errors	(2)
	Environmental errors	(1)
	observational errors	(1)
b)	Multirange Voltmeter circuit	(2)
	circuit with multipliers connected in Series string	(2)
	Explanation	(3)
c)	Given $I_m = 1mA$ and $R_m = 100\Omega$	
	case 1) for the range 0-10 mA	
	$R_{sh1} = \frac{I_m \cdot R_m}{I - I_m} = \frac{1mA \times 100}{10mA - 1mA} = \frac{100}{9} = 11.11(\Omega)$	(2)
	case 2) for the range, 0-20mA	
	$R_{sh2} = \frac{I_m \cdot R_m}{I - I_m} = \frac{1mA \times 100}{20mA - 1mA} = \frac{100}{19} = 5.2(\Omega)$	(2)
	case 3) for the range, 0-50mA	
	$R_{sh3} = \frac{I_m \cdot R_m}{I - I_m} = \frac{1mA \times 100}{50mA - 1mA} = \frac{100}{49} = 2.041\Omega$	(2)
	Module-4	
7 a)	basic principles of dual Slope DVM	(2)
	Block diagram	(3)
	Explanation	(3)
)	Basic block diagram of time measurement	(3)
	Explanation	(4)
c)	Finding R_x using the equation	
	$R_x = R_2 R_3 / R_1 = \frac{100k \times 50k}{10k} = 500k\Omega$	(2)
	Then, finding C_x using the eq.n	
	$C_x = R_1/R_2 \times C_3 = \frac{10k}{50k} \times 100 \times 10^{-6} = 20\mu F$	(2)

Subject Title : Power Electronics & Instrumentation Subject Code : 18EC36

Question Number	Solution	Marks Allocated
	The equivalent series ckt   Capacitance Comparison bridge. (1)	5
	– OR –	
8 a)	block diagram of Successive approximation DVM (3) Table (2) Explanation (3)	8
b)	block diagram of digital frequency meter (3) Explanation (4)	7
c)	Given $\omega = 2\pi f = 2 \times 3.14 \times 2500 = 15.71$ K rad/s. $R_1 = R_4/R_2\left(R_1 + \frac{1}{\omega^2 R_1 C_1^2}\right) = \frac{100k}{25k}\left(3.1k + \frac{1}{(15.71)^2(3.1k)(5.2\times10^{-6})^2}\right) = 12.4k\Omega$ (2) $C_2 = \frac{R_2}{R_4}\left(\frac{C_1}{1+\omega^2 R_1^2 C_1^2}\right) = \frac{25k}{100k}\left(\frac{5.2\times10^{-6}}{1+(15.71k)^2\times(3.1k)^2 \times (5.2\times10^{-6})^2}\right)$ $= 1.3\times10^{-6}\left(\frac{1}{1+64133.07}\right)$ $= 20.3$ pf (3) The value of C_3 can also be found out by using eqn $C_3 = \frac{1}{\omega^2 C_1 R_1 R_3}$.	5
	Module-5	
9 a)	construction of resistance position transducer (2) circuit (1) Explanation (4)	7

Subject Title : Power Electronics & Instrumentation Subject Code : 18EC36

Question Number	Solution	Marks Allocated
b)	At 25°C, $R_A = R_B = R_C = 120K$ ∴ when bridge is balanced ($V_a = V_b$) or $V_o = 0$ At 0°C, the $\Delta R = \frac{(-1K)}{°C} \times (0°C - 25°C) = 25K$ ∴ o/p voltage = $V_o = \frac{-(\Delta R)E}{2(2R+\Delta R)} \times \frac{R_F}{R_1}$ $V_o = \frac{-(25K) \times 5}{2(240K+25K)} \times \frac{10K}{2.2k} = -1.07V$	(3)
	Illy at 100°C, $\Delta R = \frac{(-1k)}{°C} \times (100°C - 25°C)$ $\Delta R = -75k\Omega$.	(1)
	and $V_o = \frac{-(-75K) \times (5)}{2(240K+74K)} \times \frac{10K}{2.2k} = 5.17V$.	(2)
c)	PLC structure with Explanation PLC operation diagram and Explanation	(4) (3)
	— OR —	
10 a)	construction of LVDT	(2)
	Various core positions of LVDT	(2)
	Variation of output Voltage Vss displacement	(2)
	Explanation	(4)
b)	Diagram of strain gauge bridge circuit for Analog weight Scale	(2)
	Explanation	(3)
c)	Relay circuit diagram	(2)
	Explanation	(3)

"APPROVED"
Registrar (Evaluation)
Visvesvaraya Technological University
BELAGAVI - 590018