December 2023

M.Sc. Physics Semester-I

Electronic Devices (MPH-104)

Time: 3 Hours   Max. Marks:75

Instructions:
1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of non-programmable scientific calculator is allowed.*

		PART -A	
Q1	(a)	Show that $I_C = \beta I_B + (1+\beta) I_{CBO}$, where the symbols have their usual meanings.	(1.5)
	(b)	In a transistor, the emitter current I_E = 1.2 mA, and β = 60. Find α, I_B and I_C.	(1.5)
	(c)	Find the pinch off voltage in an n-channel JFET at 300K with a donor concentration of 2×10^{16} cm^{-3} and junction thickness of 8.75 μm. (Given dielectric constant of Si=12).	(1.5)
	(d)	What is the difference between a wafer and a chip?	(1.5)
	(e)	Discuss the rectifying and ohmic contacts.	(1.5)
	(f)	Define CMRR and Slew-Rate in an Op-Amp.	(1.5)
	(g)	Draw the circuit of a non-inverting Op-amp of gain 11 with R_1 = 1kΩ.	(1.5)
	(h)	Draw the circuit diagram of clocked RS flip-flop using NAND gates only.	(1.5)
	(i)	How long will it take to load an 8-bit binary number in a serial in-parallel out (SIPO) shift register if the clock is 1MHz.	(1.5)
	(j)	Define ROM, EPROM and EEPROM.	(1.5)
		PART -B	
Q2	(a)	With suitable circuit diagram using n-p-n transistor in CE configuration, draw and discuss the input and output I-V characteristics. How a phase shift of 180° is obtained in output voltage w.r.t. the input voltage in CE amplifier?	(10)
	(b)	Compare CB, CE and CC amplifiers in terms of input impedance, output impedance, current gain and voltage gain.	(5)
Q3	(a)	Draw the structure of a p-channel JFET. Give its circuit symbol. Discuss the working and hence explain the I-V characteristics of a p-channel JFET.	(10)
	(b)	Explain how potential barrier arises in a Metal-semiconductor rectifying contact.	(5)
Q4	(a)	Discuss the steps involve in the fabrication process of ICs starting from the crystal growth, oxidation, lithography, etching, impurity doping, contacts and metallization using suitable flow diagram.	(10)
	(b)	Explain weak inversion condition and strong inversion condition in MOS junction diode.	(5)
Q5	(a)	Explain how an operational amplifier is used to perform the mathematical operation of differentiation. If a sine wave of 1V peak at 1000 Hz is applied to the differentiator	(10)

		$V_o = -(V_1 + 4V_2 + 2V_3)$; where V_o is the output voltage and V_1, V_2 and V_3 are the input voltages.	
Q6	(a)	Why IC-555 timer is called so? Draw the circuit for an Astable multivibrator using IC-555 and explain its operation. Derive an expression for the frequency and duty cycle of the output waveform. Discuss the condition of 50% duty cycle.	(10)
	(b)	Differentiate between Static and Dynamic RAM. For a 32-bit system, a memory is specified as 1GB. How many memory locations are there?	(5)
Q7	(a)	What is race-around condition? Explain with suitable diagram how the racing problem is resolved in Master-Slave JK flip-flop circuit.	(8)
	(b)	Design a MOD-10 up counter using T-type Flip-flops. Explain its working and draw the output timing-waveform.	(7)

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