**TDC (CBCS) Even Semester Exam., 2023**

PHYSICS

**( 6th Semester )**

Course No. : PHSDSE–602T

**( Physics of Devices and Communications )**

*Full Marks* : 70
*Pass Marks* : 28

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

SECTION—A

Answer any *twenty* questions from the following : 1×20=20

**1.** What is the main characteristic of a UJT (unijunction transistor)?

**2.** What is the $SiO_2$-Si based MOS device?

**3.** What is the equivalent circuit of a JFET for small signals?





**4.** Draw the block diagram of a power supply.

**5.** What is the main application of JFETs in electronic circuits?

**6.** What are IC regulators?

**7.** What is load regulation in voltage regulator?

**8.** What is a high-pass filter?

**9.** What is the function of an inductor in a filter?

**10.** What is an active filter?

**11.** What is IC fabrication?

**12.** What are lattice defects?

**13.** What is optical lithography?

**14.** What is the oxidation technique used for Si in IC fabrication?

**15.** What is the purpose of the lift-off technique in IC fabrication?

**16.** What is the difference between optical and electron lithography?

**17.** What are the different types of USB connectors?

**18.** What is the maximum cable length allowed for USB 3·0?

**19.** GPIB is an acronym for what?

**20.** What is the purpose of handshaking in GPIB?

**21.** What is the maximum data transfer rate for bulk transfers and interrupt transfers?

**22.** What is modulation index and how does it affect the AM waveform?

**23.** What is CE amplitude modulator and how is it used in an AM transmission?

**24.** What are phase and pulse modulation and how do they relate to frequency modulation?

**25.** What are the sideband frequencies in an AM wave and how are they related to carrier frequency? How is an AM wave demodulated using a diode detector?





SECTION—B

Answer any *five* questions from the following : 2×5=10

**26.** Discuss the working principle and applications of a tunnel diode.

**27.** Give an example of an electronic circuit where a JFET is commonly used, and explain its role in the circuit.

**28.** Explain the basic principles of a phase-locked loop, including the role of a phase detector and voltage-controlled oscillator.

**29.** Describe the operation of an astable multivibrator using transistors and its application.

**30.** How is feature size control achieved in IC fabrication, and what is the role of wet anisotropic etching in this process?

**31.** What is the basic process flow for IC fabrication and what are the key steps involved?

**32.** How can a GPIB interface be implemented on PC and which hardware and software are needed?

**33.** What is a COM port, and how is data typically sent through it in digital communication?

**34.** What is frequency modulation and how does it differ from amplitude modulation?

**35.** Draw the block diagram of an electronic communication system. What are the functions of each block?

SECTION—C

Answer any *five* questions from the following : 8×5=40

**36.** Explain the principle of operation of a tunnel diode and derive its current-voltage characteristics. Also, describe its applications in microwave devices and oscillators. 5+3=8

**37.** Explain the frequency limits of MOSFETs, and discuss the factors affecting their high-frequency performance. Also, compare the performance of enhancement mode and depletion mode MOSFETs. 5+3=8





**38.** Describe the basic principles of a phase-locked loop (PLL). Draw and explain the block diagram of a PLL system, and describe the working principle of the phase detector. Also, discuss the design and applications of voltage-controlled oscillators (VCOs) using a varactor. 2+3+3=8

**39.** Explain the working principle of multi-vibrators, and draw the circuit of astable and monostable multivibrators using transistors. Discuss the applications of multivibrators in digital circuits and waveform generations. 4+4=8

**40.** Describe the basic process flow for IC fabrication, and explain each step involved in the process. Also, discuss the requirements of electron grade silicon and the methods used to obtain it. 4+4=8

**41.** Discuss the role of diffusion and implantation in the formation of doped regions in semiconductor devices, including the different doping techniques and their impacts on device parameters.

**42.** Discuss the oxide layer in ICs and explain the oxidation technique used for Si. Describe the different types of oxidation processes and their advantages and disadvantages. 4+4=8

**43.** Describe the different types of COM ports and their characteristics. Discuss the different modes of operations in COM port communication such as polling, interrupt-driven and DMA. 4+4=8

**44.** Design a complete AM radio receiver using a block diagram of the electronic communication system.

**45.** Derive the equations for FM wave and explain modulation and demodulation.

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