

Sl No. of Ques. Paper : 6229 F-5  
Unique Paper Code : 2221503  
Name of Paper : Physics of Devices and Instruments  
Name of Course : Erstwhile FYUP B.Sc. (Hons:) Physics  
Semester : V  
Duration : 3 hours  
Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all. Q. No. 1 is compulsory. All questions carry equal marks.  
Non-programmable calculators are allowed.

1. Attempt five of the following:

- Give the circuit diagram of a dc power supply using bridge rectifier and pi-section filter.
- Draw the circuit for a monostable multivibrator using transistors.
- Design a UJT as a relaxation oscillator for 5 kHz.
- List three advantages of electrical transducers.
- Sketch the waveshape of a PAM and PWM wave.
- Distinguish between active and passive transducers. Give one example of each.
- Briefly explain the working of a voltage controlled oscillator.
- State the significance of threshold voltage in an enhancement type MOSFET.

3×5 = 15

2. (a) Draw the equivalent circuit of a UJT.

(b) Derive the I-V relation for an n-channel enhancement MOSFET.

(c) Find the depletion width of a Schottky diode for Au/Si semiconductor with  $N_d = 10^{15}$  per  $\text{cm}^3$  and  $V_{bi} = 0.43$  V. (Given  $\epsilon_r = 12$  and  $\epsilon_o = 8.854 \times 10^{-14}$  F/cm.)

2,10,3

3. (a) Draw the drain and transfer characteristic curves of an n-channel JFET. What is meant by pinchoff in JFET? Explain why the current remains constant after pinchoff.

- (b) Distinguish between accumulation, depletion and inversion for an ideal MOS configuration with help of energy band diagrams.
- (c) Find the maximum width of the depletion region for a MOS capacitor on  $p$ -type Si with  $N_a = 10^{15}$  per  $\text{cm}^3$ ,  $N_i = 1.5 \times 10^{10}$  per  $\text{cm}^3$ . (Given  $\epsilon_r = 12$  and  $\epsilon_0 = 8.854 \times 10^{-14}$  F/cm,  $V_T = 26$  mV.) 7,3,5
4. (a) Give the schematic block diagram of PLL and explain its working.
- (b) Discuss the working of edge triggered phase detector and plot the variation of output voltage with phase difference.
- (c) Derive the expressions for gain magnitude and phase angle of a first order high pass Butterworth filter. 5,5,5
5. (a) Distinguish between line and load regulation.
- (b) Draw the block diagram of a shunt voltage regulator and explain its working.
- (c) Explain the working of an astable multivibrator using transistors. Give the necessary diagrams. 3,6,6
6. (a) What is signal conditioning? Give a schematic block diagram of a dc signal conditioning system.
- (b) A strain gauge of gauge factor of 2 is cemented to a steel chamber and subjected to a strain of  $1 \times 10^{-6}$ . If the original resistance is  $150 \Omega$  calculate the change in resistance.
- (c) With the help of a diagram explain the construction and working of a LVDT. Obtain the expression of its gain magnitude. 4,3,8
7. (a) Obtain the frequency components and the total power contained in an AM wave.
- (b) Give the circuit diagram of a diode detector and explain its working.
- (c) A carrier wave of 200 watts is subjected to 50% amplitude modulation. Determine the power of the modulated wave and power contained in each of the side bands. 6,5,4