

This question paper contains 3 printed pages]

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S. No. of Question Paper : 1382

Unique Paper Code : 2221503

F-7

Name of the Paper : Physics of Devices and Instruments

Name of the Course : Erstwhile FYUP

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.

Question No. 1 is compulsory.

All questions carry equal marks.

Non-programmable calculators is allowed.

1. Attempt any *five* of the following :

5×3=15

- (a) Define the lock and capture ranges of a PLL.
- (b) Define ASK, PSK and FSK.
- (c) Explain briefly the working of a voltage controlled oscillator.
- (d) Give *three* differences between MOSFET and JFET.
- (e) Define modulation index for an AM wave. What happens when the modulation index is more than 100% ?
- (f) State the working principle of a thermistor.
- (g) What is the advantage of a shunt voltage regulator over a series voltage regulator ?
- (h) Explain the working principle of CCD.

P.T.O.

2. (a) Sketch the cross-section of an n -channel depletion MOSFET and explain its working.
 (b) Distinguish between enhancement and depletion mode MOSFET.
 (c) Obtain the expression for the time period of oscillations of a UJT relaxation oscillator. 6,3,6
3. (a) Derive an expression for the drain current of an n -channel JFET.
 (b) An n channel JFET at 300K has a doping concentration of $N_a = 10^{18}$ per cm^3 , $N_d = 10^{16}$ per cm^3 . Assume a junction thickness of $a = 0.75 \mu\text{m}$. Find the pinch off voltage (Given : $\epsilon_r = 12$ and $\epsilon_0 = 8.854 \times 10^{-14}$ F/cm).
 (c) Draw labeled energy band diagrams for Schottky and Ohmic contacts ? 8,3,4
4. (a) Explain the working of a monostable multivibrator using transistors. Give the necessary circuit diagrams.
 (b) Discuss the working of an Exclusive-OR phase detector.
 (c) Design a wide band pass Butterworth filter with $f_L = 500$ Hz, $f_H = 2$ kHz and a passband gain of 4. Given $C = 0.01 \mu\text{F}$. Find its quality factor. 6,4,5
5. (a) Derive the expressions for the gain magnitude and phase angle of a first order low pass Butterworth filter. Plot the frequency response of the filter.
 (b) Explain with help of a circuit diagram how short circuit protection is achieved to limit the load current in a series regulator circuit.
 (c) A certain power supply has a 12V output when there is no load. At full load current of 10mA, the output voltage is 11.9V. Determine the percentage load regulation. 6,6,3

6. (a) What are transducers ? List *four* ideal characteristics of a transducer.
- (b) Explain the working principle of a piezoelectric transducer.
- (c) Derive an expression for gauge factor for a bonded resistance strain gauge.
- (d) A platinum resistance thermometer has a resistance of 100Ω at 25°C . At a certain temperature, the thermometer has a resistance of 200Ω . Calculate the value of the temperature. Given $\alpha = 0.00392$ per $^\circ\text{C}$. 3,3,6,3
7. (a) What is the basic difference between analog and digital modulation ? Define PAM, PWM, PPM.
- (b) Draw the circuit of a CE amplitude modulator and derive the expression for its output.
- (c) Peak to peak value of an AM wave has maximum value of 8V (E_{max}) and minimum value of 2V (E_{min}). Find the percentage modulation and amplitude of the unmodulated carrier wave. 4,7,4