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3 (Sem-5/CBCS) PHY HE 4

2022

## PHYSICS

(Honours Elective)

Paper : PHY-HE-5046

**(Physics of Device and Instruments)**

Full Marks : 60

Time : Three hours

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

1. Answer **any seven** questions of the following : 1×7=7
  - (i) Give an example of negative resistance device.
  - (ii) What is a C filter in power supply ?
  - (iii) How can you get band reject filter with a low pass and high pass filters ?

Contd.

- (iv) What do you mean by defects in a lattice?
- (v) If you have both pMOS and nMOS embedded in the same substrate, what will you get?
- (vi) Name *one* technique used for fabrication of integrated circuit MOSFET.
- (vii) What is handshaking in digital communication?
- (viii) Name *one* advantage of FM transmission.
- (ix) Name the *two* types of FET.
- (x) State *one* use of phase locked loop.
- (xi) What is a varactor?
- (xii) What is phase modulation?

2. Answer **any four** questions of the following :  
2×4=8

- (i) What is the basic principle of a charge coupled device?

- (ii) How short circuit protection is achieved in power supply?

- (iii) Draw the block diagram of a phase locked loop.

- (iv) Draw the graphical representation of 100% modulated AM wave.

- (v) What are positive and negative mask in fabrication of IC?

- (vi) A wireless transmitter radiates 4kW with an unmodulated carrier wave and 5.2kW modulated wave. Neglecting distortion, calculate percentage of modulation.

- (vii) State *two* satisfactory condition of detection of envelope diode detector.

- (viii) Explain the operation of NMOS enhancement transistor.

3. Answer **any three** questions of the following : 5×3=15

- (i) Draw the equivalent circuit of an UJT and explain its working. 2+3=5



(ii) Draw the energy band diagram of an ideal MOS capacitor and define depletion and accumulation mode. What is flat band voltage?  $2+2+1=5$

(iii) Draw the block diagram of a power supply. What are line and load regulation?  $3+2=5$

(iv) Draw the pin out diagram of IC 565. How can it be used as VCO?  $3+2=5$

(v) Write the disadvantages of XOR frequency detector circuit. Explain how it can be removed in phase frequency detector.  $1+4=5$

(vi) What is the main purpose of UART? Briefly describe the UART communication. Write *two* advantages of UART communication.  $1+3+1=5$

(vii) Explain with diagram the generation of sawtooth wave using UJT.

(viii) What is a loop filter? How does it work?  $2+3=5$

4. Answer **any three** questions :  $10 \times 3 = 30$

(i) Explain with circuit diagram how to produce AM wave with transistor. Show that for 100% modulation power of the modulated wave is 150% of the unmodulated wave.  $6+4=10$

(ii) Show that in FM wave, maximum frequency deviation is proportional to the amplitude of modulating signal but in PM wave it is dependent on both amplitude and frequency of signal.  $5+5=10$

(iii) How does a diode envelope detector work? If a capacitor  $C$  is connected across load  $R$  in the detector, what is the condition for the product of  $RC$  to detect 100% modulated wave?  $3+7=10$

(iv) With a circuit diagram, explain the working of an astable multivibrator. What is the frequency of this vibrator? What should be minimum value of current gain  $\beta$  to ensure oscillations?  $8+1+1=10$



- (v) Draw a low pass active filter and a high pass active filter. Also draw the frequency response curves of both the filters showing 20dB/decade line. What are their cut-off frequencies?

$$2+2+2+2+2=10$$

- (vi) Write short notes on **any two** of the following :

$$5 \times 2 = 10$$

- (a) Crystal plane and orientation
- (b) Optical lithography
- (c) Electron lithography
- (d) General Purpose Interface Bus and Signals
- (e) Metallisation Technique in IC fabrication

- (vii) What is RS-232 protocol? Explain RS-232 communication in terms of protocol format? Specify the function of each pin of DB9 connectors.

$$1+4+5=10$$

- (viii) Explain the working principle of a VCO. What is free running frequency? Draw schematically the capture and lock range in reference to free running frequency.

$$5+1+2+2=10$$