Reg. No. | | | | | | | | | |

PHS 557

IV Semester M.Sc. Degree Examination, September/October 2022
PHYSICS
Electronics – IV (CBCS)

Time : 3 Hours Max. Marks : 70

Note : *Answer **any four** questions choosing **one** from **each** of the Parts – **I** to **IV** and **two** questions in Part – **V**.*

PART – I

1. a) Draw the block diagram of a simple optical fiber link and name different parts in it. Highlight the main advantages of optical fiber as communication medium. **5**

   b) Explain the following attenuation mechanisms in an optical fiber :
      i) Absorption
      ii) Scattering. **5**

   c) What is an optical connector ? With the help of diagram, explain butt-joint connector. **5**

2. a) With neat diagrams, explain the structural and dimensional features of multimode step index optical fiber. **5**

   b) What is modal delay in multimode fibers and why it is caused ? Explain how modal delay can be reduced. **5**

   c) What is an optical splice? With the help of diagram, explain elastic-tube splice. **5**

PART – II

3. a) With neat diagrams, explain the output characteristics of LED and Laser diodes. Explain why laser diodes are suited for high speed optical links. **5**

   b) With neat diagrams, explain the principle and functioning of PIN photo diode. **5**

   c) With an example, illustrate how the power budget analysis of a point-to-point optical link is established. **5**

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4. a) Mention the different types of single mode laser devices used for high-speed long distance communications. With diagram, explain the structure of vertical cavity surface emitting laser. **5**

   b) With neat diagrams, explain the structure, principle and functioning of avalanche photo diode. **5**

   c) Draw the block diagram of a simple optical fiber receiver and name different parts in it. Highlight the various noise sources which lead to performance degradation of the receiver. **5**

PART – III

5. a) Define linearity, stability and causality properties of discrete time systems. Certain system is defined by the input-output relation y[n] = Ax[n] + B where y[n] is the output for input x[n] and A and B are constants. Test whether this system is linear and stable. **5**

   b) Explain the time shifting, differentiating and convolution properties of Z- transform. **5**

   c) Determine inverse Z-transform of $H(z) = \frac{z}{\left(z+\frac{1}{4}\right)\left(z-\frac{1}{2}\right)}$, with ROC

      i) $|z| > 1/2$

      ii) $|z| < 1/4$. **5**

6. a) Explain the following classification of discrete time signals. Give one example for each.

      i) Periodic and non-periodic signals

      ii) Even and odd symmetric signals

      iii) Power and energy signals. **5**

   b) Determine the frequency response of the discrete time LTI system described by the impulse response $h[n] = (0.25)^n u[n]$. **5**

   c) Determine Z-transform of the signal $x[n] = (0.5)^n \cos(2\pi n/3)\, u[n]$. Plot the poles and zeroes and indicate the ROC. **5**

PART – IV

7. a) Define the circular convolution between two discrete time signals. Explain analytically how circular convolution can be computed using DFT with an example. **5**

b) Explain the impulse invariant transformation method of S-plane to Z-plane mapping in designing IIR filters. **5**

c) What is an IIR filter ? Describe qualitatively the steps involved in designing IIR filters using bilinear transformation method. **5**

8. a) Define N-point DFT of a signal. Draw the signal flow diagram of the Fast Fourier Transform algorithm for efficient calculation of 8-point DFT of a signal. **5**

b) With suitable example, describe the direct form I and II realization of IIR filters. **5**

c) What is linear phase FIR filter ? Describe qualitatively the steps involved in designing such filters using window functions. **5**

PART – V

9. Answer **any two** of the following. **(2×5=10)**

a) A silica step index has a core refractive index of 1.48 and a cladding refractive index 1.46. Determine the critical angle at the core-cladding interface, the numerical aperture for the fiber and the acceptance angle for the fiber. What should be the core diameter for single mode operation at 1300 nanometer wavelength ?

b) Explain the terms Quantum efficiency and Response speed of photo diodes. Why practical diodes with high quantum efficiency have generally low response speed ?

c) Explain the process of sampling continuous time signals. Analog speech signal is passed through low pass filter with cut-off frequency 15 kHz before sampling. What should be the minimum sampling frequency ?

d) Sketch the CSOS realization structures for the IIR filter described by the system function $H(z) = \dfrac{(1 - z^{-1} + 2z^{-2})\,(3 - 2z^{-2})}{(1 + 4z^{-2})\,(1 - 0.5z^{-1} + 0.25z^{-2})}$.

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