



বিদ্যাসাগর বিশ্ববিদ্যালয়  
**VIDYASAGAR UNIVERSITY**  
**Question Paper**

**B.Sc. Honours Examinations 2022**  
(Under CBCS Pattern)  
**Semester - VI**  
**Subject : PHYSICS**  
**Paper : DSE 4 - T**

**Full Marks : 60**

**Time : 3 Hours**

*Candidates are required to give their answers in their own words as far as practicable.  
The figures in the margin indicate full marks.*

[ DIGITAL SIGNAL PROCESSING ]

**Theory**

**(Marks : 40)**

**Group - A**

Answer any **four** questions :

5×4=20

1. What is phase delay and group delay? 5
2. Write down the properties of DTFT? 5
3. Define ROC in z-transform? 5
4. What are the properties of convolution? 5

5. What is an LTI system? Write down its properties. 5
6. Discuss the convergence of DTFT for energy and power signals. 5

**Group - B**

Answer any *two* questions : 10×2=20

1. Find the linear convolution of the sequences  $x[n]$  and  $h[n]$  using DFT and IDFT;  $x[n] = \{1, 0, 2\}$  and  $h[n] = \{1, 1\}$  10
2. Find out the z-transform of the sequence :  $x[n] = a^n$ . Using the result, find out the z-transform of the sequence :  $na^n$ . 5+5
3. Discuss the advantages and disadvantages of digital filters over analog filter. Define IIR and FIR filters. Compare them. 5+2+3
4. Use the 8-point radix-2 DIT FFT algorithm to find the DFT of the sequence  $x[n]=\{0.707, 1, 0.707, 0, -0.707, -1, -0.707, 0\}$ . 10

**Practical (Theory Based)**

(Marks : 20)

**Group - A**

Answer any *one* question : 5×1=5

1. Write a programme to generate and plot ramp sequence. 5
2. Design a digital filter to eliminate the lower frequency sinusoid of  $x(t)=\sin 5t+\sin 500t$ . The sampling frequency is  $f_s = 400$  Hz. 5
3. Given a casual system :  $y(n) = 0.9y(n-1) + x(n)$ , Find  $H(z)$ . 5

**Group - B**

Answer any *one* question : 10×1=10

1. Using a rectangular window, design a FIR low-pass filter with a pass-band gain of unity, cut off frequency of 1.5 kHz and working at a sampling frequency of 6 KHz. Take the length of the impulse response as 17. 10

2. Design an FIR filter to meet the following specifications : pass band edge  $F_p = 2$  KHz, stop band edge  $F_s = 5$  KHz Pass band attenuation  $A_p = 2$  dB Stop band attenuation  $A_s = 42$  dB Sampling frequency  $F_s = 20$  KHz. 10

**Group - C**

Answer the question :

3. An LTI system is specified by the difference equation  $y(n) = 0.8y(n-1) + x(n)$ . Calculate and plot the steady state response  $y_{ss}(n)$  to  $x(n) = \cos(0.5\pi n)u(n)$ . 5

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OR

[ BIOLOGICAL PHYSICS ]

Group - A

Answer any *five* questions :

2×5=10

1. Write the names of four main classes of macromolecules by which the organisms are composed of.
2. What do you mean by nucleotides?
3. Which molecule is mostly responsible for storing chemical energy in the cell.
4. What is the role of DNA helicase in DNA replication?
5. What is transcription process ?
6. What are stem cells?
7. Define food web and food chain.
8. How does the neuron carry our sensation through them?

Group - B

Answer any *four* questions :

5×4=20

1. Write in brief the functions of the proteins in the cell. 5
2. Discuss how the information encoded in DNA is converted into the amino acid sequences of proteins with necessary diagram. 5
3. Compare Darwin theory with the theory of Lamark. 5
4. Explain pattern formation citing some examples. 5
5. Explain the role of activator and repressor in genetic circuit. 5
6. What is Mendelian ratio? Explain this ratio for (a) an AA × AA cross, (b) an AA × Aa cross, and (c) an Aa × Aa cross. 1+4

**Group - C**

Answer any *three* questions :

10×3=30

1. What is Metabolism? Discuss on the energy budget required to build a cell highlighting the biosynthetic cost for protein synthesis in an E. Coli cell. 2+8
  2. Discuss the powers of 10 representation of biological length scales. Explain the 'Universality of microscopic processes and diversity of macroscopic form' in biological systems. 5+5
  3. Calculate the probability for RNA polymerase binding to its promoter by assuming a suitable partition function. 10
  4. What are the types of synapses carried by neurons? Explain the mechanism of flow of information through neurons (describe briefly action potential, depolarization and voltage-gated  $\text{Ca}^{++}$  channel).
  5. Explain the concept of genotype and phenotype. What is the difference between 'blending heredity' proposed by Darwin and 'Mendelian heredity' ?
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OR

## [ EXPERIMENTAL TECHNIQUES ]

Full Mark : 40

Time : 2 Hours

Answer any *four* from Q1 to Q6 and answer any *two* from Q 7 to Q10.

1. (a) Explain the average deviation and standard deviation. 2
- (b) A set of 10 independent measurements were made to determine radius of the bob of a simple pendulum. The measurement values in cm were 1.570, 1.597, 1.591, 1.562, 1.577, 1.580, 1.564, 1.586, 1.550 and 1.575. Determine (i) the arithmetic mean, (ii) the average deviation and (iii) the standard deviation. 3
2. Two resistor have the following values :  $R_1 = 200\Omega \pm 10\%$ ,  $R_2 = 100\Omega \pm 5\%$ . Determine the magnitudes of resistances and the limiting errors if they are connected in (a) series (b) parallel. 5
3. (a) Explain periodic and non-periodic signals. 2
- (b) Which signal is better for communication purpose? 1
- (c) From the given signals  $f(t) = \cos 10t + \cos (10 + \pi)t$  and  $f(t) = \sin 4\pi t + \sin 7\pi t$ , find out which signal is periodic and which one is non periodic? 2
4. A rotary pump removes air from a 300 litre chamber at the rate of 0.5 litre/sec. What would be the pressure in the chamber after 20 sec. if the initial pressure were 1 atm. 5
5. Discuss the difference between shielding and grounding. Explain Electrostatic shielding method. 2+3
6. Draw the Block diagram and explain the working principles of RLC Bridge. 5
7. (a) What do you mean by pumping speed of a vacuum pump? Convert 100 pascals into torr.
- (b) Explain with diagram the working principle of the diffusion (Ionization) vacuum pump. What is the working pressure range of rotary pump? (2+1)+(4+2+1)=10
8. (a) What is S/N ratio in measurement system? Explain Shot noise and 1/f noise. 1+3
- (b) Describe the working principle of thermistor and its application. 4
- (c) What is scintillation detector? 2

9. (a) Discuss the difference between digital and analog instrument. 2
- (b) Draw Block diagram of digital multimeter and discuss the principle of measurement of I, V, C. 2+3
- (c) What are the different parameters that can be measured using a Q-meter? What are the factors which affect the measurement accuracy of a Q-meter. 3
10. (a) Define temperature coefficient of resistivity of a thermistor. Give two examples of PTC and NTC thermistors. Write down resistance-temperature relation of NTC thermistors.
- (b) A copper-constantan thermocouple was found to have linear calibration between 0°C and 400°C with emf at maximum temperature (w.r.t to cold junction 0°C) equal to 20 mV. Determine the correction which must be made to the indicated emf. if the cold junction temperature is kept at 20°C. 2+2+2+4=10
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