



বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY
Question Paper

B.Sc. Honours Examinations 2022

(Under CBCS Pattern)

Semester - VI

Subject : PHYSICS

Paper : DSE 3 - T

Full Marks : 40

Time : 2 Hours

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

[MEDICAL PHYSICS]

Group - A

Answer any *four* questions :

5×4=20

1. Describe the working principle of Electrocardiogram (ECG). 5
2. How does the Electroencephalogram (EEG) study our brain function? 5
3. Explain Diagnostic of nuclear medicines. Write down the basic idea of Endoscope. 3+2=5
4. How does the CPAP machine work? 5
5. What are the principles working behind our breathing? 5

6. Compare Compton & photoelectric effect. Write short note on absorbed dose. 3+2=5

Group - B

Answer any *two* questions : 10×2=20

1. What is Coolidge tube? Describe X-ray generator circuit with proper circuit diagram. 2+8
2. Explain the working principle of nuclear magnetic resonance (NMR). Hence explain NMR imaging and MRI Radiological imaging. 4+6=10
3. How does the Geiger muller counter and scintillation counter work? Compare them. 4+4+2=10
4. Explain 'Physics' of the nervous system. Explain with schematic diagram how electrical signals and information transfer in human body. 4+6=10

OR

[NANOMATERIALS & APPLICATIONS]

Group - A

Answer any *four* questions : 5×4=20

1. (a) What is the principal behind X-ray crystallography?
(b) How electrons are detected in SEM instruments?
2. What are excitons? Why are excitonic effects more important in nanostructure than in bulk materials?
3. Write short notes on Coulomb blockade effect or hopping conductivity.
4. Describe various stages of a Pulsed Laser deposition process.
5. (a) Briefly explain the meaning of quantum confinement.
(b) What are the important effects of quantum confinement on the properties of nanomaterials?

6. What is the difference between electrical band gap and optical band gap? How can you measure these band gaps experimentally?

Group - B

Answer any *two* questions :

10×2=20

7. (a) Explain the basic differences between a PVD and CVD process.
(b) Why is spatial resolution of STM better than AFM?
8. (a) Explain surface effects on the properties of nano materials.
(b) Write short note on (i) quantum dots. (ii) Carbon Nanotubes.
9. (a) What is a transmission electron microscope (TEM)? What type of information a TEM can provide about a sample?
(b) A cubic quantum dot (QD) of GaAs has $a=7.0$ nm. Calculate the lowest three energy levels. Calculate the same if the dimensions of the QD are $a = 10$ nm, $b = 8$ nm and $c = 12$ nm and $m = 0.067 m_0$.
10. Write short notes on (a) Micro Electromechanical Systems MEMS (b) Nano Electromechanical Systems (NEMS).

OR

[COMMUNICATION ELECTRONICS]

Group - A

Answer any *four* questions :

5×4=20

1. (a) What is the necessity of modulation?
(b) Draw the circuit diagram of simple diode detector and explain its operation to detect audio signal from amplitude modulated (AM) signal. 2+3=5
2. Define noise. Briefly describe the external noise and internal noise with suitable example. 1+4=5
3. (a) Derive the formula for the instantaneous value of an FM voltage and define modulation index.

- (b) A 25 MHz carrier is modulated by a 4000 Hz audio sine wave. If the carrier voltage is 4V and the maximum frequency deviation is 10 KHz, write down the voltage equation of the FM wave. 3+2
4. What access method is used with LTE? How does it work? What do you mean by voice over LTE? 1+2+2
5. Define and describe pulse position modulation and explain with waveforms how it is derived from Pulse Width Modulation (PWM). 5
6. What do you mean by geosynchronous satellite? If the semimajor axis of a geosynchronous earth orbit is 42164 km., determine the orbital velocity of the geosynchronous satellite. 2+3

Group - B

Answer any *two* questions : 10×2=20

7. What are the advantages of digital communication over analog communication? Define and describe pulse code modulation. What do you mean by quantization and encoding? 3+4+3
8. Briefly describe the functional characteristics of an uplink, a transponder and a downlink model for a satellite system. 3+3+4
9. (a) A sinusoidal carrier voltage of frequency 1 MHz and amplitude 100 volts is amplitude modulated by sinusoidal voltage of frequency 5 KHz producing 50% modulation. Calculate the frequency and amplitude of lower and upper sideband terms.
- (b) If the earth station downlink signal received is at $f_s = 4.08$ GHz, What localoscillator frequencies f_{LO} are needed to active Ifs of 770 and 140 MHz? What is the maximum theoretical data rate if one transponder is used for transmission? It is well known that the bandwidth of one transponder channel is 36 MHz.
- (c) What do you mean TDMA and FDMA? 3+(3+1)+3
10. (a) Why is frequency modulation considered to be superior to amplitude modulation?
- (b) What is the maximum bandwidth of an FM signal with a deviation of 30 kHz and a maximum modulating signal of 5 kHz as determined by Carson's rule.

(c) A frequency modulated voltage wave is given by the equation as

$$v_{FM} = 12 \cos (6 \times 10^8 t + 5 \sin 1250t)$$

Find (i) carrier frequency (ii) signal frequency (iii) modulation index
(iv) maximum frequency deviation (v) Power dissipated by the FM wave in
10-ohm resistor. 3+2+5=10

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