

2023

6th Semester Examination

PHYSICS (Honours)

Paper : DSE 3-T

[CBCS]

Full Marks : 40

Time : Two Hours

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

[Medical Physics]

Group - A

Answer any *five* questions : $2 \times 5 = 10$

1. Where do you find phalanx in human skeleton? 2
2. What is a ligament? 2
3. Which two proteins are responsible for dark and light bands on the myofibril? 2
4. What is the role of pectoral bones in the body movement? 2
5. Fill in the blanks : The human cranium is made of _____ bones. 2
6. How does our body lose heat? 2

P.T.O.

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7. What do you mean by cold sweat? 2
8. What is the role of corti in human hearing process? 2

Group - B

Answer any *four* questions : $5 \times 4 = 20$

9. Discuss the basic principle of Mammography. 5
10. Compare cyber knife with gamma knife as a method of radiosurgery. 5
11. Discuss how brachytherapy is different from external beam radiotherapy. 5
12. Write down the working principle of thimble ionization chamber. 5
13. What is the role of cochlea in our ears? What are the common causes of reduced hearing? 3+2
14. What is the cautery procedure? What is monopolar and bipolar cautery? 5

Group - C

Answer any *one* question : $10 \times 1 = 10$

15. In radioisotope imaging, what are the various methods of production of artificial radionuclides? Explain the mechanism of image formation due to interaction of radioisotope with matter? 5+5
16. Draw a clear diagram of X-ray Coolidge tube and label important parts. Define tissue maximum ratio and tissue phantom ratio. 3+3+2+2

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OR

[Nanomaterials and Applications]

Group - A

Answer any *five* questions : $2 \times 5 = 10$

1. Draw the Density of states $D(E)$ as a function of energy (E) for zero, one and two dimensional nanostructure materials.
2. If the position ($\Delta x = 10^{-9} m$) of an electron is accurately determined, calculate the uncertainty of velocity. (Given $m_e = 9.11 \times 10^{-31} kg$)
3. What are the disadvantages of electron beam evaporation technique?
4. When a radiation ($\lambda = 0.154 nm$) is used, the diffraction peak having full width half maxima (FWHM) ~ 0.6 is obtained at an angle $\theta = 35^\circ$. Calculate the crystallites size by considering the Scherrer constant = 0.92.
5. What is quantum confinement in nanomaterials?
6. What do you mean by 'ballistic conduction'?
7. What is the function of photo-resist in context of lithography?
8. Write two applications of a carbon nanotube (CNT).

P.T.O.

Group - B

Answer any *four* questions : $5 \times 4 = 20$

9. What is quantum dot? Define top-down and bottom up approaches. What are the differences between top-down and bottom up approaches? $1+2+2$
10. Write down the basic working principle of hydrothermal method for synthesis of nanostructure materials. What are the advantages of molecular beam epitaxial (MBE) growth technique? $3+2$
11. Explain the basic working principle of Physical Vapor Deposition (PVD) process. 5
12. What is exciton? How is it formed? Why the direct band gap materials are preferred over indirect band gap materials for optoelectronic device application? $1+1+3$
13. Draw the schematic diagram of atomic force microscopy (AFM). Define three modes of operation. $2+3$
14. Write a short note on Micro-electromechanical systems (MEMS). What is NEMS? $4+1$

Group - C

Answer any *one* question : $10 \times 1 = 10$

15. What is SEM? Sketch a schematic diagram of a SEM and discuss its working principle. What is its magnification? How can the magnification of a SEM be improved? $2+5+1+2$

16. (i) Write down the working principle of light emitting diode.
- (ii) The work function of a metal is 2.5 eV . Calculate the density of electrons ejected in thermionic emission at 1227°C . Given $A = 120 \text{ A cm}^{-2}\text{K}^{-2}$ and $K_B = 1.38 \times 10^{-23} \text{ JK}^{-1}$.
- (iii) What is "Mott law" and "Efros-Shklovskii law" for variable range hopping conductivity? How Coulomb gap is formed in the vicinity of Fermi level? Comment on the change of hopping conductivity with the decrease in temperature. 3+2+(2+2+1)
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OR

[Communication Electronics]

Group - A

Answer any *five* questions : $2 \times 5 = 10$

1. What is the necessity of modulation? 2
2. Why frequency modulation is considered to be superior than amplitude modulation? 2
3. What is a vocoder? 2
4. What types of modulation methods are used with 4G cell phones? 2
5. Define Pulse Width Modulation (PWM). 2
6. Write down the advantages and disadvantages of geosynchronous satellites. 2
7. What do you mean by noise? Define signal-to-noise ratio. 2
8. What is the necessity of digital communication? 2

Group - B

Answer any *four* questions : $5 \times 4 = 20$

9. What is the bandwidth of a GSM channel? How many users can share a channel in GSM? Differentiate between GSM and CDMA. $1+1+3$

10. What is the basic function and purpose of a communication satellite? 5
11. What do you mean by frequency shift keying? Determine the peak frequency deviation, minimum bandwidth and baud for a binary FSK signal with a mark frequency of 49 kHz, a space frequency of 51 kHz and an input bit rate of 2 kbps. 2+3
12. What do you mean by information capacity? What is Shanon limit for information capacity? For a standard telephone circuit with a signal to noise power ratio of 1000 and a bandwidth of 2.7 kHz, determine the Shanon limit for information capacity. 5
13. What do you mean by thermal noise? How is the noise power related to different parameters for the noise generated by resistor? An amplifier operating in the frequency range from 18 to 20 MHz has a $10K\Omega$ input resistor. What is the rms noise voltage at the input to this amplifier if the ambient temperature is 27°C ? 2+1+2
14. Derive the formula for the instantaneous value of an AM voltage and define modulation index. Sketch roughly the waveforms of carrier wave, modulating wave and amplitude modulated wave. 3+2

P.T.O.

Group - C

Answer any *one* question : $10 \times 1 = 10$

15. (a) List four major applications of FM.
- (b) State the four main benefits of single sideband (SSB) signal over conventional amplitude modulated (AM) signal.
- (c) What do you mean by transponder? What are the basic functions of transponder? Draw the block diagram of satellite transponder. $2+4+(1+1+2)$
16. (a) Derive the relation between the output power of an amplitude modulated wave and depth of modulation.
- (b) A 400-watt carrier is modulated to a depth of 75%. Calculate the total power in the modulated wave.
- (c) Draw the circuit diagram using transistor for generation of amplitude modulated wave and explain its operation. $4+2+(2+2)$
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