*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

### [Theory]

Answer *any two* of the following: 2×15=30

1. a) Describe with proper diagram the standard anatomical position and planes. (5+2)

   b) Explain the mechanism of blood flow through the heart in the light of Bernoulli's principle. (8)

2. a) Match the following pairs: (2×4)

| Electrocardiogram (ECG) | Eye function |
| Electroencephalogram (EEG) | Brain function |
| Electroretinogram (ERG) | Muscle function |
| Electromyogram (EMG) | Heart function |

b) Calculate the capacitance of an unmyelinated axon with a length of $L = 1m$, a membrane thickness of 10 nm, and a radius of 2.5 micron. Calculate the total amount of charge on the axon surface. (4)

c) What do you mean by axon potential? (3)

3. a) Compare 3DCRT with IMRT. (4)

b) What is LDR and HDR in Brachytherapy? (2)

c) Describe the mechanism of electronic brachytherapy. (9)

4. a) What is radioisotope imaging? (3)

b) What is the instrumentation involved in radioisotope imaging? (4)

c) What is endoscopy? What are the risk factors? (4+4)

Answer *any one* of the following: 1×10=10

5. a) What is CPAP machine? What is it used for? (3+2)

b) Explain its working principle. (5)

6. a) What is OSL dosimetry? (5)

b) Describe in brief the mechanism of a ventilator system. (5)

## [Practical]

Answer *any one* of the following: 1×20=20

7. How would you correct Myopia (short sightedness) using a combination of lenses on an optical bench/bread board. (20)

8. How does Thermoluminescent dosimeter (TLD) badges work? How you can measure the back ground radiation? (10+10)

9. Explain how GM counter measures background radiation. (20)

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## *Or*
## Nano Materials and Applications

## [Theory]

Answer *any two* of the following: 2×15=30

1.  What is Coulomb blockade effect? Discuss the condition for observing Coulomb blockade. Explain the operation of single electron transistor (SET) in this context with appropriate energy-band diagram. 3+4+8

2.  Explain the basic working principle of e-beam evaporation process. Explain the basic differences between a PVD and CVD process. Describe briefly the working principle of HRTEM. 5+5+5

3.  Discuss the components of a Scanning tunneling microscope (STM) and explain its principle of operation. Explain the differences between Scanning tunneling microscope (STM) and atomic force microscope (AFM) 10+5

4.  Deduce Richardson-Dushmann equation of thermionic emission from a metal. Discuss Mott's law of variable range hopping conduction mechanism. 10+5

Answer *any one* of the following: 1×10=10

5.  What is quantum confinement? Use Schrodinger's equation to find the quantized energy of a quantum dot. Also find the density of states for the system. 10

6.  What are excitons? Write Brus equation for the size dependent band gap of semiconductors and explain each term. Sketch the variation of band gap of a semiconductor quantum dot with its particles size. 10

# [Practical]

Answer *any one* of the following: 1×20=20

7. Describe the synthesis of any metal nanoparticle by chemical synthesis method. Schematically show its UV-visible absorption spectrum and explain.

8. Describe the Particle size determination of crystalline material using X-ray diffraction pattern of the material. How will you explain the intensity variation of various diffraction planes?

9. Discuss the fabrication process of a PN diode by diffusing Al over the surface of N-type Si. Sketch its V-I characteristic curve and explain.

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## *Or*
## Communication Electronics

## [Theory]

Answer *any two* of the following:            2×15=30

1. Explain the term sampling and quantizing in pulse code modulation. Derive an expression for SNR for linear quantization. Show that an increase in number of bits in the code word by 1 enhances the output SNR by 6dB in PCM.

2. Draw the wave form of an AM wave with sinusoidal modulation. What is the modulation index? How can you measure the modulation index from the study of the waveform? What value of RC is required when modulation index is small for detection with tolerable distortion?

3. What is reactance modulator? Explain, with a circuit, the working of a BJT reactance modulator for FM generation. Describe elaborately the concept of cell sectoring and cell splitting?

4. How are the shortcomings of a straight forward AM radio receiver eliminated in a superheterodyne radio receiver? Show the basic blocks of a superheterodyne receiver and explain the function of each block. Why is the superhet receiver so named?

Answer *any one* of the following:            1×10=10

5. What is Satellite Communication? Describe the terms- Path Loss, Ground Station, Transponders. What are the advantages of Geostationary Satellites?

                                                               2+6+2

6. What do you mean by time division multiplexing? Draw a block diagram of a TDM system and explain the function of each block.          2+3+5

# [Practical]

7. Draw a circuit diagram to design an amplitude modulator using transistor. Explain its operation. How can you choose the value of the circuit components? What is the outcome of this study?

   What are the advantages of using diode envelope detector using in AM broadcast receiver?

8. To study the ASK, FSK and PSK modulators, write down the necessary theories of each one. Draw the diagrammatical representations.

9. Draw the block diagram to study the AM transmitter and receiver. Explain the operation of each component.

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