

(This Question paper contains 2 printed pages)

Roll No. _____

S.No. of Question Paper : 7977

Unique Paper Code : 2513010026

Name of the paper : Nanomaterials and their Applications (DSE)

Name of the Course : B.sc. (H) Electronics

Semester : VIII

Duration : 3 Hrs

Maximum Marks : 90

Instructions for candidates:

Question No.1 is compulsory

Attempt any five questions in all . All carry equal marks

1. (a) Describe the electrochemical methods of synthesizing conducting polymers. How do they differ from chemical methods in terms of process and applications? 3
- (b) Differentiate between 0D,1D,2D and 3D nanomaterials with suitable examples. 3
- (c) State two advantages of supercapacitors over conventional batteries. 3
- (d) How can nanomaterial be used to optimize renewable energy technologies like solar cell? 3
- (e) How do nanomaterials enhance the performance of rechargeable battery systems? 3
- (f) Explain how nanomaterials are useful for waste water treatment. 3
2. (a) How do nanoscale dimensions alter the behaviour of materials compared to their bulk counterparts? Briefly explain the general reasons behind these changes. 6
- (b) Explain how the principle of quantum confinement in semiconductor nanoparticles makes quantum dot LEDs superior than conventional LEDs? 6
- (c) Why are diblock copolymers useful in nanocomposite preparation? Do nanocomposite often show enhanced mechanical strength compared to conventional composite? If yes, why? 6
3. (a) How does the chirality of CNT influence their properties and govern their applications? 6
- (b) What are nanoscale catalysts? How do they differ from conventional catalysts in terms of surface area and reactivity? 6
- (c) What is the significance of the nanoscale in energy conversion? Why do materials behave differently at the nanoscale compared to their bulk counterparts? Differentiate between direct and indirect energy conversion processes. 6
4. (a) Differentiate between primary and secondary batteries. Explain the working of Lithium-ion battery and also explain how the performance of the battery is enhancing with the introduction of nanomaterial. 6
- (b) Explain the role of nano-electrochemical systems in modern energy storage system (ESS). List and briefly explain any three properties of nanomaterials that make them suitable for energy technology applications. 6

- (c) How are nanomaterials incorporated into membranes for water treatment? Briefly explain the role of transport processes in nanomaterial-enhanced membrane technology. 6
- 5. (a) What is hydrogen Fuel. Why is its storage important? How is nanotechnology useful in hydrogen storage. 6
- (b) Explain carbon nanotechnology and discuss the structure, properties, and applications of carbon nanotubes (CNTs). 6
- (c) Explain the working principle of a solar cell. Describe the different types of nanomaterials used in solar cells and discuss their effects on the efficiency and performance of solar cells. 6
- 6. (a) Explain the characteristics of gas sensors and describe the working principle of Chemi resistive CNT based gas sensors. 6
- (b) Explain magnetic devices based on nanotechnology. Describe the principle of operation of nanoscale magnetic devices such as spintronic devices or magnetic sensors, and discuss their applications in data storage, memory devices, and biomedical fields. 6
- (c) Explain the role of nanomaterials in microfluidics and MEMS/NEMS-based sensors. Discuss how nanomaterials improve sensitivity, miniaturization, and performance in gas and chemical sensing applications. 6
- 7. (a) What are various types of supercapacitors? Differentiate between them. 6
- (b) Discuss the improvement in LEDs with the use of carbon nanotechnology. 6
- (c) Describe the unique physical and electrical properties of graphene. Why is it considered a wonder material? 6