

**THIRD SEMESTER M.TECH. (NANO SCIENCE AND TECHNOLOGY)
DEGREE EXAMINATION, APRIL 2020**

Nano Science

NT 3E 01—NANOMATERIALS FOR ENERGY CONVERSION AND STORAGE

(2017 Admissions)

Time : Three Hours

Maximum : 60 Marks

Section A

Answer all questions.

2 marks each.

1. What are the primary causes of green house effect ?
2. How solar energy is converted into other forms ?
3. Define the components of an electrochemical cell.
4. Give the mechanism behind DMFC.
5. What are the types of materials used in solar cells ?
6. Define bulk heterojunction.
7. Differentiate EDL and electrochemical capacitance.
8. How conductive polymers are useful in energy applications ?

(8 × 2 = 16 marks)

Section B

Answer any five questions.

4 marks each.

9. Write a short note on the need for sustainable energy and the sources to produce low cost sustainable energy.
10. Differentiate conventional and non-conventional energy sources.
11. Discuss briefly the electrode kinetics in the electrochemical cells.
12. Explain the principle and working of photovoltaic energy conversion.

Turn over

13. Explain the differences between organic and inorganic hetero junction solar cells.
14. Illustrate the current scenario of solar cells energy conversion.
15. Explain the advantages of Li-ion batteries over primary and secondary batteries.
16. Discuss the components and working of electrochemical super capacitors.

(5 × 4 = 20 marks)

Section C

Answer any four questions.

6 marks each.

17. Describe in detail the ill-effects of greenhouse gases in atmosphere and explain the safety measures to avoid greenhouse effect.
18. Discuss the current trends and conversion methods to produce sustainable energy from alternative sources.
19. Illustrate the importance of fuel cells and mention the different types of fuel cells with their principle of working.
20. Explain the principle, working and advantages of SOFCs.
21. Discuss in detail the fundamentals of solar cells and discuss the thin film solar cells with example.
22. What are Si solar cells ? Discuss their principle, working and applications.
23. Discuss in detail the components of a Li-ion battery and mention their importance. With a neat diagram explain the working of Li-ion batteries.
24. Discuss the different types of nanostructured materials used for Li-ion batteries with an example.

(4 × 6 = 24 marks)

**THIRD SEMESTER M.TECH. (NANO SCIENCE AND TECHNOLOGY)
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NT 3C 11—SOCIAL AND ENVIRONMENTAL IMPACT OF NANOTECHNOLOGY

(2017 Admissions)

Time : Three Hours

Maximum : 60 Marks

Section A

Answer all questions.

2 marks each.

1. What are the objectives of Human Genom Project and National Nanotechnology Initiative ?
2. Define Ethics. List out two significant braches of ethics.
3. What are the conditions for granting a patent ?
4. What is meant by copyright ?
5. How gastrointestinal tract is affected by nanomaterials ?
6. Define sustainable nanotechnology.
7. Define Nanotoxicology.
8. What is meant by risk assessment of nanotoxicity ?

(8 × 2 = 16 marks)

Section B

Answer any five questions.

4 marks each.

9. Differentiate between principle of the common good and principle of social justice.
10. Describe how can citizen work as a moral agent.
11. Write a note on the temporal and spatial aspect of patent.
12. Write a note on the registration of copyright.
13. Define the terms : (a) Hazard ; and (b) Risk as per EPA.
14. What are the challenges and scopes of sustainable nanotechnology ?

Turn over

15. How can nanotoxicity be measured ?
16. Write a note on the dose concept in the risk assessment of nanoparticles.

(5 × 4 = 20 marks)

Section C

Answer any four questions.

6 marks each.

17. Explain the ethical framework for technology assesement.
18. Describe how science and technology turned into agents of social change.
19. Write notes on : (a) The IT act, 2000 ; and (b) Internet and copyright issues.
20. Write notes on : (a) Industrial design ; and (b) Copyright in registered designs.
21. Discuss pulmonary toxicity by inhalation of nanomaterials.
22. Explain the risk assessment of engineered nanoparticles.
23. Discuss the interaction of nanoparticles with human cells.
24. Explain the issues and challenges of increased dose of nanoparticles in humans.

(4 × 6 = 24 marks)

**THIRD SEMESTER M.TECH. (NANO SCIENCE AND TECHNOLOGY)
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Nano Science

NT 3C 10—MICRO/NANO ELECTRO-MECHANICAL SYSTEMS (MEMS/NEMS)

(2017 Admissions)

Time : Three Hours

Maximum : 60 Marks

Section A

Answer all questions.

2 marks each.

1. Define MEMS. Give some examples.
2. What do you mean by epitaxial growth of Silicon ?
3. Mention two applications of RF MEMS.
4. Name at least four materials for micromachining ?
5. What is CVD ? What are the parameters that influence CVD ?
6. What are the steps involved in silicon wafer preparation ?
7. Define stiction.
8. Mention four exposure methods in photolithography.

(8 × 2 = 16 marks)

Section B

Answer any five questions.

4 marks each.

9. Discuss different wafer bonding techniques.
10. Compare between optical and soft lithography.
11. Write short note on Ion implantation process.
12. Mention two distinct advantages and disadvantages of ion implantation.
13. List any four relevant points of comparison between wet etching and dry etching techniques.
14. Write short note on MEMS pressure sensor and MEMS gyroscope.

Turn over

15. Enumerate the biomedical application of MEMS.
16. Describe piezoresistivity. State the materials that are used as piezoresistors.

(5 × 4 = 20 marks)

Section C

Answer any four questions.

6 marks each.

17. What is microaccelerometer and explain the working of MEMS accelerometer ?
18. Briefly describe LIGA process, its basic requirement and advantages.
19. Compare between bulk and surface micromachining with suitable examples.
20. Define thermal oxidation in MEMS. Explain the difference in wet and dry oxidation.
21. Discuss the deposition methods used in fabrication of MEMS devices.
22. What are the important design requirements involved in microsystem packaging ?
23. Explain photolithography and list out its limitations.
24. Write a note on : a) DRIE ; b) Capacitive sensing.

(4 × 6 = 24 marks)

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NT 3C 09—ADVANCED NANOMATERIALS

(2017 Admissions)

Time : Three Hours

Maximum : 60 Marks

Section A

Answer all questions.

2 marks each.

1. What is fullerene ?
2. Why diamond is harder than graphite ?
3. What is the difference between mesoporosity and nanoporosity ?
4. Write any *three* important applications of core-shell structures.
5. Write a note on graphitic carbon nitride.
6. What are the properties of nanodiamond ?
7. What is optical anisotropy ?
8. What are biodegradable polymers ?

(8 × 2 = 16 marks)

Section B

Answer any five questions.

4 marks each.

9. Write a detailed note on non-covalent exohedral functionalization and its applications.
10. Describe the principle and working of CVD process.
11. Discuss in detail the structure and applications of zeolites.
12. Write a detailed note on the intercalation compounds and its various applications.

Turn over

13. Explain the process of preparing nanodiamond film using Sol-gel process.
14. Explain the preparation, functionalization and applications of boron nitride.
15. Write a detailed note on nanocomposite based on epoxy resin, hyper-branched epoxy and layered silicate.
16. Describe in detail the synthesis of hybrid polymer nanocomposites based on sol-gel process.

(5 × 4 = 20 marks)

Section C

Answer any **four** questions.

6 marks each.

17. Describe in detail the preparation of graphene using chemical exfoliation method. Also explain the preparation of CNT using electrochemical process.
18. Discuss in detail the different types of functionalization in carbon nanotubes and also write their applications in nanomedicine.
19. Describe the preparation, applications and structural determination of nanoporous materials.
20. What are the difference between hybrid and composite structures? Describe in detail the synthetic methodologies of hybrid materials.
21. What is a nanodiamond? How do they differ from regular diamond structure? Also write their electronic properties and applications.
22. Discuss in detail the role of graphitic carbon nitride in photocatalysis and energy storage devices.
23. Explain in detail the formation, properties and applications of metal-polymer nanocomposites.
24. What is host-guest chemistry? Explain the thermodynamic principle of host-guest interactions. Also explain the determinations of binding constants using NMR, absorption and fluorescence data.

(4 × 6 = 24 marks)