RW-6054 **533101**

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

BASICS OF MATHEMATICS AND QUANTUM MECHANICS

(CBCS—2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Section - A (10 × 2 = 20)

Answer **all** questions.

1. Prove that grad $(uv) = u \nabla v + v \nabla u$.

2. Define Scalar potential field or Lamellar vector field.

3. Define Gamma function $\overline{|(n)}$.

4. What is a generating function ? Give one example.

5. State variation principle.

6. What do you mean by an excited state ?

7. Write the Heisenberg's uncertainty principle.

8. Explain photoelectric effect.

9. What do you mean by negative energy states ?

10. What is an operator ? Give an example.

Section - B (5 × 5 = 25)

Answer **all** questions by choosing **either** (a) **or** (b).

11. (a) State and explain Gauss Divergence theorem.

Or

(b) Prove Cayley-Hamilton theorem.

12. (a) Explain the orthogonal properties of Hermite polynomial with proof for any one property.

Or

(b) Give an account on Bessel's Functions.

13. (a) Give an account on ground state of Deutron atom.

Or

(b) Explain Hormonic perturbation.

14. (a) What are matter waves ? Explain its hypothesis.

Or

(b) Give a note on the limitations of classical physics.

15. (a) Give an account on the simultaneous measurement of an observable.

Or

(b) State and explain Klein-Gordon equation.

Section - C (3 × 10 = 30)

Answer any **three** questions.

16. Write a short note on :

(a) Schwartz inequality.

(b) Eigenvalues.

17. Using the generating function

prove that $\frac{1}{(1-t)}\, e^{-tx/(1-t)} = \sum_{n=0}^{\infty} t^n \underset{n}{\overset{\infty}{\mathrm{L}}}(x)$

18. Apply variation method for excited states upper bound for the m^{th} excited level.

19. Derive Schrödingers time independent wave equation.

20. Discuss the case of a linear Hormonic oscillator in detail.

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RW-6055 **533102**

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

BASICS OF MATERIALS SCIENCE

(CBCS—2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** the questions.

1. Define Space symmetry and Space groups.

2. Write the procedure employed in determination of h, k and l index numbers in a crystal system.

3. Define crystallinity of a polymer.

4. Write the factors that influence the mechanical properties of semicrystalline polymers.

5. What is known as “Tie line” ?

6. What are the differences between hand and soft magnetic materials ?

7. Define Diamagnetism and Paramagnetism.

8. Briefly describe the phenomenon of Domains and Hysteresis

9. Distinguish between Oxidation and Reduction reactions.

10. Explain why ceramic materials are very resistant to corrosion

Part - B (5 × 5 = 25)

Answer **all** the questions.

11. (a) Distinguish between Single crystal and Polycrystalline materials

Or

(b) Define Crystallographic direction. Write the steps involved in the determination of the three directional indices.

12. (a) Write a brief essay on the crystallinity of polymer compounds.

Or

(b) Discuss the various characteristic features of high polymers.

13. (a) State and explain phase rule. Discuss the application of phase rule to a two component system of industrial importance.

Or

(b) Discuss the relation between growth and kinetics of a crystal system.

14. (a) Write a detailed note on Ferroelectric materials.

Or

(b) Name and describe the three types of polarization.

15. (a) List three differences between :

(i) the corrosion of ceramics, and

(ii) the degradation of polymers.

Or

(b) List five measures that are commonly used to prevent corrosion.

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. How will you determine the structure of a crystal ? Explain with suitable examples.

17. What is meant by a polymer compound ? Discuss the importance of polymer compounds in day to day life.

18. State and explain :

(a) The lever rule. (5)

(b) Microstructural cooling. (5)

19. In terms of electron energy band structure, discuss reasons for the difference in electrical conductivity between metals, semiconductors, and insulators.

20. (a) Briefly describe the two techniques that are used for galvanic protection.

(5)

(b) Briefly explain the difference between oxidation and reduction reactions.

(5)

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RW-6056 **533103**

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

BASIC BIOTECHNOLOGY

(CBCS—2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** the questions.

1. Charismatic species.

2. Chipko movement.

3. Gene therapy.

4. BAC.

5. Artificial seeds.

6. Ti plasmid.

7. CO_2 incubator.

8. Immobilization.

9. BLAST.

10. Biological databases.

Part - B (5 × 5 = 25)

Answer **all** questions by choosing **either** (a) **or** (b).

11. (a) Describe genetic based biodiversity conservation practices.

Or

(b) Write note on Biosphere reserves and National parks.

12. (a) Describe in details Microprojectile bombardment

Or

(b) Give an account on molecular tools.

13. (a) How to isolate protoplasts from plants ?

Or

(b) List the greenhouse effects and its impact on environment.

14. (a) Define the physical conditions for animal cell culture growth

Or

(b) What is bioaugmentation ? Mention its applications.

15. (a) Multiple sequence alignment.

Or

(b) How to construct Phylogenetic tree ?

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. How to conserve the biodiversity in ex-situ conditions ?

17. Give an account on plasmid cloning vectors.

18. How to develop transgenic plants with beneficial traits ?

19. Discuss in detail the bioremediation techniques.

20. Microbes are biogas producers–Discuss.

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RW-6057 533104

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

INTRODUCTION TO NANOSCIENCE

(CBCS—2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** the questions.

1. What are the ways of attaining supersaturation ?

2. Differentiate monolayer and multilayer film growth.

3. What are macroscopic crystals ?

4. What are the drawbacks in the preparation of nanoparticles by Top-down approach ?

5. What are non-stoichiometric defects ?

6. Discuss the plane defect present in solids.

7. Noncrystalline copper possess superplasticity– Comment.

8. How does melting point changes with particle size of materials ?

9. List the different types of carbon nanotubes.

10. Nanoparticles may give environmental concern– Discuss.

Part - B (5 × 5 = 25)

Answer **all** questions by choosing **either** (a) **or** (b).

11. (a) Derive Gibbs-Thompson relation to show the bigger crystals grow at the expense of smaller crystals.

Or

(b) Explain the Wulff plot method of determining the shape of equilibrium crystal.

12. (a) Write a note on 'protein crystals'.

Or

(b) Explain the effect of nucleation rate on the size of the particle.

13. (a) Explain large-angle boundaries in crystals.

Or

(b) Discuss the effect of surface defects on the properties of nanocrystals.

14. (a) Describe in detail two-dimensional materials.

Or

(b) Write a note on nanocrystalline ceramic materials.

15. (a) Explain the preparation and properties of ZnO nanotubes.

Or

(b) Explain the structure of DNA and discuss the nanodimensional features associated with it.

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. Describe the Langmuir-Blodgett film growth technique with example.

17. (a) Discuss on the control of particle size distribution during growth processes

(b) Explain the preparation of nanoparticles by sol-gel method with example

18. (a) Explain the effect of defects on the optical properties of solids.

(b) Nanocrystals are defect free compared to microcrystals–Explain.

19. With adequate examples, explain the optical and electrical properties of nanomaterials

20. (a) Explain the binding of DNA and RNA with carbon nanotubes.

(b) Write a note on quantum dots.

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RW-6058 **533301**

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

NANO BIOTECHNOLOGY AND NANOMEDICINE

(CBCS—2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** questions.

1. Silicon wafers.

2. Integrated circuits.

3. Silanisation.

4. Lab-on-a-chip.

5. Bucky ball.

6. Nanoclay.

7. Cantilever.

8. Van der Waals force.

9. Doxil.

10. Exosomes.

Part - B (5 × 5 = 25)

Answer **all** questions by choosing **either** (a) **or** (b).

11. (a) Give an account on MEMS-biased nanosensors.

Or

(b) How is the microelectrode array applied to neuronal net working ?

12. (a) How the DNA network can be used as a nanowire ?

Or

(b) What is the role of SAM in nanoelectronics ?

13. (a) How do nanoherbicides work in fields ?

Or

(b) How can we increase plant productivity by nanobiotechnology ?

14. (a) Discuss about the molecular pulling force spectroscopy.

Or

(b) Comment on the fabrication of quantum dots.

15. (a) What are the safety issues of nanoparticles in human body ?

Or

(b) Explain in detail about the nanoshells.

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. Write in detail about the preparation of nanocomposites.

17. Describe a nanosensor and give its applications.

18. Give an account on carbon nanotubes and its applications.

19. Give a detailed illustration of Atomic Force Microscopy.

20. Comment on the nanotechnology-based scaffold for bone growth.

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RW-6059 533302

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

NANOELECTRONICS AND NANODEVICES

(CBCS–2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** questions.

1. What are the advantages of Nanoelectronics ?

2. Give some examples for microfabrication tools.

3. Write some properties of ferroelectric thin film.

4. How will you monitor the roasting process of food ?

5. Write the advantages of micromagnetics.

6. Write about Spin torque transfer magnetic RAM.

7. Write about the role of single-electron dynamics in tunneling processes.

8. Distinguish between Nanomechanics and Micromechanics.

9. Differentiate Laser diodes from Semiconductor diodes.

10. How photonic crystal changed the computer field.

Part - B (5 × 5 = 25)

Answer **all** questions.

11. (a) Write brief note about "entropy" in information theory.

(*Or*)

(b) Explain in detail about Nanofabrication.

12. (a) Write a short notes on FERAM.

(*Or*)

(b) Explain in detail about the Electronic Noses.

13. (a) Write a short note on GMR effect and its application in sensors.

(*Or*)

(b) Explain Ballistic spin transport.

14. (a) Discuss briefly about Resonant Tunneling Transistor.

(*Or*)

(b) Explain with neat sketch about DNA-Based Nanodevices.

15. (a) Write a short notes on Electroluminescent Organic materials.

(*Or*)

(b) How LEDs prepared using nanotubes ? What are more advantageous compared to LEDs prepared using other materials ?

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. Write Shannon's information theory in detail with its applications.

17. Explain in detail the working prinicple and applications of Calorimetric sensors.

18. Explain Landau-Lifshitz equation and derive Landau-Lifshitz-Gilbert equation from it.

19. Discuss in brief the design, mechanism and applications of nanorobots.

20. Describe the applications of Quantum well infrared photo detectors with their working mechanism.

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RW-6060 533303

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

Nano Science and Technology

NANO ENGINEERING

(CBCS–2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** questions.

1. How single-wall carbon nanotubes formed in the laboratory ? Which mechanism for SWNT growth (catalytic root or tip growth) is most probable for the synthesis of very long (~ cm) tubes ?

2. What is meant by Coulomb blockade theory ?

3. Write about the future trend of semiconductors.

4. Write a short notes on semiconductor wafer with examples.

5. How do you confirm magnetic properties of nanoparticle ?

6. How will you synthesize $Fe@C_{60}$?

7. What is meant by CMOS fabrication technology ?

8. Define NEMS and its advantages.

9. Write about principles of excitonic Solar cells.

10. Write the applications of liquid crystals.

Part - B (5 × 5 = 25)

Answer **all** questions choosing *either* (a) *or* (b)

11. (a) Write a short notes on atomic and electronic structure of Carbon nanotubes.

(*Or*)

(b) Discuss in detail about quantum dot based SET.

12. (a) Write a short notes on the physical processes of semiconducting nanostructures.

(*Or*)

(b) Discuss briefly the Quantum Cascade Lasers.

13. (a) Write a short overview about magnetism in solids.

(*Or*)

(b) Discuss the applications of Nanocomposite Magnets.

14. (a) Write a note on choice of materials for nano-Electromechanical systems.

(*Or*)

(b) Discuss briefly about Microactuators.

15. (a) Write a brief note on molecular crystals.

(*Or*)

(b) Discuss in detail about eximers.

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. Explain briefly about single electron transistor and single electron pump.

17. Discuss in detail about the performance of semiconductor based electronic devices with its principle.

18. Explain in detail about the fabrication and properties of Nanomagnets.

19. Explain the principle, working mechanism and applications of radiation and chemical sensors.

20. Explain in detail about H- and J- aggregates with its definition, properties, characterization, detection and applications.

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RW-6061 533502

M.Sc. DEGREE EXAMINATION, NOVEMBER 2010

NanoScience and Technology

Elective—II : MICROSYSTEM TECHNOLOGY

(CBCS–2008 onwards)

Time : 3 Hours Maximum : 75 Marks

Part - A (10 × 2 = 20)

Answer **all** questions.

1. What are the applications of semiconducting thin films ?

2. Explain the term 'rapid prototyping'.

3. Give a brief note on silicon micromachining.

4. Mention the analytical models that explain microsystem fabrication.

5. Discuss briefly about masking done in lithography.

6. Write a short note on synchrotron radiation.

7. What do you mean by fusion bonding ?

8. Give the basic principle of pressure sensors.

9. What are the non-silicon materials used in MEMS technology ?

10. Mention few applications of biomedical MEMS.

Part - B (5 × 5 = 25)

Answer **all** questions choosing *either* (a) *or* (b)

11. (a) Explain the principle and working of thin film sensors.

(*Or*)

(b) Write a short note on MOCVD.

12. (a) Explain in detail the various microsystem fabrication techniques.

(*Or*)

(b) Discuss in general about the silicon micromachining.

13. (a) Explain the importance and working of electron beam lithography.

(*Or*)

(b) Discuss about the design and patterning using photolithography.

14. (a) Discuss in detail about the role of polymers in Microsystems.

(*Or*)

(b) What are the methodologies used to evaluating the MEMS performance ?

15. (a) Discuss in detail about micro-stereolithography technique.

(*Or*)

(b) What are the important applications of MEMS in industries ? Give example.

Part - C (3 × 10 = 30)

Answer any **three** questions.

16. Discuss in detail about the different chemical methods used for the deposition of thin films.

17. Explain the steps involved in silicon fabrication processes. Discuss the dry etching techniques used for metals, insulators and semiconductors.

18. Describe in detail the principle and processing of MEMS using X-ray lithography.

19. Give a detailed note on the statistical analysis of microsystem technology in an industrial fabrication route.

20. Explain the silicon carbide MEMS, biomedical MEMS and RF MEMS in detail.

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