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| **Course Code** | **17NT3001/16NT3001** | **Duration** | **3hrs** |
| **Course Name** | **NANOMATERIALS CHARACTERIZATION METHODS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain in detail the difference between simple and compound microscopy. | CO1 | U | 10 |
|  | b. | What is nano indentation? Why is it used in the field of nanotechnology? | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Briefly explain the Atomic force microscopy. | CO2 | An | 10 |
|  | b. | What is UV spectroscopy? Explain the working and its applications. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | What is differential optical and electron microscopy? Explain different sources with a neat diagram. | CO3 | E | 10 |
|  | b. | What do you understand by magnification? How is it different from resolution? | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain scanning electron microscopy and how does it function? | CO4 | An | 10 |
|  | b. | What is dynamic light scattering and its application? | CO2 | R | 10 |
|  |  |  |  |  |  |
| 5. | a. | Elaborate the sample preparation for electron microscopy. | CO5 | U | 10 |
|  | b. | Differentiate scattering and diffraction. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | How is low energy electron diffraction (LEED) different from reflection high energy electron diffraction (RHEED)? | CO2 | E | 10 |
|  | b. | Expand EDAX. Elaborate its application. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | What is Abbes equation? | CO1 | R | 10 |
|  | b. | Explain the interaction of electrons with samples used for microscopy. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | What is XPS? What is the purpose of this particular characterization? | CO4 | An | 10 |
|  | b. | Expand TEM. Describe its lens system and applications. | CO1 | An | 10 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain scanning tunneling microscopy. | CO4 | A | 10 |
|  | b. | What is powder X-ray diffraction? | CO2 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Relate the structure of nanomaterials. |
| CO2 | Demonstrate the nanoscale properties through x-ray and electron beam diffractions. |
| CO3 | Extend the microscopic techniques for nano identification. |
| CO4 | Analyze the composition of nanomaterials by EDAX and XPS. |
| CO5 | Assess the specimen preparation methods for various analyses. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 10 |  | 10 | 10 |  |  |
| CO2 | 10 | 10 | 10 | 10 | 10 |  |  |
| CO3 | 10 |  | 10 |  | 10 |  |  |
| CO4 |  | 10 | 10 | 20 |  |  |  |
| CO5 |  | 10 | 10 |  |  |  |  |
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| **Course Code** | **16NT3004 / 17NT3004** | **Duration** | **3hrs** |
| **Course Name** | **MAGNETIC NANOMATERIALS AND NANOFLUIDS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** | |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | |
| 1. | a. | Explain diamagnetism and paramagnetism with suitable diagrams. | CO1 | R | | 10 |
|  | b. | Which phenomenon makes materials strong in their magnetic behavior? Rationalize the role of exchange interaction in ferromagnetic materials. | CO2 | An | | 10 |
|  |  | **(OR)** |  |  | |  |
| 2. |  | When do materials show super paramagnetic behaviour? Justify your answer with examples. Explain anti-ferromagnetism with diagrams. | CO2 | An | | 20 |
|  |  |  |  |  | |  |
| 3. |  | Discuss the phenomena of magnetocrystalline and shape anisotropies. How do they affect the magnetization curve shapes? | CO2 | U | | 20 |
|  |  | **(OR)** |  |  | |  |
| 4. |  | Explain elaborately the domain theory in magnetic materials. Describe domain walls and domain wall width. | CO3 | U | | 20 |
|  |  |  |  |  | |  |
| 5. | a. | Describe the influence of geometry and surface on the magnetism of nanoparticles. | CO3 | U | | 10 |
|  | b. | Give an account of specific heat anomaly on magnetism. | CO3 | An | | 10 |
|  |  | **(OR)** |  |  | |  |
| 6. |  | Discuss the magnetism of free nanoparticles and nanoparticles on surfaces. | CO4 | A | | 20 |
|  |  |  |  |  | |  |
| 7. |  | Explain with a neat diagram the working of the superconducting quantum interference device. | CO4 | R | | 20 |
|  |  | **(OR)** |  |  | |  |
| 8. |  | Discuss in detail permanent magnets and their applications. | CO5 | A | | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | |
| 9. |  | Discuss the applications of magnetic nanoparticles in the diagnosis and treatment of cancer. Provide suitable examples and illustrations. | CO6 | A | | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate nanomagnetism in materials. |
| CO2 | Explain the origin of microscopic interactions in nanomaterials. |
| CO3 | Interpret nanomagnetism in spintronic devices. |
| CO4 | Choose the right magnetic nanomaterials for different applications. |
| CO5 | Apply nanofluids for heat transfer applications. |
| CO6 | Apply magnetic nanoparticles and their synthesis method to prepare new materials. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | - | - | - | - | - | 10 |
| CO2 | - | 20 | - | 30 | - | - | 50 |
| CO3 | - | 30 | - | 10 | - | - | 40 |
| CO4 | 20 | - | 20 | - | - | - | 40 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | - | - | 20 | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **16NT3002 / 17NT3002** | **Duration** | **3hrs** |
| **Course Name** | **NANOELECTRONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the Depletion MOSFET with its I-V characteristics. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Compare the MOSFET’s Constant-Field and Constant voltage Scaling with highlighted parameters. | CO1 | E | 20 |
|  |  |  |  |  |  |
| 3. |  | Analyze the various short channel effects from band diagram and transfer characteristics of short channel transistors. | CO2 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the Coulomb blockade principle and Single Electron Transistor with neat diagram. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Illustrate Tunnel Diode and Resonant Tunnelling Diode with its I-V characteristics. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain the Ferroelectric random access memory with read and write operations. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Illustrate any Nanotubes based sensors with neat diagram. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Estimate the High Electron Mobility Transistor with its schematic diagram. | CO5 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the Quantum cellular automate with various configuration includes wire, inverter and other logical gates. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Relate the transistor scaling and its limits. |
| CO2 | Infer about the short channel transistors and its limits. |
| CO3 | Analyze the various split gate transistor structures. |
| CO4 | Model the CMOS transistors for the various circuits. |
| CO5 | Utilize the Tunneling devices for high frequency applications. |
| CO6 | Design of computing model of Nanostructured Devices. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 20 | - | 20 | - | 40 |
| CO2 | - | - | - | 40 | - | - | 40 |
| CO3 | - | - | 40 | - | - | - | 40 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | - | 20 | - | - | 20 |
| CO6 | - | - | 20 | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **17NT3003** | **Duration** | **3hrs** |
| **Course Name** | **NANO-LITHOGRAPHY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | | **BL** | | **Marks** | |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | | | |
| 1. |  | Discriminate the contact, proximity and projection exposure methods of photolithography techniques. | | CO1 | | An | | 20 |
|  |  | **(OR)** | |  | |  | |  |
| 2. |  | Explain the photolithographic process of N-channel MOSFET. | | CO1 | | A | | 20 |
|  |  |  | |  | |  | |  |
| 3. |  | Explain the MEMS design flow with neat flow chart. | | CO2 | | A | | 20 |
|  |  | **(OR)** | |  | |  | |  |
| 4. |  | Explain the photolithographic process in flow steps model. | | CO2 | | A | | 20 |
|  |  |  | |  | |  | |  |
| 5. |  | Determine the 3-D printer based lithographic for the various applications. | | CO3 | | A | | 20 |
|  |  | **(OR)** | |  | |  | |  |
| 6. |  | Explain the Molecular self-assembly with neat schematic. | | CO4 | | An | | 20 |
|  |  |  | |  | |  | |  |
| 7. |  | Determine the Ion beam lithography with neat schematic. | | CO5 | | A | | 20 |
|  |  | **(OR)** | |  | |  | |  |
| 8. |  | Explain the E-beam lithography with neat schematic. | | CO5 | | An | | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | | | |
| 9. |  | Determine the Dip-pen nanolithography with neat schematic. | | CO6 | | A | | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate Photolithography process. |
| CO2 | Experiment the mask preparation |
| CO3 | Apply lithographic technique to construct a device |
| CO4 | Appraise the different lithographic techniques. |
| CO5 | Illustrate the fabrication of nanoelectronic devices and sensors. |
| CO6 | Design nanoscale devices |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 20 | 20 | - | - | 40 |
| CO2 | - | - | 40 | - | - | - | 40 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | 20 | 20 | - | - | 40 |
| CO6 | - | - | 20 | - | - | - | 20 |
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**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **17NT3003** | **Duration** | **3hrs** |
| **Course Name** | **NANO-LITHOGRAPHY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the photolithographic process of P-channel MOSFET. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the photolithographic process of CMOS MOSFET. | CO1 | A | 20 |
|  |  |  |  |  |  |
| 3. |  | Illustrate the MEMS design flow with flow chart diagram. | CO2 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the photolithographic process with step by step schematic. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Determine the Molecular self-assembly for the device applications. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Determine the 3-D printer based lithographic for the various applications. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Determine the E-beam lithography with neat schematic. | CO5 | An | 20 |
|  |  |  |  |  |  |
| 8. |  | Explain the X-ray lithography with neat schematic. | CO5 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the Dip-pen nanolithography with neat schematic. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate Photolithography process. |
| CO2 | Experiment the mask preparation |
| CO3 | Apply lithographic technique to construct a device |
| CO4 | Appraise the different lithographic techniques. |
| CO5 | Illustrate the fabrication of nanoelectronic devices and sensors. |
| CO6 | Design nanoscale devices |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 40 | - | - | - | 40 |
| CO2 | - | - | - | 40 | - | - | 40 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | - | - | 20 | - | - | - | 20 |
| CO5 | - | - | - | 40 | - | - | 40 |
| CO6 | - | - | 20 | - | - | - | 20 |
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| **Course Code** | **17NT3005** | **Duration** | **3hrs** |
| **Course Name** | **FUNCTIONALIZATION OF NANOSTRUCTURES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | How CNTs are functionalized in the following ways?  i. Attachment of oxidic groups to CNT.  ii. Reactions of carboxylic groups on CNT. | CO2 | R | 10 |
|  | b. | What are fullerenes? Explain the structure, physical property, and synthesis of fullerene. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain in detail the following reactions possible on fullerenes.  a. Bingel reaction  b. Preparation of nitrile imines | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Explain in detail silica nanoparticles, their synthesis, properties, and applications. | CO2 | U | 10 |
|  | b. | Hollow-core-shell & core-multi-shell nanoparticles - Explain with neat diagram. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Summarize the factors that affect the synthesis of gold nanoparticles. | CO3 | U | 10 |
|  | b. | Explain the properties & applications of gold nanoparticles.  Write the reactions of Turkevich and Brust and Schriffin methods for the synthesis of gold nanoparticles. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Explain the methods of surface modification of magnetic FeO nanoparticles. | CO3 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Give a detailed account of the applications of functionalized graphene oxides in various fields. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the applications of quantum dots in biology and medicine. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Write notes on the magnetic nanomaterials including their properties, synthesis, and applications. | CO6 | U | 10 |
|  | b. | What are quantum dots? Explain its synthesis, properties, and its application. | CO6 | R | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the thiol and amine functionalization methods of quantum dots. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the mechanism of functionalization. |
| CO2 | Infer the metal oxide, organic functionalization in carbon nanomaterials. |
| CO3 | To solve problems on functionalization methods. |
| CO4 | To choose reagents for deriving functional group on nanomaterials. |
| CO5 | To envisage the tailoring of properties of nanomaterials based on functionalization. |
| CO6 | To understand recent newer developments in functionalized nanomaterials for plausible new devices. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | 20 | 20 | - | - | - | - | 40 |
| CO3 | 20 | 20 | - | - | - | - | 40 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | 10 | 30 | - | - | - | - | 40 |
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**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **17NT3005** | **Duration** | **3hrs** |
| **Course Name** | **FUNCTIONALIZATION OF NANOSTRUCTURES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain in brief about fullerenes, physical property and synthesis of fullerenes. | CO2 | R | 10 |
|  | b. | Explain in detail the functionalization of CNTs. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain in detail the following reactions possible on fullerenes.  i. Bingel reaction ii. Preparation of nitrile imines | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Explain in detail what are silica nanoparticles, their synthesis, properties, and applications. | CO2 | U | 10 |
|  | b. | Hollow-core-shell & core-multi-shell nanoparticles - Explain with diagram. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Summarize the factors that affect the synthesis of gold nanoparticles | CO3 | U | 10 |
|  | b. | Explain the properties & applications of gold nanoparticles.  Write the reactions of Turkevich and Brust and Schriffin methods for the synthesis of gold nanoparticles | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the applications of quantum dots in biology and medicine. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Write notes on the magnetic nanomaterials including their properties, synthesis, and applications. | CO6 | U | 10 |
|  | b. | What are quantum dots? Explain its synthesis, properties, and its application. | CO6 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the methods of surface modification of magnetic FeO nanoparticles. | CO3 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Give a detailed account of the applications of functionalized graphene oxides in various fields. | CO4 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the thiol and amine functionalization methods of quantum dots. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the mechanism of functionalization |
| CO2 | Infer the metal oxide, organic functionalization in carbon nanomaterials |
| CO3 | To solve problems on functionalization methods |
| CO4 | To choose reagents for deriving functional group on nanomaterials |
| CO5 | To envisage the tailoring of properties of nanomaterials based on functionalization |
| CO6 | To understand recent newer developments in functionalized nanomaterials for plausible new devices |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | 20 | 20 | - | - | - | - | 40 |
| CO3 | 20 | 20 | - | - | - | - | 40 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | 10 | 30 | - | - | - | - | 40 |
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**Graphical user interface, application

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**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **17NT3006** | **Duration** | **3hrs** |
| **Course Name** | **NANOSAFETY AND ENVIRONMENTAL ISSUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Identify two area in which nanotechnology is applied and explain. | CO1 | R | 04 |
|  | b. | List out any eight areas in which research is needed to understand the effects of nanotechnology and give a brief note on each. | CO1 | U | 16 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Analyse environmental risk reduction through any 5 ways each from product/substance control and engineering controls. | CO1 | R | 20 |
|  |  |  |  |  |  |
| 3. | a. | Review any four frameworks for characterisation of environmental risk of engineered nano materials (ENM). | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain how material characterisation plays a major role in establishing the environmental effect of nanomaterials. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 5. | a. | Analyse the six principle to be followed in risk based policy making. | CO3 | U | 12 |
|  | b. | How nanoparticles are inhaled and deposited in human respiratory system? | CO3 | An | 08 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyse the way by which the inhaled nanoparticles are cleared through pulmonary clearance. | CO3 | U | 08 |
|  | b. | Analyse the process of systemic translocation of inhaled nano particles. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 7. | a. | Review the aspects associated with short term test in ecotoxicological test. | CO4 | R | 12 |
|  | b. | Identify the terms and parameters frequently used in ecotoxicological test. | CO4 | A | 08 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyse the end point classification in ecotoxicological test. | CO4 | U | 06 |
|  | b. | By applying Ames test how genotoxicity will be measured? | CO4 | A | 14 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain how bioethics principles are to be followed in nanotechnology? | CO5 | U | 10 |
|  | b. | Discuss in detail the FDA regulations on ENMs. | CO6 | R | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Relate the toxic effects of nanotechnology on human health |
| CO2 | Analyse the various issues on environmental effects |
| CO3 | Identify suitable remedial measures |
| CO4 | Suggest start-of-the pipe solution for environmental issues based on nanomaterials |
| CO5 | Work out problems on nanomaterials related to toxicity |
| CO6 | To frame a model policy on preventing health hazards |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 24 | 16 |  |  |  |  | 40 |
| CO2 |  | 20 | 20 |  |  |  | 40 |
| CO3 |  | 20 |  | 20 |  |  | 40 |
| CO4 | 12 | 06 | 22 |  |  |  | 40 |
| CO5 |  | 10 |  |  |  |  | 10 |
| CO6 | 10 |  |  |  |  |  | 10 |
|  | | | | | | | **180** |



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| **Course Code** | **16NT3006/17NT3006** | **Duration** | **3hrs** |
| **Course Name** | **NANO SAFETY AND ENVIRONMENTAL ISSUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | What are the four major problems with the airborne nanoparticles towards safety? | CO1 | R | 04 |
|  | b. | Illustrate the various methods of engineering and personal protective equipment controls by which risk is reduced. | CO1 | U | 16 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Analyse the various factors to be considered when transporting nanomaterials. | CO1 | An | 15 |
|  | b. | What are the preventive measures to be considered to avoid accidents while handling ENMs? | CO1 | A | 05 |
|  |  |  |  |  |  |
| 3. | a. | Analyse the life cycle analysis and US EPA’s comprehensive environmental assessment (CEA) frameworks for characterization of environmental risk of ENMs. | CO2 | An | 12 |
|  | b. | Explain the two factors which are essential for the development of risk assessment framework. | CO2 | U | 08 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | What are the definitions of various terms frequently used in risk based policy making? | CO2 | R | 5 |
|  | b. | Explain the role of material characterization in evaluating the potential risk of nanomaterial. | CO2 | A | 15 |
|  |  |  |  |  |  |
| 5. | a. | Critically review the inhalation and deposition of nanoparticles in lungs. | CO3 | An | 10 |
|  | b. | Explain in detail on how the bio-persistence of inhaled solid materials affect the lungs. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the various factors that affect the translocation of inhaled particles. | CO3 | R | 10 |
|  | b. | Analyse the inflammatory response and oxidative stress aspects of nanotoxicology. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Analyse how multi-species test is advantageous over single species test. | CO4 | U | 10 |
|  | b. | Discuss the terms and parameters frequently used in ecotoxicological tests. | CO4 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the ecotoxicological approaches in the evaluation of soil quality. | CO5 | An | 10 |
|  | b. | Explain how genotoxicity is measured using Ames test. | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | What are the reasonable precautions a policymaker should take to prevent, minimize and manage risk? | CO6 | U | 05 |
|  | b. | Review the legal regulatory considerations of nanotechnology. | CO6 | R | 15 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Relate the toxic effects of nanotechnology on human health. |
| CO2 | Analyse the various issues on environmental effects. |
| CO3 | Identify suitable remedial measures. |
| CO4 | Suggest start-of-the-pipe solution for environmental issues based on nanomaterials. |
| CO5 | Workout problems on nanomaterials related to toxicity. |
| CO6 | To frame a model policy on preventing health hazards. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 16 | 5 | 15 |  |  | 40 |
| CO2 | 5 | 8 | 15 | 12 |  |  | 40 |
| CO3 | 10 |  | 10 | 10 |  |  | 30 |
| CO4 | 10 | 20 |  |  |  |  | 30 |
| CO5 |  |  | 10 | 10 |  |  | 20 |
| CO6 | 15 | 5 |  |  |  |  | 20 |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **17NT3007** | **Duration** | **3hrs** |
| **Course Name** | **BIOMEDICAL NANOSTRUCTURES AND NANOMEDICINE** | **Max. Marks** | **100** |

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| **Q.No.** | | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | |
| 1. | a. | | Describe the role and synthesis of biocompatible materials in nanomedicine. | CO2 | U | 10 |
|  | b. | | Give a detailed account of thermally responsive carriers. | CO2 | An | 10 |
|  |  | | **(OR)** |  |  |  |
| 2. | a. | | Explain bioconjugated nanoparticles for ultrasensitive detection of molecular biomarkers and infectious agents. | CO4 | An | 10 |
|  | b. | | Explain in detail the extracellular matrix. Describe the cell-ECM interactions. | CO5 | A | 10 |
|  |  | |  |  |  |  |
| 3. | a. | | Discuss the following with relevance to drug delivery: (a) Ability to cross biological membranes (b) Drug targeting through targeting molecules. | CO3 | A | 10 |
|  | b. | | Detail three dimensional lithography with a suitable diagram. | CO2 | U | 10 |
|  |  | | **(OR)** |  |  |  |
| 4. | a. | | How do nanostructures function in tissue engineering and regenerative medicine? | CO5 | An | 10 |
|  | b. | | Explain micro / nanomachining in the design of dental and orthopedic materials. | CO1 | U | 10 |
|  |  | |  |  |  |  |
| 5. | a. | | “Hydrogels play a significant role in biomedical engineering”. True or false. Justify your answer. | CO2 | An | 10 |
|  | b. | | Elaborate the orthopedic applications of ion-implanted materials. | CO4 | A | 10 |
|  |  | | **(OR)** |  |  |  |
| 6. | a. | | Differentiate thermal responsive and photochemical controlled drug delivery systems with suitable diagram. | CO4 | An | 10 |
|  | b. | | Describe DNA / RNA transfection and the barriers associated with it. | CO3 | U | 10 |
|  |  | |  |  |  |  |
| 7. | a. | | Differentiate nanomaterials, nanocrystals and nanocluster. Explain the synthesis and applications. | CO4 | A | 10 |
|  | b. | | Elaborate the role of retroviral vectors and recombinant viral vectors in the biomedical field. | CO4 | U | 10 |
|  |  | | **(OR)** |  |  |  |
| 8. | a. | | Describe virus-like particles and their applications with suitable diagram. | CO4 | A | 10 |
|  | b. | | Describe the applications of microgels and nanogels in nanomedicine. | CO1 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | |
| 9. | a. | | How are nanoparticles used in gene delivery? Explain the types of nanoparticles used. | CO2 | E | 10 |
|  | b. | | Comment on bioconjugation of soft nanomaterials. How are such nanomaterials used in biological applications? | CO3 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the properties of biomedical nanostructures. |
| CO2 | Explain the applications of biomedical nanomaterials in nanomedicine. |
| CO3 | Utilize nanomaterials in biomedical field. |
| CO4 | Justify the suitability of various nanostructures. |
| CO5 | Demonstrate the nanofiber synthesis for medical fabrics. |
| CO6 | Predict any possible downsides of each nanomaterial. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 20 |  |  |  |  | 20 |
| CO2 |  | 20 | 20 |  | 10 |  | 50 |
| CO3 |  | 10 | 10 | 10 |  |  | 30 |
| CO4 |  | 10 | 30 | 20 |  |  | 60 |
| CO5 |  |  | 10 | 10 |  |  | 20 |
| CO6 |  |  |  |  |  |  |  |
|  | | | | | | | **180** |



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| **Course Code** | **17NT3009** | **Duration** | **3hrs** |
| **Course Name** | **NANOTECHNOLOGY FOR CANCER DIAGNOSIS AND TREATMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Describe how Gleevec acts in the treatment of chronic myeloid leukemia, the occurrence of relapse at the blast crisis phase, and the further inhibition of the relapse by Sprycel. | CO2 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain monoclonal antibodies and topoisomerase inhibitors in the chemotherapy for cancer. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Discuss the applications of antibiotics and alkylating agents in the treatment of cancer. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the principle and applications of SPECT in the diagnosis of cancer. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Elaborate on the working principle, mechanism, and advantages of ultrasonography in the diagnosis of cancer. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | What is the role of rare earth element-based materials in the diagnosis of cancer? Give a detailed account citing suitable examples. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the applications of magnetic nanomaterials in cancer diagnosis. | CO6 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the types of mutations in the development of cancer. | CO1 | R | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | What are the applications of magnetic nanoparticles in targeted drug delivery of cancer drugs? What are the criteria for designing nanomaterials for hyperthermia applications? | CO5 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the mechanism of mutation and cancer-causing cells |
| CO2 | Identify the different cancer diagnosis techniques. |
| CO3 | To explain the pros and cons of cancer nanotechnology methods |
| CO4 | To justify the best method from the student’s perspective |
| CO5 | To choose methods of improvising cancer diagnosis and treatment using nanomaterials |
| CO6 | Demonstrate the applications of nanomaterials in cancer diagnosis and treatment |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | - | - | - | - | - | 20 |
| CO2 | - | 20 | - | 20 | - | - | 40 |
| CO3 | - | - | 40 | - | - | - | 40 |
| CO4 | 20 | - | - | - | - | - | 20 |
| CO5 | - | 20 | - | 20 | - | - | 40 |
| CO6 | - | - | - | 20 | - | - | 20 |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **17NT3010** | **Duration** | **3hrs** |
| **Course Name** | **NANO-BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 × 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain biological neurons and the function of neuronal cells. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the role of biological networks in nanotechnology. | CO1 | R | 20 |
|  |  |  |  |  |  |
| 3. |  | Citing suitable examples, explain biochips and DNA analyzers. | CO2 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the properties and applications of lipid-based self-assembled structures. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Describe the properties of nucleic acids and ribosomes and their relevance to nano-biotechnology. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain electrochemical gradients across membranes and stabilization of transition states by enzymes. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Give an account of light capture by small molecules and bio-macromolecules. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the common functional bio-nanomachines. | CO6 | R | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the ethical challenges in nanotechnology and the vision of design using biological selection. | CO6 | An | 20 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the concepts of nanobiotechnology. |
| CO2 | Identify new materials based on nanobiotechnology. |
| CO3 | Apply nanomaterials to interface with the biological systems. |
| CO4 | Prepare newer nanomaterials with a focus on nanobiotechnology. |
| CO5 | Articulate the trend of the present scenario on nanobiotechnology research. |
| CO6 | Explain the foreseen ideas on nanobiotechnology for electronics and medicine. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | 20 | - | 5 | - | - | 40 |
| CO2 | 20 | - | - | - | - | - | 20 |
| CO3 | - | - | 40 | - | - | - | 40 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | - | - | - | 20 | - | - | 20 |
| CO6 | 20 |  |  | 20 | - | - | 40 |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **17NT3015** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL NANOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 × 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the types of information storage devices. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the role of nanotechnology in data storage. | CO1 | R | 20 |
|  |  |  |  |  |  |
| 3. |  | Citing suitable examples, explain Optical Data Storage Write and Read techniques. | CO2 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the properties and applications of thin-film Si solar cells. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Describe the properties and applications of quantum dot solar cells. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain nanosuspensions, nanogels, and nanocarrier systems. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Give an account of nano-pharmaceuticals generation and the significance of nano-pharmaceuticals. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the role of nanomaterials in bone substitution and dentistry. | CO5 | R | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the applications of nanomaterials in food and cosmetics. | CO5 | An | 20 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Appraise the magnetic storage devices. |
| CO2 | Demonstrate the optical storage devices. |
| CO3 | Apply nano in energy storage devices. |
| CO4 | Design nano encapsulated drug for targeted delivery. |
| CO5 | Develop nano chip for biomedical applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | 20 | - | 5 | - | - | 40 |
| CO2 | 20 | - | - | - | - | - | 20 |
| CO3 | - | - | 40 | - | - | - | 40 |
| CO4 | - | 20 | - | 20 | - | - | 40 |
| CO5 | 20 | - | - | 20 | - | - | 40 |
|  | | | | | | | **180** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **17NT3016** | **Duration** | **3hrs** |
| **Course Name** | **NANOTECHNOLOGY IN FUEL CELLS AND ENERGY STORAGE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | | **BL** | | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | | |
| 1. | Explain the working principle of a fuel cell. | CO1 | | A | | 20 | |
|  | **(OR)** |  | |  | |  | |
| 2. | Elucidate the advantages, disadvantages and environmental impacts on the applications of fuel cells. | CO1 | | A | | 20 | |
|  |  |  | |  | |  | |
| 3. | Discuss the importance of dye-sensitized solar cells. | CO2 | | An | | 20 | |
|  | **(OR)** |  | |  | |  | |
| 4. | Explain the fabrication and working principle of dye sensitized solar cell with a neat sketch. | CO2 | | A | | 20 | |
|  |  |  | |  | |  | |
| 5. | Explain the porous oxides used in SSSC and compare their performance. | CO3 | | An | | 20 | |
|  | **(OR)** |  | |  | |  | |
| 6. | Illustrate the zeolite structures and transition metal based structures used for hydrogen storage. | CO4 | | A | | 20 | |
|  |  |  | |  | |  | |
| 7. | Illustrate the materials, design and working principle of organic solar cells. | CO5 | | A | | 20 | |
|  | **(OR)** |  | |  | |  | |
| 8. | Discuss the role of hole conductor in ETA solar cell. Illustrate with examples. | CO6 | | An | | 20 | |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | | |
| 9. | Describe the methods used for the characterization of hydrogen storage materials. | CO4 | | An | | 20 | |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | To appraise the working of fuel cells. |
| CO2 | To demonstrate the working of solar cells. |
| CO3 | To appraise the oxides of semiconductor materials. |
| CO4 | To demonstrate the hydrogen evaluation and storage. |
| CO5 | To apply kinetic properties in hydride systems. |
| CO6 | To apply fuel cell and solar energy for long term energy storage. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 40 | - | - | - | 40 |
| CO2 | - | - | 20 | 20 | - | - | 40 |
| CO3 | - | - | - | 20 | - | - | 20 |
| CO4 | - | - | 20 | 20 | - | - | 40 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | - | - | - | 20 | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **17NT3016** | **Duration** | **3hrs** |
| **Course Name** | **NANOTECHNOLOGY IN FUEL CELLS AND ENERGY STORAGE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Using a clean diagram, describe the operational principle of a hydrogen/oxygen fuel cell. | CO1 | Analyze | 10 |
|  | b. | Illustrate the advantages of using the nanoporous carbon materials as catalyst support. | CO1 | Analyze | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare the various methods utilized for preparing the carbon supported catalysts. | CO1 | Analyze | 5 |
|  | b. | Explain the importance of hierarchical pore structures | CO1 | Understand | 5 |
|  |  |  |  |  |  |
| 3. | a. | How does the dye-sensitized solar cells work? | CO2 | Analyze | 10 |
|  | b. | Discuss about the materials used in the dye-sensitized solar cells | CO2 | Analyze | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe the major recombination processes of dye-sensitized solar cells. | CO2 | Analyze | 10 |
|  | b. | Explain the principle of Liquid junction semiconductor sensitized solar cells. | CO2 | Apply | 10 |
|  |  |  |  |  |  |
| 5. | a. | Compare the characteristics of liquid junction SSSCs and Solid state SSSCs. | CO3 | Analyze | 10 |
|  | b. | Describe the operating principle of three component ETA cell. | CO3 | Analyze | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss about the effect of multilayer semiconductors deposited on the porous oxides. | CO3 | Understand | 10 |
|  | b. | How does two-component ETA cell work? | CO3 | Apply | 10 |
|  |  |  |  |  |  |
| 7. | a. | Summarize the importance of hydrogen storage. | CO4 | Analyze | 10 |
|  | b. | Discuss about the nanoporous inorganic materials used for hydrogen storage. | CO5 | Understand | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Compare the characteristics of supercapacitors and batteries. | CO4 | Understand | 10 |
|  | b. | Summarize the challenges in material development for hydrogen storage. | CO5 | Apply | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | How hydrogen can be stored in metal-organic frameworks? | CO6 | Analyze | 10 |
|  | b. | Describe about the chemisorption materials used for hydrogen storage. | CO6 | Analyze | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | To appraise the working of fuel cells. |
| CO2 | To demonstrate the working of solar cells. |
| CO3 | To appraise the oxides of semiconductor materials. |
| CO4 | To demonstrate the hydrogen evaluation and storage. |
| CO5 | To apply kinetic properties in hydride systems. |
| CO6 | To apply fuel cell and solar energy for long term energy storage. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 10 |  | 30 |  |  | 40 |
| CO2 |  |  | 10 | 30 |  |  | 40 |
| CO3 |  | 10 | 10 | 20 |  |  | 40 |
| CO4 |  | 10 | 10 |  |  |  | 20 |
| CO5 |  | 10 | 10 |  |  |  | 20 |
| CO6 |  |  |  | 20 |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20NT3005** | **Duration** | **3 hrs** |
| **Course Name** | **SYNTHESIS AND FUNCTIONALIZATION OF NANOMATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the role of surfactants in Nanotechnology. | CO1 | U | 10 |
|  | b. | Analyze the importance of monolayers and multilayers in surfactant molecules. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Examine about pure surfactant and liquid crystals, as well as the surfactant aggregated in liquid media. | CO1 | A | 10 |
|  | b. | Discuss the nanoparticle growth inhibition and size control in surfactant molecule. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the Sol-gel method in solution phase fabrication. | CO2 | A | 10 |
|  | b. | Categorize the solvothermal and hydrothermal synthesis of nanoparticles. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss sonochemical method for the synthesis of nanomaterials with a neat sketch. | CO2 | U | 10 |
|  | b. | Describe laser pyrolysis process in Nanotechnology with a neat sketch. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Evaluate Nanolithography with its advantages and applications. | CO3 | An | 10 |
|  | b. | Develop the shell heterostructures in top-down and bottom-up approaches. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the process of Biomineralization with a neat diagram. | CO4 | U | 10 |
|  | b. | Examine the synthesis of nanoparticles using plant extracts. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. |  | Analyze the factors affecting green synthesis in hollow and shell nanoparticles. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate about Plasma surface modifications with neat diagram. | CO5 | A | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Examine about the surface functionalization of nanoparticles in chemical  surface modification. | CO6 | A | 10 |
|  | b. | Chart the strategies employed to link ligand with targeted Nanoparticles. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Select suitable surfactants for synthesis of desired nanoparticles. |
| CO2 | Understand the mechanism of solution –phase synthesis of nanoparticles. |
| CO3 | Classify and utilize top-down and bottom-up approaches in the synthesis of nanomaterials. |
| CO4 | Understand green synthesis of nanomaterials. |
| CO5 | Choose suitable methods for functionalization of nanoparticles. |
| CO6 | Design surface-functionalized nanoparticles for planned applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | 10 | 10 | - | - | 40 |
| CO2 | - | 10 | 10 | 10 | - | - | 30 |
| CO3 | - | 10 | 10 | 10 | - | - | 30 |
| CO4 | - | 10 | 10 | 20 | - | - | 40 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | - | - | 20 | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20NT3019** | **Duration** | **3hrs** |
| **Course Name** | **CANCER NANOMEDICINE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the role of DNA in brief in treating cancer. | CO1 | R | 4 |
|  | b. | Illustrate the details of oncogenes and its significance in cancer nanomedicine. | CO1 | An | 16 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the term ‘apoptosis’ in brief. | CO1 | U | 4 |
|  | b. | Explain the role of p53 in cancer suppression and describe how cancer is onset due to mutation. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the stages of cancer based on their factors. | CO2 | A | 6 |
|  | b. | Illustrate the basic subclasses of drugs in chemotherapy in detail. | CO2 | An | 14 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe biomarkers and their uses in brief. | CO2 | U | 6 |
|  | b. | Explain chemotherapeutic agents in detail in the treatment of cancer. | CO2 | A | 14 |
|  |  |  |  |  |  |
| 5. |  | Explain the principle and working of Magnetic Resonance Imaging in detail. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Illustrate the concept of Positron Emission Tomography in detail. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Describe the role of nanomateirals in the diagnosis of cancer. | CO4 | U | 4 |
|  | b. | Explain the applications of cyclodextrins in anticancer formulation. | CO4 | A | 16 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the concept of surface plasmon resonance and its importance in cancer treatment | CO5 | R | 6 |
|  | b. | Illustrate cancer therapy in detail and discuss the ways of prevention. | CO5 | An | 14 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Compare and contrast the usage of gold and magnetic nanoparticles in cancer treatment. | CO6 | A | 4 |
|  | b. | Illustrate clinical trials in detail and discuss its significance in the diagnosis and treatment of cancer. | CO6 | An | 16 |

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the mechanism of mutation and cancer-causing cells. |
| CO2 | Explain the methods in cancer chemotherapy and identify anticancer drugs. |
| CO3 | Identify the different cancer diagnosis techniques. |
| CO4 | To explain the pros and cons of cancer nanotechnology methods. |
| CO5 | To choose methods of improvising cancer diagnosis using nanomaterials. |
| CO6 | Demonstrate the applications of nanomaterials in cancer treatment. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 4 | 16 | 16 |  |  | 40 |
| CO2 |  | 6 | 20 | 14 |  |  | 40 |
| CO3 |  |  | 20 | 20 |  |  | 40 |
| CO4 |  | 4 | 16 |  |  |  | 20 |
| CO5 | 6 |  |  | 14 |  |  | 20 |
| CO6 |  |  | 4 | 16 |  |  | 20 |
|  | | | | | | | **180** |