R2822	Sub. Code
	540201

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Energy Science

ENVIRONMENTAL SCIENCE

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective questions by choosing the correct option.

1. Could you explain what the primary hazard is associated with exposure to nuclear radiation? (CO1, K1)
   (a) Air Pollution
   (b) Water Contamination
   (c) Radiation Poisoning
   (d) Climate Change
2. How does thermal pollution affect aquatic life? (CO1, K2)
   (a) It increases fish reproduction
   (b) It decreases oxygen levels in water
   (c) It improves water clarity
   (d) It increases biodiversity
3. Which of the following heavy metals is most commonly associated with contamination of drinking water from industrial waste? (CO2, K2)
   (a) Lead (Pb) (b) Iron (Fe)
   (c) Calcium (Ca) (d) Magnesium (Mg)
4. Can you explain why chlorination is used in waste water treatment and what its main purpose is? (CO2, K1)
   (a) To remove heavy metals
   (b) To disinfect the water
   (c) To remove organic mailer
   (d) To increase oxygen levels

5. Could you explain which principles of Green Chemistry focus on minimizing waste generation? (CO3, K2)

   (a) Waste Minimization

   (b) Prevention

   (c) Use of Catalysts

   (d) Atom Economy

6. Which principle of Green Chemistry focuses on using catalysts instead of stoichiometric reagents? (CO3, K1)

   (a) Use of Renewable Feedstocks

   (b) Prevention

   (c) Catalysis

   (d) Safer Solvents and Auxiliarz

7. Can you identify which of the following is not considered a type of enzyme used as a biocatalyst? (CO4, K1)

   (a) Amylase (b) Lipase

   (c) Protease (d) Sulfuric acid

8. Benefit of using a polymer support in the context of chemical reactions? (CO4, K1)

   (a) Reduces the need for catalysts

   (b) Makes the reaction faster

   (c) Facilitates easy separation of reactants and products

   (d) Increases solvent usage

9. The main goal of using Green Synthesis in agriculture? (CO5, K1)

   (a) To create chemical fertilizers that are more toxic

   (b) To develop pesticides that persist in the environment

   (c) To design fertilizers and pesticides that have minimal environmental impact

   (d) To increase the use of genetically modified crops

10. Which of the following is an example of a Green Chemistry application in the synthesis of biodegradable pesticides? (CO5, K2)

(a) Use of solvents that persist in the environment

(b) Synthesis of non-toxic and biodegradable pesticide formulations

(c) Increased use of genetically modified crops resistant to all chemicals

(d) Application of high-energy methods for synthesis

Part B ($5 \times 5 = 25$)

Answer **all** the questions not more than 500 words each.

11. (a) Determine the major causes of water pollution and explain its impact on both aquatic life and human health. (CO1, K4)

Or

(b) Analyze the major control methods used to mitigate air pollution caused by industrial activities. (CO1, K4)

12. (a) Summarize the role of micronutrients in water bodies and their impact on aquatic life. (CO2, K2)

Or

(b) Explain the role of activated carbon in water treatment and, discuss its advantages and Limitations. (CO2, K2)

13. (a) Discuss the importance of green chemistry in developing alternative reaction pathways. (CO3, K6)

Or

(b) Write about the role of Green Chemistry in the development of alternative energy sources.(CO3, K6)

14. (a) Show how microwave-assisted synthesis is used in Green Chemistry and discuss its advantages. (CO4, K2)

Or

(b) Express the role of catalysts in chemical reactions and discuss their significance in Green Chemistry. (CO4, K2)

15. (a) Determine the application of Green Chemistry in energy production and explain its benefits.(CO5, K4)

Or

(b) Simplify the significance of Green Chemistry in the pharmaceutical industry and explain its impact. (CO5, K4)

Part C $(5 \times 8 = 40)$

Answer **all** the questions not more than 1000 words each.

16. (a) Explore the causes, effects, and control methods of air pollution in detail. (CO1, K4)

Or

(b) Categorize the various impacts of nuclear hazards on the environment and discuss them in detail. (CO1, K4)

17. (a) Classify the various water quality parameters and explain each in detail. (CO2, K2)

Or

(b) Express the tertiary methods of water treatment and illustrate them with examples. (CO2, K2)

18. (a) Estimate the significance of the twelve principles of green chemistry and illustrate them with suitable examples. (CO3, K6)

Or

(b) Elaborate on the need and basis of green methods and green products. (CO3, K6)

19. (a) Explain the design and characteristics of green synthesis. (CO4, K2)

Or

(b) Classify the different synthesis methods that incorporate the principles of Green Chemistry and discuss each in detail. (CO4, K2)

20. (a) Analyze the role of green chemistry in agriculture with examples. (CO5, K4)

Or

(b) Explore the environmental and biomedical applications of Green Chemistry and evaluate their impact. (CO5, K4)

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R2823	Sub. Code
	540202

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Energy Science

SOLAR THERMAL ENERGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Section A (10 × 1 = 10)

Answer **all** questions, by choosing the correct option.

1. Global radiation equal to _____. (CO1, K2)
   (a) Direct radiation+Diffuse radiation
   (b) Direct radiation-Diffuse radiation
   (c) Direct radiation/Diffusion radiation
   (d) Diffuse radiation/Direct radiation
2. What is extraterrestrial radiation? (CO1, K2)
   (a) Energy of sun at the top of earth's atmosphere
   (b) Intensity sun at the top of its atmosphere
   (c) Intensity of sun at the top of earth's atmosphere
   (d) Force of sun on earth
3. The maximum efficiency obtained in. (CO2, K2)
   (a) Paraboloid dish collector
   (b) Flat plate collector
   (c) Line focussing collector
   (d) Evacuated tube collector

4. Which of the following is used to make a glass–glass evacuated tube? (CO2, K2)

(a) Carbon fibres (b) Borosilicate

(c) Quartz (d) Glass fibres

5. What is the operating temperature of turbines in a central receiver thermal power system? (CO3, K4)

(a) 500–800ºC (b) 5000ºC

(c) 10–100ºC (d) 200–500ºC

6. Which of the following is/are examples of heat engines? (CO3, K4)

(a) Fuel cell energy power plants

(b) Fuel cell vehicles

(c) Rankine cycle and Brayton cycle

(d) Concentrating mirrors

7. Which of the following is a site-specific design consideration for a passive solar heating and cooling system? (CO4, K3)

(a) Orientation of the building

(b) Latitude

(c) Building window size

(d) Placement of rooms

8. Solar air collectors transfer sun's thermal energy to air via _____. (CO4, K3)

(a) Convection (b) Conduction

(c) Peltier effect (d) Seebeck Effect

9. What are the factors limiting the efficiency of solar cell? (CO5, K2)

(a) Metal coverage loss

(b) Series resistance loss

(c) Both (a) and (b)

(d) None of the these above

10. Which industry primarily uses solar air collectors? (CO5, K2)

(a) Industries manufacturing plastic

(b) Industries melting metals

(c) Semiconductor industry

(d) Food processing industry

Section B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) Explain the Terrestrial and Extra–terrestrial. (CO1, K2)

Or

(b) Discuss about the beam radiation. (CO1, K2)

12. (a) How does a flat plate sol& collector work? (CO2, K2)

Or

(b) Describe the air based solar collector. (CO2, K2)

13. (a) Explain the solar thermal power plant. (CO3, K4)

Or

(b) Write a note on solar pond electric power plant. (CO3, K4)

14. (a) Explain the active solar heating system. (CO4, K3)

Or

(b) Discuss about solar space heating. (CO4, K3)

15. (a) Describe the electrical specification of solar panel. (CO5, K2)

Or

(b) Discuss about the challenges solar thermal market in India. (CO5, K2)

Section C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Write about the spectral energy distribution of solar radiation. (CO1, K2)

Or

(b) Discuss about the solar radiation measurements. (CO1, K2)

17. (a) Explain the concentrating solar collector. (CO2, K2)

Or

(b) Describe the swimming pool absorber. (CO2, K2)

18. (a) Discuss in detail about any two thermodynamic cycles with an neat diagram. (CO3, K4)

Or

(b) Discuss about the hybrid solar power plants. (CO3, K4)

19. (a) Explain the working principle and advantage of solar furnace. (CO4, K3)

Or

(b) Describe the solar refrigeration system with neat diagram. (CO4, K3)

20. (a) Discuss about solar manufacturing technologies in India. (CO5, K2)

Or

(b) Explain the outlook and development of industrial solar systems. (CO5, K2)

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R2824

Sub. Code
540203

M.Sc. DEGREE EXAMINATION, APRIL – 2025

Second Semester

Energy Science

HYDROGEN ENERGY SYSTEMS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. _____Energy source is primarily used in photoelectrochemical cells. (CO1, K2)
   (a) Wind energy
   (b) Solar energy
   (c) Geothermal energy
   (d) Nuclear energy

2. Most challenge in hydrogen storage. (CO1, K1)
   (a) High cost
   (b) Toxicity
   (c) Low density of hydrogen
   (d) Inflammability

3. Commonly used fossil fuel for hydrogen production. (CO2, K2)
   (a) Coal (b) Natural Gas
   (c) Oil (d) Peat

4. Membrane is commonly used for hydrogen separation. (CO2, K2)

(a) Polymeric (b) Ceramic

(c) All of the above (d) Metallic

5. Chemical energy is converted to _____ energy by a fuel cell. (CO3, K2)

(a) solar (b) potential

(c) mechanical (d) electrical

6. Co-product in fermentative hydrogen production. (CO3, K1)

(a) Acetate (b) Methanol

(c) Ethylene (d) Methane

7. _____ equation is used to calculate the potential of a fuel cell. (CO4, K3)

(a) Maxwell's equation

(b) Arrhenius equation

(c) Nernst equation

(d) Ohm's law

8. _____ fuel used in direct methanol fuel cells (DMFCs) (CO4, K2)

(a) Hydrogen (b) Natural gas

(c) Ethanol (d) Methanol

9. Primary chemical is used in hydrogen storage as a metal hydride. (CO5, K2)

(a) Sodium borohydride

(b) Ammonia

(c) Methane

(d) Water

10. Which hydrogen storage method involves glass microspheres? (CO5, K1)

(a) Chemical storage

(b) Physical storage

(c) Compressed hydrogen

(d) Liquid hydrogen

Part B $(5 \times 5 = 25)$

Answer **all** questions not more than 500 words each.

11. (a) Describe the principle of water electrolysis and its role in hydrogen production. (CO1, K2)

Or

(b) Compare the photo-biochemical cells and photoelectrochemical cells. (CO1, K2)

12. (a) Explain the working principle of a membrane reactor and its role in hydrogen production. (CO2, K4)

Or

(b) Highlight the coal gasification and natural gas reforming for hydrogen production. (CO2, K4)

13. (a) Discuss the biochemical pathway for fermentative hydrogen production. (CO3, K3)

Or

(b) Explain the co-product formation of hydrogen from biomass. (CO3, K3)

14. (a) Describe the working mechanism of proton exchange membrane fuel cells (PEMFCs). (CO4, K2)

Or

(b) Solve the Nernst equation. (CO4, K2)

15. (a) Illustrate the cryo-compressed hydrogen storage techniques. (CO5, K2)

Or

(b) Describe the applications of underground hydrogen storage. (CO5, K2)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Describe the design and operation of a hydrogen production plant using water splitting. (CO1, K2)

Or

(b) Briefly explain the working principle of photoelectrochemical cells and its potential in renewable hydrogen production. (CO1, K2)

17. (a) Examine the reforming natural gas and gas separation of hydrogen from fossil fuels. (CO2, K4)

Or

(b) Describe the partial oxidation process of hydrocarbons, including their chemical reactions and efficiency. (CO2, K4)

18. (a) Comparative analysis of hydrogen production through fermentation and photobiological methods. (CO3, K3)

Or

(b) Discuss the process and culture parameters of hydrogen production from biomass. (CO3, K3)

19. (a) Provide a detailed explanation of a fuel cell's working principle and components. (CO4, K2)

Or

(b) Relate the comparison aspects for battery vs fuel cells. (CO4, K2)

20. (a) Explain the process of underground hydrogen storage for stationary applications. (CO5, K2)

Or

(b) Detailed overview of hydrogen storage technologies, including compressed, liquid, and chemical storage methods. (CO5, K2)

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R2825	Sub. Code
	540503

M.Sc. DEGREE EXAMINATION, APRIL 2025

Second Semester

Energy Science

Elective : ADVANCED NANOMATERIALS AND THEIR APPLICATIONS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective questions by choosing the correct option.

1. What is the primary significance of the nanoscale in materials science? (CO1, K1)

   (a) Enhanced magnetic properties

   (b) High surface–to–volume–ratio

   (c) Reduced density

   (d) Lower thermal conductivity

2. Which of the following is an example of a semiconductor nanocrystal? (CO1, K2)

   (a) Gold nanoparticle (b) Carbon nanotube

   (c) CdSe quantum dot (d) Graphene sheet

3. Which of the following is a physical method for synthesizing nanomaterials? (CO2, K2)

(a) Ball milling

(b) Sol-gel method

(c) Chemical vapor deposition

(d) Electrochemical deposition

4. What process involves using a solution to create solid nanoparticles by inducing a chemical reaction? (CO2, K1)

(a) Ball milling (b) electroplating

(c) Precipitation (d) Physical vapor deposition

5. What is a key characteristic of metal-metal oxide nanocomposites? (CO3, K1)

(a) Enhanced electrical conductivity

(b) increased optical transparency

(c) improved mechanical strength

(d) improved catalytic properties

6. Which property is commonly enhanced in nanocomposites? (CO3, K2)

(a) Density (b) Hardness

(c) Weight (d) Transparency

7. Which of the following is an example of a biopolymer? (CO4, K2)

(a) Polyethylene (b) Nylon

(c) Starch (d) Polystyrene

8. Which of the following is a type of magnetic material that is permanently magnetized? (CO4, K1)

(a) Ferromagnetic (b) Paramagnetic

(c) Diamagnetic (d) Antiferromagnetic

9. How are nanomaterials used in Dye-Sensitized Solar Cells (DSSCs)? (CO5, K2)

(a) To reduce the cost of production

(b) To increase the size of the solar cells

(c) To improve light absorption and electron transport

(d) To make the cells biodegradable

10. How do nanomaterials aid in cancer detection? (CO5, K2)

(a) By increasing the growth rate of cancer cells

(b) By reducing the side effects of treatments

(c) By eliminating cancer cells

(d) By enhancing the sensitivity of imaging techniques

Part B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) Summarize the significance of the nanoscale in influencing material properties and applications. (CO1, K2)

Or

(b) Express how metals, semiconductors, ceramics, and composites exhibit size- dependent properties at the nanoscale. (CO1, K2)

12. (a) Discuss electrospinning and its utilization in the fabrication of nanofibers. (CO2, K6)

Or

(b) Write about how phytosynthesis utilizes plant-based resources for the green synthesis of nanoparticles and other materials. (CO2, K6)

13. (a) Analyze the advantages and applications of metal-metal oxide nanocomposites in catalysis and energy storage. (CO3, K4)

Or

(b) Explore the properties of nanocomposite materials that make them ideal for advanced applications. (CO3, K4)

14. (a) Differentiate between bioactive and bioresorbable biomaterials in terms of them function and application in medical devices. (CO4, K2)

Or

(b) Express the magnetic phenomena at the nanoscale differ from those in bulk materials and their applications. (CO4, K2)

15. (a) Write about how nanomaterials enhance the efficiency of water purification processes. (CO5, K6)

Or

(b) Discuss how nanomaterials enhance the sensivity and functionality of biosensors in detecting biological targets. (CO5, K6)

Part C ($5 \times 8 = 40$)

Answer **all** the questions not more than 1000 words each.

16. (a) Explain the influence of surface area, quantum confinement effects, and barrier penetration on the properties and behavior of nanoscale materials. (CO1, K2)

Or

(b) Demonstrate the different types of nanocrystals and explain how they vary in structure and characteristics. (CO1, K2)

17. (a) Elaborate on RF/DC magnetron sputtering and its application in material deposition. (CO2, K6)

Or

(b) Estimate the impact of microwave irradiation on the uniformity and efficiency of material synthesis compared to conventional heating methods. (CO2, K6)

18. (a) Determine the key properties of carbon nanotubes (CNTs) that make them ideal for use in electronic, mechanical, and energy storage applications. (CO3, K4)

Or

(b) Analyze the primary applications of nanocomposite materials in industry and technology. (CO3, K4)

19. (a) Explain the classifications of biomaterials according to their composition and application. (CO4, K2)

Or

(b) Classify the differences between giant and colossal magnetoresistance, and explain how they impact the performance of magnetic devices. (CO4, K2)

20. (a) Evaluate how nanomaterials enhance the performance of electrical and magnetic devices in various applications. (CO5, K6)

Or

(b) Explain how nanomaterials improve the functionality of medical implements and enable self-cleaning properties in various applications. (CO5, K6)

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