R0273	Sub. Code
	540101

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Energy Science

BASIC ENERGY SCIENCES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

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

1. The annual depreciation of a hydropower plant is about ———— (CO1, K2)

   (a) 0.5% to 1.5% (b) 10% to 15%

   (c) 15% to 20% (d) 20% to 25%

2. Energy resources derived from natural organic materials are called (CO1, K2)

   (a) Geothermal energy sources

   (b) Fossil fuels

   (c) Biomass

   (d) All of these

3. Which meter is used to measure the beam radiations ————? (CO2, K2)

   (a) Pyrheliometer (b) Sunshine recorder

   (c) Anemometer (d) All of the above

4. Which cell is used to convert solar energy directly into electrical energy ———— (CO2, K2)

   (a) Dry cell (b) Photovoltaic cell

   (c) Battery (d) None

5. The wind intensity can be expressed in terms of (CO3, K4)

(a) Reynolds number

(b) Mach number

(c) Beaufort number

(d) Froude number

6. A wind turbine designed to come into operation at a minimum wind speed is called ———— (CO3, K4)

(a) Cut in velocity (b) Windward

(c) Cut out velocity (d) Upwind location

7. Anemometer measures ———— (CO4, K4)

(a) Feet per minute

(b) Litres per minute

(c) Centimetres per minute

(d) Meters per second

8. The aerobic digestion of sewage is used to produce ———— (CO4, K2)

(a) Biomass (b) Biofuels

(c) Synthetic fuels (d) Metal fuels

9. A fuel cell is used to convert chemical energy into (CO5, K2)

(a) Mechanical energy

(b) Solar energy

(c) Electrical energy

(d) Potential energy

10. In anaerobic digestion, biogas production by bacterial decomposition is (CO5, K2)

(a) Absence of oxygen

(b) Presence of oxygen

(c) Presence of CO_2

(d) Absence of CO_2

Part B (5 × 5 = 25)

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

11. (a) Justify why does we need to conserve energy resources. (CO1, K5)

Or

(b) Explain primary and secondary energy resources. (CO1, K2)

12. (a) Classify the different types of solar cells and explain in brief. (CO2, K4)

Or

(b) Explain the principle of photovoltaic conversion of solar energy. (CO2, K2)

13. (a) Illustrate the criteria for selecting site for a wind farm in India. (CO3, K2)

Or

(b) Classification of hydropower plants and explain. (CO3, K4)

14. (a) Elaborate the classification and estimation of biomass. (CO4, K4)

Or

(b) Discuss briefly the types of biomass energy conversion systems. (CO4, K4)

15. (a) Explain the applications of geothermal energy. (CO5, K2)

Or

(b) Classify the main types of tidal energy. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1,000 words each.

16. (a) Compare the advantages and limitations of conventional and non-conventional energy resources. (CO1, K5)

Or

(b) Explain in detail an overview of the global and Indian energy scenario. (CO1, K4)

17. (a) Outline the working of the Pyrometer with the help of a neat sketch. (CO2, K2)

Or

(b) Relate briefly about the following : (CO2, K4)

(i) Thin film solar cells

(ii) Perovskite solar cells.

18. (a) Show the hydropower plant schematic diagram and explain. (CO3, K4)

Or

(b) Outline the prospects of technologies for wind energy conversion. (CO3, K2)

19. (a) Elaborate the source and characterizations of biofuels (CO4, K4)

(i) Biodiesel

(ii) Bioethanol.

Or

(b) Draw the Schematic representation of various designs of high-rate biogas digesters. (CO4, K4)

20. (a) Compare the types of tidal power plants and explain the advantages and limitations. (CO5, K4)

Or

(b) Summarize the recent scenario of geothermal energy in India. (CO5, K2)

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R0274	Sub. Code
	540102

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Energy Science

CHEMISTRY FOR ENERGY SCIENCES

(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. Which one of the following is acidic? (CO1, K4)

   (a) Lemon juice (b) Tomatoes

   (c) Milk (d) All

2. Molecules are held together in a crystal by (CO1, K2)

   (a) Hydrogen bond

   (b) Electrostatic attraction

   (c) Van der waal's attraction

   (d) Dipole-dipole attraction

3. Among the following which one is the best conductor of electric current? (CO2, K2)

   (a) Acetic acid (b) Hydrochloric acid

   (c) Ammonia (d) Fructose

4. One Faraday equal to ————————. (CO2, K4)

(a) 96,485 C/mol (b) 96,400 C/mol

(c) 96,485 mol (d) 96,400 mol

5. Which of the following is a unit of heat transfer?(CO3, K4)

(a) Kelvin (K) (b) Joule (J)

(c) Watt (W) (d) Pascal (Pa)

6. The second law of thermodynamics states that (CO3, K3)

(a) Energy cannot be created or destroyed

(b) The entropy of a closed system tends to decrease over time

(c) Heat naturally flows from a colder object to a hotter object

(d) Heat naturally flows from a hotter object to a colder object

7. Which of the following factors does not typically influence the rate of a chemical reaction? (CO4, K4)

(a) Temperature

(b) Concentration of reactants

(c) Pressure

(d) Molecular weight of the reactant

8. The half-life of a first-order reaction is ————————. (CO4, K4)

(a) Constant

(b) Dependent on the initial concentration of the reactant

(c) Independent of temperature

(d) Always shorter than the half-life of a second-order reaction

9. In photochemical reactions, which of the following processes occurs upon the absorption of light? (CO5, K2)

(a) The breaking of chemical bonds

(b) The formation of chemical bonds

(c) Both the breaking and formation of chemical bonds

(d) No chemical changes occur

10. The phenomenon in which a molecule absorbs light and returns to its ground state without undergoing a chemical change is called (CO5, K4)

(a) Photodissociation

(b) Photoluminescence

(c) Phosphorescence

(d) Photostability

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

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

11. (a) Describe the theory and properties of acid and base. (CO1, K2)

Or

(b) What is hybridization? Explain the types of hybridization. (CO1, K4)

12. (a) 'What are batteries and how are they classified? Write the electrochemical reaction and explain its working. (CO2, K4)

Or

(b) What are redox reactions? Describe the typical steps involved in balancing redox reactions. (CO2, K4)

13. (a) Explain reversible and irreversible PV works. (CO3, K2)

Or

(b) Describe in detail about Gibbs and Helmholtz free energy. (CO3, K2)

14. (a) Explain in detail about Stokes-Einstein equation. (CO4, K4)

Or

(b) Illustrate temperature dependence reaction rate. (CO4, K3)

15. (a) Describe transition of molecules by Jablonski diagram. (CO5, K3)

Or

(b) What are radiation less transitions? Explain the types of radiation less transitions. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1,000 words each.

16. (a) What is meant by chemical periodicity? How do the properties change in rows and columns? (CO1, K2)

Or

(b) Describe the various types of chemical bonds. Among the chemical bonds, which one is more stable and why? (CO1, K2)

17. (a) Explain following. (i) Derive Nernst equation (ii) Electrochemical cell. (4 + 4) (CO2, K4)

Or

(b) Describe the principle and working of a fuel cell. (CO2, K2)

18. (a) Explain the following (i) Carnot's principle (ii) Le-Chatelier principle. (4 + 4) (CO3, K4)

Or

(b) Derive Maxwell relations for thermodynamic relations. (CO3, K4)

19. (a) Explain (i) Arrhenius parameters. (ii) Kinetic isotope effect. (4 + 4) (CO4, K4)

Or

(b) Describe in detail about steady state approximation. (CO4, K4)

20. (a) Explain (i) Fluorescence (ii) Phosphorescence. (4 + 4)

(CO5, K4)

Or

(b) What is meant by luminescence? How does photoluminescence take place? (CO5, K3)

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R0275	Sub. Code
	540103

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Energy Science

PHYSICS FOR ENERGY SCIENCES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

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

1. What is the relation between conservative and non-conservative forces? (CO1, K2)

   (a) Conservative forces depend on the path taken by the object, while non-conservative forces do not.

   (b) Conservative forces do not depend on the path taken by the object, while non-conservative forces do.

   (c) Conservative forces are always positive, while non-conservative forces are always negative.

   (d) Conservative forces are always negative, while non-conservative forces are always positive.

2. Show the term used to describe the smallest amount of energy that can be emitted or absorbed by a system? (CO1, K2)

   (a) Quantum (b) Photon

   (c) Electron (d) Atom

3. Show the name of the temperature scale that is based on the constant volume gas thermometer and has the lowest possible temperature as zero (CO2, K2)

(a) Celsius scale (b) Fahrenheit scale

(c) Kelvin scale (d) Rankine scale

4. Express the definition of entropy according to the second law of thermodynamics? (CO2, K2)

(a) Entropy is the measure of disorder or randomness in a system

(b) Entropy is the measure of heat transfer or energy flow in a system

(c) Entropy is the measure of work done or energy converted in a system

(d) Entropy is the measure of temperature or kinetic energy in a system

5. Choose the difference between direct current (DC) and alternating current (AC). (CO3, K6)

(a) DC flows in one direction, while AC changes direction periodically

(b) DC changes direction periodically, while AC flows in one direction

(c) DC has a constant voltage, while AC has a varying voltage

(d) DC has a varying voltage, while AC has a constant voltage

6. Choose the formula for calculating the resistance of a conductor in terms of its resistivity, length, and cross-sectional area? (CO3, K6)

(a) $R = \rho L/A$ (b) $R = \rho A/L$

(c) $R = L/\rho A$ (d) $R = A/\rho L$

7. Adding impurities in the intrinsic semiconductor is called as (CO4, K2)

(a) Etching (b) Doping

(c) Heating (d) Saturating

8. In Fermi Dirac distribution E_f is called as (CO4, K2)

(a) Free energy (b) Fermi energy

(c) Vacuum energy (d) Orbital energy

9. For the scattering event X,Y nucleus should be (CO5, K2)

(a) Excited (b) Neutral

(c) Non identical (d) Identical

10. In nuclear reaction if Q value is negative then the reaction is called as (CO5, K2)

(a) Isolated (b) Adiabatic

(c) Exothermic (d) Endothermic

Part B (5 × 5 = 25)

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

11. (a) Outline potential energy and conservative forces and how are they related? How can you calculate the potential energy of an object due to a conservative force using a formula? (CO1, K2)

Or

(b) Compare work done by a constant force and work done by a varying force on an object. Give examples of each type of force and how to calculate the work done by them using formulas? (CO1, K2)

12. (a) Explain the factors that affect the thermal expansion of solids and liquids? How can you calculate the change in length or volume of a solid or liquid due to a change in temperature? (CO2, K2)

Or

(b) Outline the physical meaning and mathematical expression of entropy? How can you calculate the change in entropy of a system undergoing a reversible and irreversible process? (CO2, K2)

13. (a) Discuss the rules for combining resistors in series and in parallel? How can you use Kirchhoff's rules to analyse complex circuits with multiple loops and junctions? (CO3, K6)

Or

(b) Elaborate RLC series circuits. (CO3, K6)

14. (a) Explain Josephson effect and explain superconductivity. (CO4, K2)

Or

(b) Outline the band theory of solids. (CO4, K2)

15. (a) Explain the nuclear fusion and explain the fusion reaction on the stars. (CO5, K2)

Or

(b) Illustrate the shell model for the nucleus. (CO5, K2)

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

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

16. (a) Explain mass-energy equivalence and quantization of energy. (CO1, K2)

Or

(b) Derive work-kinetic energy theorem. Give examples of how it can be used to find the change in kinetic energy of an object when a net force acts on it. (CO1, K2)

17. (a) Compare the differences between heat and internal energy? How can you measure the heat capacity and specific heat of a substance using experiments? How can you calculate the latent heat of a phase change? (CO2, K2)

Or

(b) Illustrate heat engines and how do they work? What are the criteria for an ideal heat engine and what is the maximum efficiency that can be achieved by any heat engine according to the second law of thermodynamics? (CO2, K2)

18. (a) Estimate the characteristics and applications of rectifiers and filters in AC circuits? How can you convert an AC voltage to a DC voltage using a full-wave rectifier? (CO3, K6)

Or

(b) Formulate the principles and advantages of transformer and power transmission in AC circuits. How can you increase or decrease the voltage of an AC source using a step-up or a step-down transformer? (CO3, K6)

19. (a) Illustrate free electron theory of metals. (CO4, K2)

Or

(b) Illustrate various bonding of metals. (CO4, K2)

20. (a) Explain α, β, γ decay and write down the uses of radiation. (CO5, K2)

Or

(b) Obtain the relationship between the half-life period and mean life. (CO5, K2)

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R0276	Sub. Code
	540104

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Energy Science

POLYMER SCIENCE AND TECHNOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

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

1. Which of the following kind of polymers are known for their high crystallinity? (CO1, K2)

   (a) Isotactic

   (b) Syndiotactic

   (c) Atactic

   (d) None of the mentioned

2. Which of the following monomers are unsuitable for condensation polymerization? (CO1, K2)

   (a) Propanoic acid and ethanol

   (b) Butane-dioic acid and glycol

   (c) Diamines and dicarboxylic acids

   (d) Hydroxy acids

3. On the basis of the mode of formation, polymer can be classified as (CO2, K2)

(a) Addition polymers only

(b) Condensation polymers only

(c) Copolymers

(d) Addition and condensation polymer

4. Which of the following does not undergo addition polymerization? (CO2, K2)

(a) Vinyl chloride

(b) Butadiene

(c) Styrene

(d) All of the above

5. Polymer formation from monomer starts by (CO3, K3)

(a) The condensation reaction

(b) The coordinate reaction

(c) Conversion of monomer to monomer ions by protons

(d) Hydrolysis of monomers

6. What are the physical measurements which characterize nonpolymeric molecules? (CO3, K3)

(a) Freezing-point depressions

(b) Vapour pressures

(c) Boiling points

(d) All of the above

7. Which of the following monomers form biodegradable polymers? (CO4, K2)

(a) 3-hydroxybutanoic acid + 3-hydroxypentanoic acid

(b) Glycine + amino caproic acid

(c) Ethylene glycol + phthalic acid

(d) Both (a) and (b)

8. The polymer used in making hair synthetic hair wigs is made up of (CO4, K2)

(a) CH_2=CHCl

(b) CH_2=CHCOOCH_3

(c) C_6H_5CH=CH_2

(d) CH_2=CH-CH=CH_2

9. What is the range of tensile strength, exhibited by fibers? (CO5, K2)

(a) 300-3,000

(b) 4,000-15,000

(c) 20,000-150,000

(d) 5,000-10,000

10. Which of the following category does cellulose nitrate fall into? (CO5, K2)

(a) Natural

(b) Synthetic

(c) Semi-synthetic

(d) None of the mentioned

Part B (5 × 5 = 25)

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

11. (a) Explain the functionality of Monomers. (CO1, K2)

Or

(b) Show the condensation Polymerization detail. (CO1, K2)

12. (a) Outline polymer reactors. (CO2, K2)

Or

(b) Illustrate the polymeric process in detail. (CO2, K2)

13. (a) Develop a note on melt flow index test. (CO3, K3)

Or

(b) Predict the melting point and softening point of the polymer with an example. (CO3, K3)

14. (a) Explain a note on magnetic polymers. (CO4, K2)

Or

(b) Illustrate bio-medical polymers. (CO4, K2)

15. (a) Summarize the toxicity of polymers and their efficient disposal. (CO5, K2)

Or

(b) Outline feedstock searching and fire hazards of polymers. (CO5, K2)

Part C (5 × 8 = 40)

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

16. (a) Classify the mechanisms of cationic polymerization. (CO1, K2)

Or

(b) (i) Summarize polymerization.

(ii) Explain degree of polymerization. (4+4) (CO1, K2)

17. (a) Outline the structure of the polymer and its properties. (CO2, K2)

Or

(b) Explain the components of polymer and polymer fabrication. (CO2, K2)

18. (a) (i) Identify molecular weight of polymers. (4+4)

(ii) Predict density and bulk factor in polymers. (CO3, K3)

Or

(b) (i) Explain water and moisture absorption in polymers.

(ii) Discuss particle sizes in polymer. (4+4) (CO3, K3)

19. (a) (i) Identify water and moisture absorption in polymers.

(ii) Solve particle sizes in polymer. (4+4) (CO4, K2)

Or

(b) (i) Construct a note about bio-degradable polymers.

(ii) Develop a note on conducting polymers. (4+4) (CO4, K2)

20. (a) (i) Summarize the water treatment process using polymers.

(ii) Outline the application of polymers in tissue engineering. (4+4)
(CO5, K2)

Or

(b) Explain the application of polymers in the energy, optical, electrical, and drug industry. (CO5, K2)

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R0277	Sub. Code
	540501

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

First Semester

Energy Science

Elective: BIOFUELS

(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 are all biofuels made from? (CO1, K2)
   (a) Corn
   (b) Animal fat
   (c) Biological ingredients
   (d) Silver

2. Which of the following is not a potential biofuel? (CO1, K2)
   (a) Gasoline (b) Hydrogen fuel cells
   (c) Algae biodiesel (d) All the above

3. ———— is an example of starch crops biomass feedstocks (CO2, K2)
   (a) Corn stover (b) Wheat straw
   (c) Orchard pruning (d) Sugar cane

4. What is the primary source of biodiesel? (CO2, K2)

(a) Soyabeans (b) Plant oil

(c) Animal fat (d) None of these

5. Ethanol refers to any biofuel made from (CO3, K2)

(a) Grass

(b) Corn

(c) Plant carbohydrates

(d) Leaves

6. Production of biothanol is through fermentation of ———————— and starch components (CO3, K4)

(a) Alcohol (b) Sugar

(c) Milk (d) Acid

7. In biomethane, the percentage of carbon dioxide is (CO4, K4)

(a) 55-60 (b) 35-45

(c) 30-40 (d) 32-43

8. Bioethanol is denatured alcohol, also referred to as (CO4, K2)

(a) Methylene (b) Ethylene

(c) Ethylene glycol (d) Methylated spirit

9. This forestry material is used as biomass (CO5, K2)

(a) Fish oil (b) Logging residues

(c) Manure (d) Tallow

10. The aerobic digestion of sewage is utilized in the production of (CO5, K4)

(a) Metal articles (b) Biofuels

(c) Biomass (d) Synthetic fuels

Part B (5 × 5 = 25)

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

11. (a) Explain the techniques for biomass resource assessment. (CO1, K4)

Or

(b) Convert the process of Biomass into Biofuel (CO1, K4)

12. (a) Summarize the recent initiatives regarding Biofuels. (CO2, K2)

Or

(b) Illustrate the third generation of Biofuel with example. (CO2, K4)

13. (a) Interpret the production of Biomethanol. (CO3, K2)

Or

(b) Compare the properties of Biopropanol and Biobutanol. (CO3, K4)

14. (a) Elaborate the current technologies of biodiesel production. (CO4, K4)

Or

(b) Construct the purification techniques of biodiesel. (CO4, K4)

15. (a) Explain the properties of biogas and biogas production. (CO5, K4)

Or

(b) Compare the advantages and limitations of biohydrogen. (CO5, K4)

Part C (5 × 8 = 40)

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

16. (a) Illustrate the combustion on woody biomass to give the energy balance calculations involved? (CO1, K5)

Or

(b) Explain the various types of biomass and estimation in detail. (CO1, K4)

17. (a) Compare the generation of biofuels with example. (CO2, K4)

Or

(b) Explain the advantages and disadvantages of biofuels. (CO2, K4)

18. (a) Illustrate the several types of feedstocks and process technologies in bioethanol. (CO3, K4)

Or

(b) Compare the properties of Bioethanol and Biomethanal and explain its limitations. (CO3, K4)

19. (a) Estimate the microorganisms and raw materials used for microbial oil production. (CO4, K4)

Or

(b) Discuss about the biodiesel production from single cell oil in brief (CO4, K3)

20. (a) Interpret the schematic mechanism of biogas production with neat sketch. (CO5, K4)

Or

(b) Determine the biological hydrogen production methods. (CO5, K4)

R0278	Sub. Code
	540301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Energy Science

PHOTOVOLTAICS

(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. The device that converts optical radiation into electrical energy is ———— (CO1, K2)

   (a) LED (b) Photo-detector

   (c) Solar cell (d) P-I-N diode

2. A solar cell unit is basically a ————. (CO1, K2)

   (a) Semiconductor triode

   (b) Semiconductor Diode

   (c) Junction between two good conductors

   (d) All the above

3. ———————— photovoltaic devices in the form of thin films. (CO2, K2)

(a) Cadmium Telluride

(b) Cadmium oxide

(c) Cadmium Sulphide

(d) Cadmium sulphate

4. ———————— technique is a method of preparing extremely pure optical glasses. (CO2, K4)

(a) Liquid phase (melting)

(b) Radio frequency induction

(c) Optical attenuation

(d) Vapour phase deposition (VPD)

5. The general range of solar cell efficiency is ————————. (CO3, K4)

(a) 5% → 10% (b) 10% → 15%

(c) 15% → 20% (d) All are correct

6. Dye-sensitized solar cells are made from _____ organic dye (CO3, K2)

(a) Ruthium (b) Aniline

(c) Safranine (d) Induline

7. Which type of solar cell gives the highest efficiency? (CO4, K2)

(a) Monocrystalline

(b) Polycrystalline germanium

(c) Thin film

(d) Polycrystalline silicon

8. Aperture area of a solar collector is roughly equal to ———— (CO4, K4)

(a) Coolant area (b) Generator area

(c) Absorber area (d) System area

9. A charge controller limiting the charging current to a battery system by open-circuiting the array is ————. (CO5, K4)

(a) Shunt controller

(b) Series charge controller

(c) Parallel charge controller

(d) Array controller

10. An electrical system consisting of an array of one or more PV modules, conductors, electrical components and one or more loads is? (CO5, K2)

(a) Photovoltaic system

(b) Hybrid system

(c) Grid-Tied system

(d) Standalone system

Part B (5 × 5 = 25)

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

11. (a) Distinguish between the direct band gap and indirect band gap. (CO1, K4)

Or

(b) Explain the role of anti-reflection coating play in PV cell fabrication and characterization. (CO1, K2)

12. (a) Show the neat sketch of cadmium telluride solar cell, CZTS solar cell and explain both briefly. (CO2, K2)

Or

(b) Classify the types of silicon solar cells. (CO2, K2)

13. (a) Develop the working mechanism of Perovskite Solar cell. (CO3, K4)

Or

(b) Identify the components and fabrication techniques of Dye sensitized solar cells. (CO3, K4)

14. (a) Illustrate about the hybrid SPV power systems. (CO4, K4)

Or

(b) Summaries the issues with solar PV modules. (CO4, K4)

15. (a) Compare the following

(i) Remote area power systems

(ii) Grid connected power systems. (CO5, K4)

Or

(b) Categories the different types of solar PV module. (CO5, K2)

Part C (5 × 8 = 40)

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

16. (a) Examine the expression for energy gap (Eg) of an intrinsic semiconductor. (CO1, K5)

Or

(b) Compare the properties of elemental semiconductors and compound semiconductors. (CO1, K4)

17. (a) Explain the following thin film deposition techniques.

(i) PVD-Physical vapour deposition

(ii) MBE-Molecular beam epitaxy (CO2, K2)

Or

(b) Illustrate the advantages of thin films. (CO2, K4)

18. (a) Summaries a short note on

(i) Organic solar cell

(ii) Tandem solar cell (CO3, K4)

Or

(b) Construct the schematic diagram of dye sensitized solar cells and explain the working principle. (CO3, K6)

19. (a) (i) Explain the role of encapsulation materials and protective layers in solar panel assembly. (4)

(ii) How do these components safeguard the solar cells against environmental factors and extend their lifespan? (4)
(CO4, K4)

Or

(b) Compare the identical and nonidentical cells in solar PV modules. (CO4, K4)

20. (a) Interpret the applications of photovoltaic systems in space and telecommunication. (CO5, K2)

Or

(b) Examine in detail with necessary diagram, the principle of SPV power plant design tools and methodologies. (CO5, K4)

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R0279	Sub. Code
	540302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Energy Science

ENERGY STORAGE SYSTEMS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

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

1. What is the advantage of thermal energy storage over other modes of energy storage? (CO1, K2)

   (a) Thermal energy storage has a higher energy density and lower cost than other modes of energy storage.

   (b) Thermal energy storage has a higher power density and faster response than other modes of energy storage.

   (c) Thermal energy storage has a higher efficiency and lower losses than other modes of energy storage.

   (d) Thermal energy storage has a higher flexibility and scalability than other modes of energy storage.

2. What is an example of biological energy storage that is widely used by humans (CO1, K2)

   (a) Photosynthesis (b) Biomass

   (c) DNA (d) ATP

3. What is the term used to describe the lead sulfate build-up on the plates of a lead-acid battery that reduces its efficiency and capacity? (CO2, K6)

(a) Sulfation (b) Corrosion

(c) Stratification (d) Gassing

4. What is the typical voltage per cell of a lead-acid battery? (CO2, K6)

(a) 1.2V (b) 2 V

(c) 3.6 V (d) 4.5 V

5. What is the main challenge lithium Sulphur batteries? (CO3, K2)

(a) Low specific energy

(b) High cost

(c) Polysulfide shuttle effect

(d) Safety issues

6. What is the most commonly used anode material for lithium-ion batteries? (CO3, K2)

(a) Graphite (b) Lithium

(c) Cobalt (d) Nickel

7. What is the main advantage of supercapacitors over conventional batteries? (CO4, K6)

(a) Higher energy density

(b) Higher power density

(c) Lower cost

(d) Longer lifespan

8. What are the main types of low temperature fuel cells? (CO4, K6)

(a) Proton exchange membrane fuel cell (PEMFC) and alkaline fuel cell (AFC)

(b) Proton exchange membrane fuel cell (PEMFC) and solid oxide fuel cell (SOFC)

(c) Alkaline fuel cell (AFC) and solid oxide fuel cell (SOFC)

(d) Alkaline fuel cell (AFC) and molten carbonate fuel cell (MCFC)

9. What is an example of a battery/supercapacitor hybrid system? (CO5, K2)

(a) Electric vehicles

(b) Solar power systems

(c) Wind power systems

(d) All of the above

10. What is the main challenge of hybrid fuel cell/battery systems? (CO5, K2)

(a) High cost (b) Complex control

(c) Safety issues (d) All of the above

Part B (5 × 5 = 25)

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

11. (a) Illustrate chemical energy storage in different forms and devices, such as fossil fuels, hydrogen, synthetic fuels, and biofuels? (CO1, K2)

Or

(b) Compare the advantages and disadvantages of chemical energy storage each form and device in terms of efficiency, safety, and sustainability? (CO1, K2)

12. (a) Discuss the principle and construction of a Lead-acid battery. How does it differ from other types of batteries in terms of chemistry, structure and performance? (CO2, K6)

Or

(b) Discuss the charging and discharging properties of SLA (sealed lead-acid batteries. What are the factors that affect their efficiency, lifespan and safety? (CO2, K6)

13. (a) Explain the principle and construction of Lithium-ion batteries. How do they differ from primary batteries? (CO3, K2)

Or

(b) Compare the advantages and disadvantages of using nanomaterials for anodes and cathodes in Lithium ION batteries. Give some examples of nanomaterials that are used or being developed for this purpose. (CO3, K2)

14. (a) Discuss the types of electrodes used in supercapacitors and their advantages and disadvantages. What are the criteria for selecting suitable electrode materials for supercapacitors. (CO4, K6)

Or

(b) Discuss the fabrication process of fuel cells and the main components involved. What are the challenges and opportunities for improving the efficiency and durability of fuel cells? (CO4, K6)

15. (a) Explain the concept of hybrid energy systems and why they are needed. What are the benefits and drawbacks of using hybrid energy systems for different applications? (CO5, K2)

Or

(b) Compare and contrast battery / supercapacitor hybrid systems and hybrid fuel cell/battery systems. (CO5, K2)

Part C (5 × 8 = 40)

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

16. (a) (i) Compare the ways of electric energy be stored in different forms and devices, such as capacitors, flywheels, superconducting magnetic energy storage, and pumped hydroelectric storage

(ii) Classify the advantages and disadvantages of each form and device in terms of performance, cost, and environmental impact. (CO1, K2)

Or

(b) Explain are the main challenges and opportunities for energy storage in the context of the global energy transition and the increasing share of renewable energy sources. (CO1, K2)

17. (a) Compile and contrast the types of Lead acid batteries, such as flooded, sealed, gel and AGM. What are the applications and limitations of each type? (CO2, K6)

Or

(b) Construct the concept and function of SLI (starting, lighting and ignition) batteries. How are they designed and used in automotive vehicles? (CO2, K6)

18. (a) Compare the fabrication and evaluation methods of metal-air batteries. What are the challenges and opportunities for improving their performance and durability? (CO3, K2)

Or

(b) Compare and contrast Lithium-sulphur batteries with lithium-ion batteries. What are the co a merits and demerits of each type of battery? (CO3, K2)

19. (a) Discuss the comparison between supercapacitors with conventional batteries in terms of merits and demerits. What are the applications of supercapacitors in various fields? (CO4, K6)

Or

(b) Formulate the different types of low temperature fuel cells and their operating principles. What are the advantages and disadvantages of each type? What are some examples of reversible fuel cells? (CO4, K6)

20. (a) Describe the structure and function of hybrid fuel cell/battery systems. How do they overcome the limitations of fuel cells and batteries alone? (CO5, K2)

Or

(b) Illustrate the structure and function of battery/supercapacitor hybrid systems. How do they overcome the limitations of batteries and supercapacitors alone? (CO5, K2)

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R0280	Sub. Code
	540303

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Energy Science

ADVANCED INSTRUMENTAL METHODS OF ANALYSIS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

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

1. Which of the following component convert absorption into corresponding electrical signals? (CO1, K2)

   (a) Amplifier

   (b) Monochromator

   (c) Detector

   (d) Source

2. What are the kind of energies associated with molecules?

   (CO1, K2)

   (a) Rotational energy

   (b) Vibrational energy

   (c) Electronic energy

   (d) All the above

3. Which of the following is measured in potentiometry? (CO2, K4)

(a) Potential and Current

(b) Potential

(c) Charge

(d) Resistance

4. According to Faraday's First Law of electrolysis, the extent of electrochemical reaction depends on _____. (CO2, K3)

(a) Voltage applied

(b) Conductance of solution

(c) Electrical charge applied

(d) All of the above

5. Which instrument is more useful to study the surface analysis of the specimen? (CO3, K4)

(a) Transmission electron microscope

(b) Scanning electron microscope

(c) Atomic force microscope

(d) Raman spectroscope

6. In Bragg equation θ is angle between _____. (CO3, K4)

(a) Specimen surface and incident ray

(b) Incident ray and scatter plane

(c) Specimen surface and scatter ray

(d) None of the above

7. Thermal analysis is measures _____ as a function of temperature (CO4, K2)

(a) Concentration of materials

(b) Solubility of materials

(c) Physical properties

(d) Line positions of crystals

8. In Differential Thermal Analysis (DTA) thermal effects are caused by chemical reactions such as _____. (CO4, K4)

(a) Dissociation or decomposition

(b) Oxidation or Reduction

(c) Dehydration

(d) All the above

9. Which technology is used to get low-cost resistors and capacitors? (CO5, K2)

(a) Thin film technology

(b) Thick film technology

(c) Thin and thick film technology

(d) None of the above

10. Circuit films are still produced using an ancient process called _____. (CO5, K4)

(a) Screen printing technique

(b) Surface mount technology

(c) Ceramic print technology

(d) All the above

Part B (5 × 5 = 25)

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

11. (a) Summarise the principle, instrumentation and applications of atomic absorbance spectroscopy. (CO1, K2)

Or

(b) What is UV-Visible spectrum range? Examine its working and applications. (CO1, K4)

12. (a) Describe the principle involved in amperometry. Discuss its applications. (CO2, K2)

Or

(b) Enumerate the working principle and applications of conductometry. (CO2, K3)

13. (a) Discuss in detail about characterization of specimen by XRD. (CO3, K4)

Or

(b) Illustrate the instrumentation and applications of AFM. (CO3, K3)

14. (a) Describe the working principle of DTA. Summarise the applications of DTA. (CO4, K2)

Or

(b) Discuss the principle and applications of BET. (CO4, K4)

15. (a) Illustrate DC electrical resistivity. (CO5, K2)

Or

(b) What is meant by Hall effect? Discuss in detail about Hall effect. (CO5, K4)

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

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

16. (a) Discuss the principle, instrumentation and applications of FTIR spectroscopy. (CO1, K2)

Or

(b) Explain following (CO1, K3)

(i) Principle and application of Flame emission spectroscopy.

(ii) How does flame emission spectroscopy works. (4 + 4)

17. (a) How to analyse electrochemical behaviour of substance by Cyclic voltammetry? (CO2, K4)

Or

(b) Discuss in detail about Impedance analysis.

(CO2, K2)

18. (a) Discuss the principle, instrumentation and applications of SEM. (CO3, K2)

Or

(b) Describe the principle, instrumentation and applications of XPS. (CO3, K4)

19. (a) Explain the principle involved in Thermo-gravimetric analysis (TGA) and discuss its applications. (CO4, K4)

Or

(b) Describe the principle and applications of DSC. Discuss the factors influencing the DSC curves. (CO4, K4)

20. (a) How to analyse electrical, magnetic and optical characterization of thin film? (CO5, K4)

Or

(b) Describe in detail about bulk and grain boundary capacitance. (CO5, K4)

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R0281	Sub. Code 540506

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2023

Third Semester

Energy Science

Elective : ENERGY AUDIT AND MANAGEMENT

(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. "The judicious and effective use of energy to maximize profits and enhance competitive positions". This can be the definition of: (CO1, K2)

   (a) Energy conservation

   (b) Energy management

   (c) Energy policy

   (d) Energy Audit

2. The objective of energy management includes. (CO1, K2)

   (a) Minimizing energy costs

   (b) Minimizing waste

   (c) Reduce environmental degradation

   (d) All the above

3. The benchmarking parameter for air conditioning equipment is ————————. (CO2, K4)

(a) kW/Ton of Refrigeration

(b) kW/kg of refrigerant handled

(c) kcal/m^3 of chilled water

(d) Differential temperature across the chiller

4. The percentage of energy saved at the current rate of use, compared to the reference year rate of use, is called (CO2, K2)

(a) Energy audit

(b) Energy Performance

(c) Energy Efficiency

(d) None

5. B.E.E stands for (CO3, K2)

(a) Board of Energy Efficiency

(b) Bureau of Energy Efficiency

(c) Branch of Energy Efficiency

(d) None of these

6. The various types of instruments, which required during audit need to be (CO3, K2)

(a) Easy to carry

(b) Easy to operate

(c) Inexpensive

(d) All (a) to (c)

7. A Lux meter is used to measure ————————. (CO4, K2)

(a) Illumination level

(b) Sound intensity and illumination level

(c) Harmonics

(d) Speed

8. Infrared thermometer is used to measure ————————. (CO4, K2)

(a) Surface temperature

(b) Flame temperature

(c) Flue gas temperature

(d) Hot water temperature

9. The location of energy manger in a large organization could be (CO5, K2)

(a) Marketing division

(b) Plant maintenance unit

(c) Corporate Management Services Department

(d) Finance division

10. Providing information to BEE is the role of energy manager as per (CO5, K2)

(a) Energy Conservation Act 2003

(b) Energy Conservation Act 2004

(c) Energy Conservation Act 2002

(d) Energy Conservation Act 2001

Part B (5 × 5 = 25)

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

11. (a) Explain the general principles of Energy Management. (CO1, K4)

Or

(b) Illustrate the managerial skills are as important as technical skills in an organization. (CO1, K4)

12. (a) Summaries a short note on (CO2, K4)

(i) Benchmarking

(ii) Energy management approach

Or

(b) Compare the preliminary energy audit and detailed energy audit. (CO2, K4)

13. (a) Interpret the barrier to use of Energy Information Systems. (CO3, K2)

Or

(b) Examine the role and responsibilities of Energy Manager. (CO3, K4)

14. (a) Show the Energy balance diagram with detail. (CO4, K2)

Or

(b) Identify how does material and Energy balance help in energy conservation. (CO4, K3)

15. (a) Classify the types and accuracy of the Energy Audit Instrument. (CO5, K4)

Or

(b) Show a process flow chart for any product manufacture. (CO5, K2)

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

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

16. (a) Summaries the steps involved in Energy Management Strategy. (CO1, K2)

Or

(b) Explain Energy Management. What are the objectives of Energy Management? (CO1, K2)

17. (a) Interpret about the following: (CO2, K4)

(i) Accountability

(ii) Motivation of employees.

Or

(b) Explain an optimizing the input energy requirement and increase efficiency. (CO2, K2)

18. (a) Explain brief with examples on fuel and energy substitution. (CO3, K2)

Or

(b) Interpret briefly as to where the energy manager should be located in the organization structure. (CO3, K4)

19. (a) Summaries a short note on : (CO4, K4)

(i) Energy Balance sheet

(ii) Management Information System.

Or

(b) Identify how Sankey diagram is useful in energy balance calculations. (CO4, K4)

20. (a) Outline the major en energy audits instruments and explain any four. (CO5, K2)

Or

(b) Illustrate the essential elements of Monitoring energy and Energy savings. (CO5, K2)

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