CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

(Deemed to be University)

KOKRAJHAR :: BTR :: ASSAM :: 783370

MID – SEMESTER EXAMINATION

PG

Session: January-June, 2025 | Time: 3Hrs. | Full Marks: 100

Course Code: MGE 214 | Course Title: Nanotechnology | Semester: II

ANSWER ANY FIVE (5) OF THE FOLLOWING QUESTIONS

1. Discuss the followings. (5 × 4 = 20)
   (a) Nanometer, Nanomaterial, Nanoscience and nanotechnology.
   (b) 0D,1D,2D and 3D nanomaterials.
   (c) Salient properties of nano-materials.
   (d) Role of Nanomaterials for Energy conversion.

2. Explain the following: (Any four) (5 × 4 = 20)
   (a) The construction and working of Fuel cell.
   (b) UV and FTIR analysis of nanomaterials and their significance.
   (c) The importance of XRD analysis in nanomaterial characterization.
   (d) How is SEM used for nanomaterial characterization
   (e) Nanostructured materials for solar cell applications

3. What is a quantum dot? Why it is called so? What is meant by quantum confinement? Mention some effects of size reduction of nano particles. (5 × 4 = 20)

4. Write short notes on (5 × 4 = 20)
   (a) Surface plasmon resonance (SPR)
   (b) Band gap engineered nano materials
   (c) Challenges in nanotechnology?
   (d) Nano technology applications in electronics

5. Answer the following questions. (10 × 2 = 20)
   (a) What is a wavefunction. What is its physical interpretation? Mention the conditions for a well-behaved wave-function. How do you represent the wave-function of a wave-packet?
   (b) What is meant by normalization of a wave-function. Write the normalization condition of a wavefunction representing a matter wave. The wave function of a certain particle is given by $\Psi(x) = A\cos^2 x$ for $-\pi/2 < x < \pi/2$. Find the value of A. Find also the probability that the particle be found between $x = 0$ and $x = \pi/4$.

6. Answer the following questions. (10 × 2 = 20)
   (a) Discuss the significance of Schrodinger equation in quantum mechanics. Write the time-Independent and time-dependent Schrodinger equation in three dimensions. What are the energy and momentum operators in quantum mechanics? What is a Hamiltonian operator?
   (b) Discuss the energy eigen values, eigen wavefunction and probability densities of a particle trapped in an infinitely deep potential well.

Or

(c) An electron is trapped in a one-dimensional infinite potential box of length $1\dot{A}$. Calculate the wavelength of photon when the electron makes a transition from first excited state to the ground state.

7. Answer the following questions. (10 × 2 = 20)

(a) Define density of states. Discuss the density of states for 3D, 2D, 1D and 0D nanostructures.

(b) Give a qualitative discussion on the tunnelling of a quantum particle through a finite potential barrier V_o. Write the expressions of reflection and transmission co-efficient for a particle incident with an energy $E < V_o$. Electrons of energy 2.0eV are incident on a potential barrier 3.0eV high and 0.4nm wide. Calculate the transmission and reflection probability.

Total number of printed pages: 2 **Electrical Machines** PG/2nd semester/MGE221
End Term Full Marks: 100
Time: Three Hours Session: Jan-June, 2025

Answer any five

1. a) What is transformer? How is transformer core laminated? Why is lamination required? [2+2+1=5]

   b) The nameplate of a single-phase transformer is giving the follwing data: 5 kVA, 500 V/250 V. What informations are obtained from the above? [5]

   c) Calculate in terms of the primary the effective (equivalent) resistance and the leakage reactance of a transfrmer which gave the following data on test with the secondary terminals short-circuited: applied voltage 60 V: current: 100 A; power input 1.2kW. [10]

2. a) What do you mean by open circuit and short circuit? [5]

   b) Draw the phasor diagram of a non-ideal single-phase transformer when load is lagging. Explain the diagram. [5]

   c) The high and low voltage windings of 6600/250 V, 50 Hz, 1-phase transformer have resistances of 0.21 Ω and 2.72×10^{-4} Ω and reactances of 1 Ω and 1.3×10^{-3}Ω respectively. Determine the current and power input when the high voltage winding is connected to a 400-V, 50 Hz supply, the low-voltage winding being short-circuited. [10]

3. a) Explain the revolving field of a three-phase induction motor with proper diagrams. [10]

   b) A 3-phase, 50 Hz induction motor has full load speed of 1440 rpm. Calculate (i) number of poles (ii) slip frequency (iii) speed of rotor field with respect to rotor structure; with respect to stator structure and with respect to stator field. [10]

4. a) Why is capacitor connected to single-phase induction motor? [5]

   b) The rotor speed of a 440-V, 50-Hz, 8-pole, three-phase induction motor is 720 rpm. Determine (i) the synchronous speed (ii) the slip (iii) the rotor frequency. [5]

   c) A 6-pole, 3-phase induction motor develops 30 h.p., including mechanical losses total 2 h.p., at a speed of 950 rev per min on 550-V, 50 Hz mains. The power factor is 0.88. Calculate for this load (a) the slip; (b) the rotor copper loss; (c) the total input if the stator losses are 2000W; (d) the efficiency [10]

5. a) What do you mean by dynamic braking or rheostatic braking of DC motor? [6]

(b) Derive the condition for maximum efficiency of a DC motor. [6]

(c) A 100 kW, 500 V shunt generator run as motor on no load at its rated voltage and speed. The total current taken was 9.5 A, including a shunt field current of 2.5 A. The resistance of the armature circuit as normal working temperature is 0.1 Ω. Calculate the efficiency of the generator at full load and at half load. [8]

6. (a) Derive the torque equation of the DC motor. [6]

(b) A120 V, DC shunt motor has an armature resistance of 0.2 Ω and a field resistance of 60 Ω. It runs at 1800 r.p.m. taking a full load current of 40 A. Find the speed on 1/3 load condition. [6]

(c) Derive the speed equation of DC motor and discuss the N vs I_a characteristics of DC series and shunt motor. [8]