SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF PHYSICS

QUESTION BANK

SEMESTER - II

1920203 - PHYSICS FOR ELECTRONICS ENGINEERING

(Common to ECE, EEE, E&I & MDE)

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DEPARTMENT OF PHYSICS

SUBJECT: 1920203 - PHYSICS FOR ELECTRONICS ENGINEERING

SEM/YEAR: II SEM / AY-2022-2023

UNIT I - ELECTRICAL PROPERTIES OF MATERIALS

Classical free electron theory - Expression for electrical conductivity and Thermal conductivity -Wiedemann-Franz law - Success and failures – Quantum Free electron theory – Fermi Distribution function – Density of energy states –Energy bands in solids; conductors, semiconductors and insulators.

PART – A

S.No	Questions	Level	Competence
1.	Define drift velocity.	BTL1	Remembering
2.	What is meant by mobility of electrons?	BTL1	Remembering
3.	What is relaxation time?	BTL1	Remembering
4.	Define mean free path.	BTL1	Remembering
5.	Distinguish between relaxation time and collision time	BTL2	Understanding
6.	Calculate the drift velocity of the free electron with a mobility of 3.5×10^{-3} $m^2V^{-1}s^{-1}$ in copper for an electric field strength of 0.5 V/m.	BTL3	Applying
7.	A conducting rod contains 8.5×10^{28} electrons per m^3. Calculate the electrical conductivity at room temperature if the collision time for electron is 2×10^{-14} s.	BTL3	Applying
8.	The mobility of electron in copper is 3×10^{-3} m^2/Vs. Assuming $e = 1.6 \times 10^{-19}$ C and $m_e = 9.1\times10^{-31}$ kg. Calculate the mean free time.	BTL3	Applying
9.	List any two merits of classical free electron theory of metals.	BTL2	Understanding
10.	Define electrical conductivity.	BTL1	Remembering
11	Define thermal conductivity.	BTL1	Remembering
12.	Write any two postulates of quantum free electron theory.	BTL2	Understanding
13.	State Wiedemann-Franz law.	BTL1	Remembering
14.	What are the drawbacks of classical free electron theory?	BTL3	Applying
15.	The thermal conductivity of copper at 300 K is 470 W/m/K. Calculate the electrical conductivity. Given Lorentz number, $L= 2.45 \times 10^{-8}$ $W\Omega K^{-2}$.	BTL1	Remembering
16.	What is meant by Fermi energy level?	BTL2	Understanding
17.	Write a note on electron occupancy based on Fermi distribution function.	BTL3	Applying
18.	Draw the Fermi distribution curve at any temperature T > 0 K.	BTL1	Remembering
19.	Evaluate the Fermi function for energy K_BT above the Fermi energy.	BTL1	Remembering
20.	Define density of energy states.	BTL1	Remembering
21.	Write about periodic potential in band theory.	BTL1	Remembering

22.	What are valence band and conduction band?	BTL1	Remembering
23.	Define forbidden energy gap in the energy band structure.	BTL1	Remembering
24.	Illustrate diagrammatically the variation of energy bands in conductors, semiconductors and Insulators.	BTL3	Applying

PART –B			
1.	(i) Explain the assumptions of classical free electron theory with its merits and demerits. (10) (ii) Calculate the electrical conductivity and Lorentz number for a metal with thermal conductivity 123.92 W/m/K and relaxation time 10^{-14} second at 300 K. (Density of electrons = 6 x10^{28} m^{-3}). (3)	BTL2	Understanding
2.	Deduce an expression for electrical conductivity of a conducting material by using classical free electron theory and list out its merits and demerits. (13)	BTL1	Remembering
3.	(i) Derive an expression for electrical conductivity of a metal. (10) (ii) A copper wire having a cross-sectional area 1 mm^2 carries a current of 10 A. Find the drift velocity. Given n = 8.5 x 10^{28} electrons per m^3. (3)	BTL1	Remembering
4.	Derive an expression for thermal conductivity of a conducting material. (13)	BTL1	Remembering
5.	(i) Write any three postulates of classical free electron theory. (3) (ii) Deduce an expression for thermal conductivity of a conducting material. (10)	BTL1	Remembering
6.	(i) Obtain the expression for thermal conductivity of a conducting material. (10) (ii) The thermal conductivity of copper at 300 K is 470.4 W/mK. Calculate the electrical conductivity of copper at 300 K. Lorentz number L = 2.45 x $10^{-8.}$ (3)	BTL1 BTL2	Remembering Understanding
7.	Obtain Wiedemann Franz law using the expressions of electrical and thermal conductivity. (13)	BTL2	Understanding
8.	Derive the mathematical expression for electrical conductivity and thermal conductivity of a conducting material and hence obtain Wiedemann-Franz law. (13)	BTL1	Remembering
9.	(i) Write an expression for Fermi Dirac distribution function F(E) and discuss the effect of temperature on Fermi function with neat diagrams. (10) (ii) Calculate Fermi distribution function F (E) for the energy level lying 0.01 eV above the Fermi level at 270 K. (3)	BTL2	Understanding
10.	Discuss Fermi Dirac distribution function and explain its variation with temperature. (13)	BTL4	Analyzing
11.	(i) Explain Fermi Dirac distribution for electrons in a metal and discuss the effect of temperature on Fermi function. (7) (ii) Use the Fermi distribution function to obtain the value of F(E) for $E-E_F$ = 0.01 eV at 200 K. (6)	BTL2	Understanding
12.	Derive an expression for the density of energy states for a metal. (13)	BTL1	Remembering
13.	Derive an expression for the number of energy states per unit volume of a metal. (13)	BTL1	Remembering
14.	Using the expression for density of energy states derive (i) Carrier concentration in metals. (7)	BTL2	Understanding

	(ii) Fermi energy of electrons at 0 K. (6)		
15.	(i) Define density of energy states and derive an expression for the carrier concentration in metals. (7) (ii) Calculate the lowest energy of the system containing two electrons confined to a box of length of 1Å. (6)	BTL2	Understanding
16.	Explain energy bands in conductors, semiconductors and insulators, with examples. (13)	BTL2	Understanding
17.	Discuss the classification of materials based on band theory of solids. (13)	BTL1	Remembering

	PART - C		
1.	Based on the free electron theory of metals, derive an expression for Lorentz number. (15)	BTL1	Remembering
2.	The electrons of conducting material have different states at a particular energy level. Formulate mathematically an expression for density of energy states. (15)	BTL4	Analyzing
3.	F (E) represents the probability of an electron occupying the energy state. Find the solution for Fermi-Dirac distribution function and summarize the effects of temperature on Fermi function with a neat diagram. (15)	BTL4	Analyzing
4.	Write the expression for the probability of electron occupying the energy state. Draw the Fermi distribution curve at 0 K and at any temperature T K and explain. (15)	BTL4	Analyzing
5.	Energy levels and bands are the convenient way of representing a solid material. With neat sketch, explain the band theory. (15)	BTL2	Understanding

UNIT II SEMICONDUCTOR PHYSICS			
Direct and indirect semiconductors - Intrinsic Semiconductors –Carrier concentration in intrinsic semiconductors – Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport– Drift and Diffusion transport – Hall effect - Theory and Experiment – Applications.			
PART – A			
S.No	**Questions**	**Level**	**Competence**
1.	List any two properties of a semiconductor.	BTL2	Understanding
2.	What are the charge carriers in a semiconductor?	BTL1	Remembering
3.	What happen to the conductivity of a semiconductor when temperature increases?	BTL1	Remembering
4.	Why there is negative temperature coefficient of resistance in semiconducting materials?		
5.	What are elemental semiconductors?	BTL1	Remembering
6.	Differentiate direct and indirect band gap semiconductors.	BTL2	Understanding
7.	Why elemental semiconductors are called indirect band gap semiconductors?	BTL4	Analyzing
8.	Why compound semiconductors are preferred for making LEDs?	BTL4	Analyzing
9.	What are intrinsic semiconductors? Give an example.	BTL1	Remembering
10.	Draw an energy band diagram of an intrinsic semiconductor, at room temperature.	BTL2	Understanding
11.	The intrinsic carrier density at room temperature in Ge is $2.37\times10^{19}/m^3$. If the electron and hole mobilities are 0.38 and 0.18 $m^2V^{-1}s^{-1}$. Calculate the electrical conductivity.	BTL3	Applying
12.	Define doping.	BTL1	Remembering
13.	What are extrinsic semiconductors? Give an example.	BTL1	Remembering
	Write few differences between intrinsic and extrinsic semiconductors.		
14.	How p-type semiconductors are obtained?	BTL2	Understanding
15.	Why holes are majority carriers and electrons are minority carriers in p-type semiconductors?	BTL1	Remembering
16.	Define donors and acceptors and give its ionization energy.	BTL1	Remembering
18.	What is meant by carrier transport in semiconductor?	BTL1	Remembering
19.	Differentiate between drift and diffusion transport.	BTL2	Understanding
20.	State Hall effect.	BTL1	Remembering

21.	How p-type and n-type semiconductors are identified using Hall coefficient?	BTL2	Understanding
22.	Mention any two applications of Hall Effect.	BTL1	Remembering
23.	An n-type semiconductor has Hall coefficient, $R_H = 4.16 \times 10^{-14}$ m^3/C. The conductivity is 108 ohm^{-1} m^{-1}. Calculate the charge carrier density, n_e at room temperature.	BTL3	Applying
24.	The Hall Co-efficient of a specimen of doped silicon is found to be 3.66×10^{-4} m^{-3}/C. The resistivity of specimen is 8.93×10^{-3} Ωm. Find the mobility and density of charge carriers. Given: $R_H = 3.66 \times 10^{-4}$ m^{-3}/C, $\rho_e = 8.93 \times 10^{-3}\Omega$ m	BTL3	Applying
	PART B		
1.	Deduce an expression for density of electrons in a conduction band of an intrinsic semiconductor. (13)	BTL2	Understanding
2.	Derive an expression for concentration of holes in valance band of an intrinsic semiconductor. (13)	BTL2	Understanding
3.	Derive an expression for density of electrons in the conduction band and density of holes in the valence band of an intrinsic semiconductor. (13)	BTL2	Understanding
4	Derive an expression for intrinsic carrier concentration. (13)	BTL1	Remembering
5.	Obtain the intrinsic carrier concentration using the expressions of density of electrons in conduction band and density of holes in valence band. (13)	BTL1	Remembering
6.	Obtain an expression for carrier concentration of electrons in conduction band of an n-type semiconductor. (13)	BTL1	Remembering
7.	Derive an expression for density of electrons in conduction band of an n-type semiconductor. (13)	BTL2	Understanding
8.	Show that for n-type semiconductor, density of electrons in the conduction band is proportional to the square root of the donor concentration.	BTL2	Understanding
9.	Obtain an expression for carrier concentration of holes in a valance band of a p-type semiconductor. (13)	BTL1	Remembering
10.	Derive an expression for density of holes in a valance band of a p-type semiconductor. (13)	BTL1	Remembering
11.	Show that for p-type semiconductor, density of holes in the valence band is proportional to the square root of the acceptor concentration at low temperatures. (13)	BTL2	Understanding
12.	What is carrier transport? Explain its types. (13)	BTL1	Remembering
13.	Explain the following		
	i) Drift transport (6)	BTL2	Understanding
	ii) Diffusion transport (7)	BTL2	Understanding
14.	Obtain an expression for the Hall coefficient of n-type and p-type semiconductor. (13)	BTL1	Remembering
15.	Show that the Hall Coefficient is negative for an n-type semiconductor and positive for p-type semiconductor. (13)	BTL2	Understanding
16.	i) State and explain Hall effect (3)	BTL1	Remembering
	ii) With necessary theory and diagram, derive the Hall coefficient of a semiconductor (10)	BTL1	Remembering

17.	i) Find the hall coefficient of a specimen in a Si doped with 10^{20} phosphor atoms. (3) ii) Derive the hall coefficient of a semiconductor and write the applications of hall effect. (10)	BTL2	Understanding

PART – C

1.	Show that in an intrinsic semiconductor, Fermi energy level (E_F) lies in the midway between highest level of the valance band (E_V) and lowest level of the conduction band (E_C). (15)	BTL3	Applying
2.	(i) Obtain an expression for Fermi energy in terms of donor concentrations of electrons. (10) (ii) Derive an expression for density of electrons (n_e) in conduction band in terms of donor concentration (N_d). (5)	BTL2	Understanding
3.	With neat sketch, show that for p-type semiconductors, density of holes in valence band is proportional to the square root of the acceptor concentration (N_a) at low temperatures. (15)	BTL2	Understanding
4.	Define carrier transport and explain the various types of carrier transport in semiconductors. (15)	BTL2	Understanding
5.	(i) Show that for an n-type and a p-type semiconductors, the value of Hall coefficients are negative and positive respectively. (10) (ii) Describe an experimental set up for the measurement of Hall voltage. (5)	BTL2	Understanding

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS

Magnetism in materials – magnetic field and induction - magnetic permeability and susceptibility— classification of magnetic materials - types of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Energy involved in Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius- Mosotti relation- dielectric breakdown – high-k dielectrics.

PART – A

S.No	Questions	Level	Competence
1.	Write a short note on diamagnetic and paramagnetic materials?	BTL1	Remembering
2.	Elucidate the spin arrangement of Para and Ferro magnetic materials.	BTL4	Analysing
3.	Why diamagnets are called weak magnets?	BTL1	Remembering
4.	Define magnetic dipole moment.	BTL1	Remembering
5.	What is magnetic susceptibility?	BTL1	Remembering
6.	Give the relation between magnetic susceptibility and relative permeability.	BTL2	Understanding
7.	Magnetic field Intensity of a paramagnetic material is 10^4 A/m. At room temperature, its susceptibility is 3.7 x 10^{-3}. Calculate the magnetisation in the material.	BTL3	Applying
8.	What are magnetic domains and domain walls?	BTL1	Remembering

9.	Why diamagnetic materials are called weak magnets and ferromagnetic materials are called strong magnets?	BTL1	Remembering
10.	The magnetic susceptibility of a medium is 940 x 10^{-4}. Calculate its relative permeability.	BTL3	Applying
11.	State Curie-Weiss law	BTL2	Understanding
12.	Why ferrites are advantageous for use as transformer core ?	BTL2	Understanding
13.	Mention the four types of energies involved in the growth of magnetic domains.	BTL2	Understanding
14.	Define electric susceptibility	BTL2	Understanding
15.	Define Ionic polarization.	BTL1	Remembering
16.	Define dielectric loss.	BTL1	Remembering
17.	Calculate the polarization produced in a dielectric medium of dielectric constant 6 and it is subjected to an electric field of 100 V/m. Given ε_0 = 8.85 x 10^{-12} F/m.	BTL3	Applying
18.	Define dielectric strength.	BTL2	Understanding
19.	What are the factors affecting dielectric loss?	BTL3	Applying
20.	Distinguish Lorentz force and Coloumb force in dielectrics.	BTL1	Remembering
21.	Find out the average radius of the atom of an air molecule if the polarisability of atoms in the air molecules is 9 x 10^{-41} Fm^2.	BTL3	Applying
22.	Compare active and passive dielectrics.	BTL2	Understanding
23.	What is meant by high-k-dielectrics?	BTL1	Remembering
24.	Write the applications of high k-dielectrics.	BTL2	Understanding

PART -B

S.No	Questions	Level	Competence
1.	(i) How magnetic materials are classified based on magnetic moments? (3)	BTL2	Understanding
	(ii) Compare their properties and characteristic with examples. (10)	BTL2	Understanding
2.	Explain the different classifications of magnetic materials. (13)	BTL2	Understanding
3.	Differentiate dia, para and ferromagnetic materials. (13)	BTL2	Understanding
4.	i) Discuss about the origin of ferromagnetism and exchange interaction in ferromagnetic materials. (6)	BTL2	Understanding
	ii) Discuss about saturation magnetisation and Curie temperature. (7)	BTL2	Understanding
5.	Explain ferromagnetic domain theory. Briefly explain different types of energy involved in domain growth. (13)	BTL2	Understanding
6.	Explain the different types of energies that are responsible for growth of domains in a ferromagnetic material. (13)	BTL2	Understanding
7.	(i) Derive the expression for electronic and ionic polarizability (10)	BTL2	Understanding

	(ii) A solid contains 5×10^{28} identical atoms /m^3, each with a polarizability of 2×10^{-40} Fm^2. Assuming that internal field is given by the Lorentz relation, calculate theratio of internal field to the applied field. ($\varepsilon_0 = 8.85 \times 10^{-12}$ F/m). (3)	BTL3	Applying
8.	Explain the different types of polarization mechanisms involved in a dielectric material. (13)	BTL2	Understanding
9.	Explain orientation polarization and space charge polarization with suitable diagram. (13)	BTL2	Understanding
10.	Explain the comparison chart of various types of polarization mechanisms. (13)	BTL2	Understanding
11.	What is dielectric loss? Derive the expression for dielectric power loss (13)	BTL1	Remembering
12.	Write a note on (i) Dielectric loss (ii) Clausius-Mosotti relation (iii) Different types of breakdown in a dielectric medium. (3+5+5)	BTL1	Remembering
13.	What is meant by local field in a dielectric and how it is calculated for a cubic structure? (13)	BTL1	Remembering
14.	Derive the expression for local field and using the same, deduce clasius-Mosotti relation. (13)	BTL2	Understanding
15.	(i) What are the different types of dielectric break down in dielectric medium (3)	BTL1	Remembering
	(ii) Discuss in detail the various types of dielectric breakdown. (10)	BTL1	Remembering
16.	Define Dielectric breakdown. Summarize the various factors contributing to breakdown in dielectrics. (13)	BTL2	Understanding
17.	Explain the theory of high-k-dielectrics and give a brief note on its properties and applications (13)	BTL2	Understanding

PART – C

S.No	Questions	Level	Competence
1.	The behaviour of magnetic materials varies with electron spins. Compare and contrast the properties of the following elements with its spin nature. (15)	BTL2	Understanding
2.	Imagine a bounded region occupied with atomic dipoles. Discuss the spontaneous magnetization of ferromagnetic materials with the help of domains. Compile the theory based on energy involved in the ferromagnetic material. (15)	BTL2	Understanding
3.	What is domain? Based on movement of domains and rotation of domain walls, explain the domain theory with necessary diagram. (15)	BTL2	Understanding
4.	(i) Discuss the four different polarization mechanism. (3)	BTL2	Understanding
	(ii) Obtain an expression for the total polarisation using Electronic, Ionic , orientation and space charge polarisability. (12)	BTL3	Analyzing
5.	(i) Define Internal field (3)	BTL2	Understanding
	(ii) Obtain an expression for internal field using Lorentz method and hence deduce the Clausius Mosotti relation. (12)	BTL2	Understanding

UNIT IV OPTICAL PROPERTIES OF MATERIALS

Classification of optical materials – carrier generation and recombination processes - excitons - Absorption emissionand scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED.

PART – A

S. No	Questions	Level	Competence
1.	What are optical materials? Give its types.	BTL1	Remembering
2.	Define carrier generation and recombination.	BTL2	Understanding
3.	What is transparent materials? Give examples.		
4.	What are translucent materials? Give examples.	BTL1	Remembering
5.	Mention the condition to identify the band gap of a semiconducting material to be transparent to visible light.	BTL3	Applying
6.	What is dark current?	BTL1	Remembering
7.	What are excitons?	BTL1	Remembering
8.	What is the principle used in PIN Photodiode?	BTL2	Understanding
9.	Give any four applications of photodiode.	BTL2	Understanding
10.	Write the working principle of solar cell.	BTL2	Understanding
11.	Mention any two merits and demerits of solar cell.	BTL3	Applying
12.	Outline the principle of photo detectors.	BTL1	Remembering
13.	Mention the properties of the photo detectors.	BTL2	Understanding
14.	What is meant by LED? Give its principle.	BTL1	Remembering
15.	What are the main requirements for a suitable LED material?	BTL2	Understanding
16.	Why group III and group V elements are used for the manufacturing of LED's?	BTL5	Evaluating
17.	Justify why hemispherical shape LED's are most preferrable?	BTL4	Analyzing
18.	List any two advantages of LED in electronic display.	BTL3	Applying
19.	The wavelength of light emission in an LED is 1.55µm. Calculate the band gap in eV?	BTL3	Applying
20.	List the main two layers in an OLED.	BTL1	Remembering
21.	Calculate the wavelength of radiation emitted by an LED made up of a semiconducting material with band gap energy 2.8 eV.	BTL3	Applying
22.	What is the working principle of OLED?	BTL1	Remembering
23.	In what way OLED is advantageous than LED/LCD?	BTL2	Understanding
24.	List out the recent applications of OLED.	BTL2	Understanding

	PART-B		
1.	Describe the absorption and emission of light in metals, semiconductors and insulators (13)	BTL2	Understanding
2.	Summarize the three types of carrier generations and recombination process in semiconductors. (13)	BTL2	Understanding
3.	(i) Explain carrier generations process in semiconductors. (7)	BTL4	Analyzing
	(ii) Write short notes on a. Transparent b. Translucent materials. c. Opaque materials (6)	BTL1	Remembering
4.	Explain the principle, construction and working of a photo diode with necessary diagrams (13)	BTL2	Understanding
5.	Discuss the response of reverse biased P-N junction diode to light along with the merits, demerits and applications (13)	BTL2	Understanding
6.	Describe the principle, construction and working of a photodiode. (13)	BTL1	Remembering
7.	(i) Describe the principle, construction and working of a solar cell with a neat diagram. (10) (ii)Menton the advantages and disadvantages of a solar cell. (3)	BTL1	Remembering
8.	Elaborate the working of a photo-voltaic device which converts sunlight directly into electricity. (3)	BTL4	Analyzing
9.	Explain the principle of the working of solar cell made of a semiconductor. (13)	BTL1	Remembering
10.	What is meant by photodetector? Describe anyone in detail. (13)	BTL1	Remembering
11.	Describe the construction and working of a p-i-n photo detector. (13)	BTL2	Understanding
12.	What is meant by minority charge carrier injection? Explain how a P-N junction diode acts as a LED. (13)	BTL2	Understanding
13.	Explain how a P-N junction diode acts as a Light Emitting Diode. (13)	BTL2	Understanding
14.	Explain the principle and working of LED with a neat diagram and mention its advantages and disadvantages. (13)	BTL2	Understanding
15.	Explain the principle, construction and working of OLED. (13)	BTL2	Understanding
16.	What is meant by OLED? Explain the principle, construction and working of OLED? (13)	BTL2	Understanding
17.	Explain the construction and working of optoelectronic device made up of many layers with organic molecules of different conductivity levels? (13)	BTL2	Understanding
	PART – C		
Q.No	**Questions**	**Level**	**Competence**
1.	Design a solar cell using a semiconducting material with a neat diagram and explain the operation of the above circuit when exposed to sunlight along with its advantages and disadvantages. (15)	BTL2	Understanding
	(i) What is Injection Luminesence? (3)	BTL1	Remembering

2.	(ii)Explain the theory and working of Light emitting Diode with neat diagram. (12)	BTL2	Understanding
3.	Construct a semiconductor light source with thin films of organic molecules, and explain the working with neat diagram. (15)	BTL2	Understanding
4.	With suitable diagram, explain the operation of (i) p-i-n photo detector (8)	BTL2	Understanding
	(ii) avalanche photo detector. (7)	BTL2	Understanding
5.	Describe the construction and working of OLED and explain in what way it is more efficient than LED. (15)	BTL2	Understanding

UNIT V NANO MATERIALS AND DEVICES

Introduction - Size dependence of Fermi energy– quantum confinement – quantum structures - Density ofstates in quantum well, quantum wire and quantum dot structures – quantum interference effects – Coulomb blockade effects - Single electron phenomena and Single electron Transistor - quantum dot laser – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

PART – A

S.No	Questions	Level	Competence
1.	What are nanomaterials?	BTL2	Understanding
2.	Fermi energy of a material varies with its size. Justify.	BTL4	Analyzing
3.	What happens to the band gap when a solid material is reduced into a nanomaterial?	BTL2	Understanding
4.	What will happen when we decrease the size of the particle to nano size?	BTL4	Analyzing
5.	What is meant by quantum confinement?	BTL1	Remembering
6.	Define the term quantum dot.	BTL2	Understanding
7.	Define the term quantum wire	BTL2	Understanding
8.	Define the term quantum well.	BTL2	Understanding
9.	List any two applications of quantum dot.	BTL1	Remembering
10.	Write any two applications of quantum well, quantum wire?	BTL2	Understanding
11.	What is the purpose of coulomb blockade?	BTL2	Understanding
12.	What is meant by quantum tunneling?	BTL1	Remembering
13.	Define coulomb blockade.	BTL1	Remembering
14.	How coulomb blockade prevent unwanted tunneling?	BTL4	Analyzing
15.	What is meant by single electron transistor (SET)?	BTL2	Understanding
16.	What are the limitations of single electron transistor?	BTL2	Understanding
17.	Mention the two conditions for the single electron phenomena to occur.	BTL1	Remembering

18.	What are magnetic semiconductors?	BTL1	Remembering
19.	What is spintronics?	BTL1	Remembering
20.	What are the applications of spintronics?	BTL1	Remembering
21.	What are carbon nano tubes (CNTs)?	BTL2	Understanding
22.	Based on the rolling of the graphene sheet, how carbon nano tubes are classified?	BTL2	Understanding
23.	List any two properties of carbon nano tubes.	BTL2	Understanding
24.	Mention any two applications of CNT.	BTL2	Understanding
PART-B			
1.	Explain the electron density in bulk materials and its size dependence with Fermi energy. (13)	BTL2	Understanding
2.	Describe quantum confinement and quantum structures in nano materials. (13)	BTL2	Understanding
3.	Discuss density of states in quantum well, quantum wire and quantum dot. (13)	BTL2	Understanding
4.	Derive the expression for density of states for different quantum confinements. (13)	BTL2	Understanding
5.	Derive an expression for density of states in zero-dimension, one dimension and two-dimension quantum confinement structures. (13)	BTL1	Remembering
6.	(i) Explain coulomb blockade effect. (6)	BTL2	Understanding
	(ii)Explain the phenomena of single electron which is used in single electron transistor. (7)	BTL1	Remembering
7.	Explain single electron phenomena. (13)	BTL2	Understanding
8.	Describe single electron phenomena and single electron transistor. (13)	BTL2	Understanding
9.	Describe the construction and working of a single electron transistor.(13)	BTL2	Understanding
10.	Explain the tunnelling phenomenon. Mention the conditions necessary for the single electron phenomenon to occur. (13)	BTL4	Analyzing
11.	(i) Describe the working of semiconductor laser in which the active medium is embedded with quantum dots. (10)	BTL2	Understanding
	(ii) Mention any one advantage, disadvantage and applications of quantum dot. (3)	BTL2	Understanding
12.	Explain quantum dot lasers. What are the advantages and applications? (13)	BTL2	Understanding
13.	Construct and discuss the working of an active region using a material whose all three dimensions are minimized which act as a light emitter. (13)	BTL2	Understanding
14.	Explain magnetic semiconductors. (13)	BTL2	Understanding
15.	What are magnetic semiconductors? List out the properties and applications	BTL2	Understanding

	of magnetic semiconductors? (13)		
16.	Describe the CNT structures with their properties and its applications. (13)	BTL2	Understanding
17.	Mention the physical properties and applications of CNT. (13)	BTL1	Remembering
PART - C			
Q.No	**Questions**	**Level**	**Competence**
1.	Elaborate mathematically how we can confine the motion of randomly moving electron to restrict its motion in specific energy levels with respect to one, two, or three dimensions in solids which leads to increased electronic band gaps. (15)	BTL2	Understanding
2.	With a suitable diagram, explain the construction and working of quantum dot laser. (15)	BTL2	Understanding
3.	Describe the construction, working, advantages and disadvantages of quantum dot laser which can tune the wavelength by changing the dot size. (15)	BTL2	Understanding
4.	Design a transistor in which the current flows from source to drain due to movement of only one electron at a time. Explain the conditions necessary for this single electron phenomenon and the working of the Single electron transistor. (15)	BTL3	Applying
5.	Explain the types, properties and applications of carbon nano tubes. (15)	BTL2	Understanding