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SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD.

Department of Physics
Semester End Examination

Sub Code : 15UPHC100 **Semester: I**

Sub Title : Engineering Physics

Duration : 3hrs **Max Marks : 100**

Note: Part A is compulsory; Answer any four questions from Part B.

Physical constants:

Planck's constant (h) = 6.63×10^{-34} J.s
Mass of an electron (m_e) = 9.11×10^{-31} kg
Charge of an electron (e) = 1.6×10^{-19} C
Mass of the proton (m_p) = 1.67×10^{-27} kg
Boltzmann constant (k_B) = 1.38×10^{-23} J/K
Avogadro Number (N_A) = 6.022×10^{23}/mol

PART-A

Q1 10 Marks

i The speed of matter waves in the given medium depends upon its _____.

ii The value of wave function at the boundaries of a potential well is always _____.

iii Fermi velocity of the electrons with Fermi energy 7 eV is_____.

iv In an intrinsic semiconductor, the location of Fermi level is at the_____.

v A unit cell that contains lattice points only at the corners of the parallelepiped is known as _____.

vi In FCC structure the relation between 'a' and 'R' is _____.

vii The acceptance angle for an optical fiber with numerical aperture of 0.28 is _____.

viii The type of optical fiber used in long distance communications is _____.

ix With reduction in the size of the quantum dots, emission spectrum shift towards _____ region.

x Length of the carbon nanotubes is in the order of _____.

Q2

a Justify the success of quantum free electron theory to explain the specific heat of metals. 3 Marks

Prove the statement – 'Matter waves are not physical waves'. 2 Marks

b Calculate Bragg's angle for the first order X- ray diffraction from a nickel crystal, if the interplanar spacing of the corresponding planes is 0.91 Å. Assume wavelength of X- ray as 1.74 Å. 3 Marks

Write the silent features of optical fiber communication. 2 Marks

PART-B

Q3

a Verify the diffraction of electron by applying the observations made in the Davisson-Germer's experiment. 5 Marks

Calculate the de-Broglie's wavelength and phase velocity of the particle of mass 0.01m moving with a velocity of 0.01c. Given: m = 1.67 x 10^{-27} kg and c= 3 x 10^{8} ms^{-1}. 5 Marks

b By referring Heisenberg's Uncertainty Principle draw the inference on electron existence in the atomic nucleus. 5 Marks

Evaluate the energy associated with first four energy states of a subatomic particle of mass 9.1 x 10^{-31} kg which is bound in one-dimensional potential box of width 4 x 10^{-10} m. 5 Marks

Q4

a List the assumptions of quantum free electron theory. 4 Marks

Show that probability of occupation of electron f(E) = 1 and f(E) = 0 at below and above Fermi level respectively when T=0K and f(E) = ½ at $E=E_F$ when T>0K. 6 Marks

b Distinguish between direct and indirect bandgap semiconductors. 5 Marks

Hall coefficient of a specimen of silicon is found to be 3.66×10^{-4} m^3 C^{-1}. The resistivity of the specimen is 8.93 ohm-m. Find the mobility and density of the charge carriers. 5 Marks

Q5

a Derive the Bragg's condition for X-rays diffraction in crystals. 5 Marks

Draw the following crystal planes in cubic unit cells (0 0 1) (1 1 0), (1 1 1), (1 2 0) and ($1\bar{2}$ 1). 5 Marks

b Discuss the classification of liquid crystals based on degree of ordering of mesogens. 6 Marks

Illustrate the deposition of metallic glasses by DC sputtering technique. 4 Marks

Q6

a Based on the mode of propagation, describe the classification of optical fibers. 5 Marks

Calculate the refractive index of the cladding of an optical fiber whose numerical aperture is 0.32 and refractive index of core is 1.5. Also calculate the angle of acceptance when the fiber is immersed in the liquid of refractive index 1.2. 5 Marks

b Explain different types of optical fiber sensors. 6 Marks

Compare LASER welding, drilling and cutting with conventional methods. 4 Marks

Q7

a What are carbon nanotubes? Explain their fascinating properties and mention their applications? 10 Marks

b With neat diagrams, explain the variation of density of states in nano-films, nano-wire and nano-particles. 5 Marks

Explain the synthesis of nano material by laser ablation with neat diagram. 5 Marks

Q. No	2. a	2.b	3.a	3.b	4.a	4.b	5.a	5.b	6.a	6.b	7.a	7.b
CO	1	1	2	2	3	3	4	4	5	5	6	6
PO	1	1	1 & 2	1 & 2	1 & 2	1	1 & 2	1	1 & 2	1 & 2	1	1

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SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD.

Department of Engineering Physics

Semester End Examination

Sub Code : 15UPHC200 **Semester: II**

Sub Title : Engineering Physics

Duration : 3 Hrs **Max Marks: 100**

Note: Part A is compulsory; Answer any four questions from Part B

Physical constants:

Boltzmann constant (k) = $1.38 \times 10^{-23} JK^{-1}$
Avogadro's number (N_A) = 6.023×10^{26}/kmol
Planck's constant (h) = 6.63×10^{-34} J.s
Mass of an electron (m_e) = 9.11×10^{-31} kg
Charge of an electron (e) = 1.6×10^{-19} C
Mass of the proton (m_p) = 1.67×10^{-27} kg

PART-A

Q1 Fill in the blanks 10 marks

i Kinetic energy of the photon having a wavelength of 663 nm is _____ J.

ii Quantized energy associated with a particle in the second excited state is _____ times more than ground state.

iii Current density of a copper wire of radius 0.5 mm carrying current of 0.5 A is _____ Am^{-2}.

iv Pure silicon at _____ temperature behaves like an insulator.

v The periodic arrangement of points in space is known as _____.

vi The first order Bragg's diffraction for X-ray of wavelength 10^{-10} m occurs at a diffraction angle of 60˚. An inter-atomic spacing of a material is _____ A˚.

vii Stimulated emission produces _____ photons / radiation.

viii The value of refractive index of graded index multimode optical fiber is maximum along the _____.

ix If the size of a nano particle is reduced, its melting point _____.

x In a _____ the density of states varies as a step function.

Q2

a A crystal plane is intercepting crystallographic axes at x = a, y = 2b and z = 3c. Find the miller indices. 3 marks

Estimate the wavelength of a matter waves associated with an electron accelerated through the grid potential of 68 V. 2 marks

b Mention the significant failures of classical free electron theory. 3 marks

When a light is made to incident on an open end of a fiber with an angle equal to acceptance angle, it grazes the core cladding interface. Make two similar statements when angle of incidence is less than the acceptance angle and it is more than the acceptance angle. 2 marks

PART-B

Q3

a Using Davisson-Germer's experimental observations prove the diffraction of electrons. 5 marks

A particle has a de Broglie wavelength of 2×10^{-10} m. Find its group velocity and phase velocity. (Given: rest mass energy of the particle is 817.6×10^{-48} J) 5 marks

b By applying time independent Schrodinger's wave equation obtain the expression for wave function equation of the particle confined in one-dimensional potential well of infinite height. 5 marks

An electron and a proton are travelling with a velocity of 6.63×10^{5} ms^{-1} measured with the accuracy of 0.001%. Determine the uncertainties with which their positions can be located. (Given: Mass of proton = 1.67×10^{-27} kg) 5 marks

Q4

a Analyse the dependence of Fermi Dirac distribution function on temperature. 6 marks

In the equilibrium state, evaluate the probability of electrons occupation in an energy level 0.02 eV below the Fermi level at a temperature of 300 K. 4 marks

b Deduce the classical expression for electrical conductivity of metal. 4 marks

Elaborate the significant features of direct and indirect band gap semiconductors. 6 marks

Q5

a Draw the crystal directions for the following [111], [121], [102], $[\bar{1}10]$ and $[0\bar{1}1]$ 5 marks

A sample of BCC iron is placed in an X-ray diffractometer operating at a wavelength 0.1541 nm. First order diffraction through (110) plane occurs at a glancing angle of 22.35°. Calculate the lattice constant. 5 marks

b With a proper representation of molecular alignment, brief the nematic, cholestric and smectic phases of liquid crystals. 6 marks

Draw (100), (110) and $(\bar{1}\,01)$ planes in a cubic unit cell. 4 marks

Q6

a Define (i) induced absorption, (ii) spontaneous emission, (iii) stimulated emission, (iv) metastable state and (v) population inversion. 5 marks

Following parameters are recorded for a step index multimode optical fiber employed in the telecommunication networking system. Determine the numerical aperture, fractional index change and acceptance angle.

Core refractive index = 1.50, V-number = 30, Core diameter = 100 µm and operating wavelength of signal = 1300 nm. 5 marks

b Explain the construction and working of optical fiber temperature sensor. 6 marks

Compare laser welding and cutting with conventional methods. 4 marks

Q7

a Describe the classification of nanomaterials based on their dimensional confinement. 6 marks

Write the significant properties of nano-materials. 4 marks

b Explain the different types of carbon nanotubes and mention their applications. 10 marks

Q. No	2. a	2.b	3.a	3.b	4.a	4.b	5.a	5.b	6.a	6.b	7.a	7.b
CO	1	1	2	2	3	3	4	4	5	5	6	6
PO	1	1	1 & 2	1 & 2	1 & 2	1	1 & 2	1	1 & 2	1 & 2	1	1

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SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD.

Department of Engineering Physics

Semester End Examination

Sub Code : 15UPHC100 **Semester: I**

Sub Title : Engineering Physics

Duration : 3hrs **Max Marks: 100**

Note: Part A is compulsory; Answer any four questions from Part B

Physical constants:

Boltzmann constant (k) = $1.38 \times 10^{-23} JK^{-1}$
Avogadro's number (N_A) = 6.02×10^{26}/kmol
Planck's constant (h) = 6.63×10^{-34} J.s
Mass of an electron (m_e) = 9.11×10^{-31} kg
Charge of an electron (e) = 1.6×10^{-19} C
Mass of the proton (m_p) = 1.67×10^{-27} kg

PART-A

Q1 10 marks

i Momentum of an electron having a kinetic energy of 100 keV is _____ Ns.

ii Ground state energy Eigen value of a particle is 8×10^{-3} eV, then the second excited state energy is _____ eV.

iii The distribution of electrons in the conduction band of a metal is according to_____ principle.

iv _____ band gap semiconductors are used in the fabrication of Light Emitting Diodes.

v The periodic arrangement of points in space is known as _____.

vi Silicon crystallizes as _____ crystal structure.

vii The excitation energy of a lasing system having induced absorption at 450 nm is _____ eV.

viii Sine inverse of numerical aperture is the _____ of the optical fiber.

ix Melting point of a nano particles _____ with decreases in its size.

x In the case of nano-films variation of density of states is a _____ function.

Q2

a The fractional index change and acceptance angle of a single mode optical fiber are 0.015 and 14° respectively. Estimate the refractive index of the core. 3 marks

With proper experimental evidences justify the duality of energy. 2 marks

b Compare p-type semiconductor with n-type semiconductor. 3 marks

First-order Bragg's reflection occurs when a X-ray radiations of wavelength 1 Å incident on a crystal at glancing angle of 8.35^0. Evaluate the corresponding inter-planar spacing. 2 marks

PART-B

Q3

a Elaborate the significant properties of mater waves. 5 marks

Wavelength associated with the moving electron is 1.66×10^{-7} mm. Determine its particle velocity, group velocity, phase velocity, kinetic energy and momentum. 5 marks

b Evaluate the probability density and energy Eigen value for the first two energy states of the particle confined in one-dimensional potential well of infinite height. 7 marks

If the speed of an electron is 8 kms^{-1} with a maximum uncertainty of 2.3×10^{-3} %, determine the minimum uncertainty in the position of electron. 3 marks

Q4

a Analyze the dependence of electrical resistivity of metal on temperature, impurities and defects. 5 marks

Determine the Fermi energy and Fermi velocity of electron in the FCC copper wire with a lattice constant of 3.6147Å. 5 marks

b Plot the graph of energy against inter-atomic distance and explain the formation of energy bands in semiconductor. 5 marks

Determine the electric conductivity and Hall coefficient of a Hall sensor made of germanium having a carrier density 2.37×10^{19} m^{-3}. The mobility of electrons and holes are 0.38 $m^2 V^{-1} s^{-1}$ 0.18 $m^2 V^{-1} s^{-1}$ respectively. 5 marks

Q5

a With a generalized example explain the procedure to obtain Miller indices of the crystal planes. 5 marks

A monochromatic X- ray beam of wavelength 1.745 Å undergoes first order Bragg's reflection from a crystal plane (2 1 1) of a cubic crystal at a glancing angle 28^0. Calculate lattice constant. 5 marks

b Give an account of classification of liquid crystals on the basis of ordering of mesogens. 5 marks

Describe the deposition of metallic glasses by DC sputtering method with suitable diagram. 5 marks

Q6

a Give the stepwise procedure of light amplification in a typical laser system. 5 marks

V-number and core diameter of a step index optical fiber used in the communication system operating at a wavelength of 1300 nm are 26.6 and 50 µm. Determine the numerical aperture. 5 marks

b Based on the modes of propagation and refractive index profile explain the classification of optical fibers. 5 marks

If n_1 and n_2 are the refractive indices of core and cladding respectively, show that the sine of angle of acceptance of the optical fiber is square root of $n_1^2 - n_2^2$. 5 marks

Q7

a Explain density of states for various quantum structures. 6 marks

Write the significant properties of nano-materials. 4 marks

b Furnish the details of Top-Down and Bottom-Up synthesis process of nano-materials. 6 marks

With the suitable example, explain how the surface to volume ration increases in nano-scale. 4 marks

Q. No	2. a	2.b	3.a	3.b	4.a	4.b	5.a	5.b	6.a	6.b	7.a	7.b
CO	1	1	2	2	3	3	4	4	5	5	6	6
PO	1	1	1 & 2	1 & 2	1 & 2	1	1 & 2	1	1 & 2	1 & 2	1	1

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