Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech.

Summer – 2016

Course Code: SHU102 **Course Name: Applied Physics**

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given: $m_p = 1.67 \times 10^{-27}$ kg , $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.602 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J.s.

1. Solve any three.

a) Discuss Fraunhofer diffraction due to a single slit. Draw a curve indicating distribution of light in the diffraction pattern. 5

b) What is quarter wave plate? Explain with neat labeled diagram, how to obtain elliptically and circularly polarized light. 5

c) A soap bubble 250 nm thick is illuminated by white light. The refraction index of the soap film is 1.36. Find the missing & strongly appeared colours in the reflected light at normal incidence. 5

Contd.

d) Sodium light with wavelengths 5890 & 5896 Å falls normally on a diffraction grating. It is observed that in the first order diffracted beam, the two sodium lines are separated by exactly 2 minutes of arc. What is the spacing of the grating? 5

2. Solve any three.

a) How does the Fermi level change with temperature in *p*-type semiconductors? Discuss the effect of increasing amount of dopants in extrinsic semiconductors. 5

b) Draw neat energy band diagrams for PN-junction at equilibrium, forward biased and reverse biased. 5

c) Explain the behavior of dielectrics under static electric fields. Derive a relation between polarization P and the external electric field E. 5

d) The Hall coefficient of a specimen of doped silicon is found to be 3.66×10^{-4} m^3/C. The resistivity of the specimen is 8.93×10^{-3} Ω-m. Find the mobility and density of the charge carriers, assuming single carrier concentration. 5

3. Solve any three.

a) What are ferroelectric materials? How do dielectric constant and polarization change with temperature in ferroelectric material? 5

b) What is the significance of critical temperature, critical magnetic field and critical current density for superconductors? 5

c) Derive the Schrodinger's time independent wave equation for matter waves. Calculate the energy levels of a particle confined in an infinite potential well. 5

d) Draw the internal block diagram of CRO and explain the working of intensity control, focusing control and time base generator. 5

4. a) Discuss two pumping schemes for the production of LASER. 4

b) Draw schematic diagram for fiber drawing apparatus using the double-crucible technique and explain its working. 4

c) An electron is moving with speed of 500 m/s with an accuracy of 0.0065%. Calculate certainty with which we can locate the position of electron. 4

5. Solve any one

a) For an optical fiber, core and cladding refractive indices are 1.6 and 1.3 respectively. Find the value of critical & acceptance angle. 3

b) A proton accelerates from rest in a uniform electric field of 500 V/m. At some time later its speed is 2.5×10^6 m/s. Calculate the acceleration of the proton and the time taken to reach that much speed. 3

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech. (All Branches)

Winter – 2016

Course Code: SHU 102 **Course Name: Applied Physics**

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given: $m_p = 1.67 \times 10^{-27}$ kg , $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.602 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J.s., $c = 3 \times 10^{8}$ m/s

Solve any three.

1.

a) Why circular fringes are obtained in Newton's rings arrangement? Why these fringes are called fringes of equal thickness? Why the central fringe is a dark spot when examined in reflected light? **5**

b) Obtain the expression for location of minima in single slit Fraunhofer diffraction. Also draw a curve indicating distribution of light in the diffraction pattern. **5**

c) Discuss Huygens' construction of the wave fronts when a ray of light is doubly refracted through a **5**

Contd..

calcite crystal when the incident light is normal to the surface and the optic axis is
i) in the plane of incidence and
ii) parallel to the crystal surface

d) A grating of width 2 inch is ruled with 15000 lines per inch. Find the smallest wavelength separation that can be resolved in second and third order at mean wavelengths of 5000 & 7000 Å. 5

2. **Solve any three.**

a) Discuss electron and hole concentrations in intrinsic semiconductors and obtain expressions for effective density of states N_C for conduction band. 5

b) What causes majority carriers to flow at the moment when *p*-region and *n*-region are brought together? Why does this flow not continue until all the carriers have recombined? 5

c) Explain the Hall effect and derive expression for Hall coefficient & Hall voltage. 5

d) Differentiate with suitable examples the polar & non-polar dielectrics. 5

3. **Solve any three.**

a) How the solution of Schrodinger wave equation for a particle in a box leads to the concept of quantization of energy? 5

b) Explain the construction and working of He-Ne LASER. 5

c) Show that an electron moving with uniform velocity follows a parabolic path in transverse uniform electric field. 5

d) Calculate the lowest four permissible quantum energies of the electron if it is bound by an infinite square well potential of width 2.5×10^{-10} m. 5

a) Describe the salient features of ferromagnetic materials. 4

b) State & explain Heisenberg's uncertainty principle with experimental proof. 4

c) Write note on positive rays. 4

Solve any one

a) For a step index optical fiber with core refractive index 1.48 & a numerical aperture of 0.649, calculate the refractive index of clad-glass material used. Also calculate maximum entrance angle of the light if fiber is placed in air. 3

b) A LASER emits a wavelength of 632.8 nm. What is the difference in energy levels involved in lasing action? What will be the frequency of the photon emitted? 3

(3)

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech.

Summer – 2013

Course Code : SHU102 **Course Name : Applied Physics**

Time : 2 hr. 30 min. **Max. Marks : 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given data : $e = 1.602 * 10^{-19}$ C, $m_e = 9.1 * 10^{-31}$ kg.
$h = 6.62 * 10^{-34}$ J.sec.

1. **1. Attempt any three**

a) Derive the expression for brightness and darkness For a monochromatic light beam reflected from a thin parallel film of transparent material. **4**

b) Explain the formation of Newtons rings and show that the raddi of dark rings are proportional to under root of natural numbers. **4**

c) Show how fraunhofer diffraction of a single slit can be used to determine the width of a narrow slit **4**

d) Can a thin film of water ($\mu f = 1.33$) formed on a glass window pane ($\mu = 1.52$) act as a non reflecting film? If so how thick should be the water film Take $\lambda = 5500\ A^0$ **4**

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2. Attempt any three

a) Discuss the production and detection of circularly polarized light. 4

b) What is Hall effect. Derive an expression for Hall coefficient. 4

c) Draw energy band diagram for pn junction diode in forward biased condition and describe the process in brief. 4

d) Describe ferroelectricity with the help of hysteresis loop. 4

3. Attempt any three

a) Describe the salient features of diamagnetic materials. 4

b) The transition temperature for Pb is 7.2 K. However at 5 K it loses the superconducting property if subjected to a magnetic filed of $3.3.*10^4$ A.m. Find the maximum value of H which will allow the metal to retain its superconductivity at 0^o K. 4

c) Explain the Meissner effect with proper diagram. 4

d) What are fluxoides? What role do they play in type II superconductivity in the mixed state? 4

4.

a) What is meant by acceptance angle for an optical fibre? Show how it is related to numerical aperture. 4

b) A glass clad fibre is made with core glass of refractive index 1.5 and cladding is doped to give a fractional 4

index difference of 0.0005 find the cladding index and the numerical aperture.

c) Distinguish between spontaneous and stimulated emission. 4

5. Attempt any three

a) Explain the working and use of time base circuit of CRO. 4

b) Show that an electron moving with uniform velocity follows a parabolic path in a transverse uniform electric field. 4

c) An electron projected at an angle of 37^{o} to the horizontal at an initial speed of $4.5*10^{5}$ m/s in a region of a uniform Electric filed of Intensity 200 N/C oriented vertically upward..Find the acceleration gained by electron and the time taken by electron to return to its initial level. 4

d) Derive Schroedingers time dependent wave equation 4

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech. (All)

Winter - 2015

Course : SHU102 (APPLIED PHYSICS)

Time : 2 hr.30min. Max. Marks : 60

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given: $m_e = 9.1 \times 10^{-31}$kg , $e = 1.6 \times 10^{-19}$C

1. Solve any three. 12

(a) Discuss the Fraunhofer diffraction pattern due to a single slit. How can you utilize it to determine the wavelength of light?

(b) In Newton's rings pattern show that the radii of dark rings are proportional to square root of natural numbers.

(c) Obtain an expression for phase difference between ordinary and extraordinary rays when plane polarized light is incident normally on a bi-refringent crystal of thickness d.

(d) A camera lens is to be coated for antireflection effect. The refractive index of the lens material is 1.55. Discuss the principle involved and find out

Cont.

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the requirement of the coating. (Assume λ = 5500AU)

2. Solve any three. 12

(a) Draw a well-labeled energy band diagram showing variation of electron energy in Germanium crystal as a function of inter-atomic distance and explain why it shows semi-conducting behaviour.

(b) Define intrinsic semiconductor and show that Fermi level lies at $E_g/2$ in it.

(c) Draw a well labeled energy band diagram for forward biased PN junction diode and explain its working.

(d) The resistivity of a doped silicon crystal is 9.25×10^{-3} Ωm and charge carrier concentration is $1.63 \times 10^{22}/m^3$. Assuming that the conduction is by single type of charge carriers. calculate the value of hall coefficient and mobility of the carriers.

3. Solve any three. 12

(a) Determine the wave function ψ for motion of an electron confined in one-dimensional infinite potential well by using Schrodinger's time independent equation.

(b) Write a short note on (a) population inversion and (b) optical resonator

(c) A measurement establishes the position of a proton with an accuracy of 1.0×10^{-11}m. Find the uncertainty in its momentum at that instant. Also determine the uncertainty in its velocity v if we assume $v << c$. (Given: $\hbar = 1.054 \times 10^{-34}$ J s, $m_p = 1.673 \times 10^{-27}$kg)

(d) Explain how optical fibers are classified. Discuss their characteristic features.

4. Solve any three.

(a) Define magnetic susceptibility. Alumina material subjected to an external magnetic field of 10^5 A/m produces magnetization of –5A/m. Determine the value of its magnetic susceptibility and write the type of magnetic nature.

(b) What are hard and soft magnetic materials? Give their characteristic properties and applications?

(c) Define critical magnetic field for a superconductor. The critical field for Lead is 3.3×10^{-4} A/m and 6.37×10^{-4} A/m at 7.2 K and 0 K respectively. Calculate the transition temperature of the element.

(d) Derive an expression for internal field in one-dimensional solid.

5. Solve the following.

(a) Describe Thomson's parabola method to determine specific charge of positive rays. What are its drawbacks?

(b) Explain the working principle of a velocity selector. An electron with velocity 1.7×10^7 m/s passes undeviated through a crossed magnetic and electric field acting simultaneously at a point. Determine the value of electric field if magnetic field induction at the point is 3.4×10^{-4} Wb/m^2.

(c) An electron is accelerated through a potential difference of 20kV and then projected at right angles into a magnetic field of induction 0.23 wb/m^2. Calculate the velocity of electron and the radius of circular path it subsequently describes.

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech. (All)

Summer Term- 2016

Course Code: SHU102

Course Name: Applied Physics

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given: $e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$kg, $h = 6.63 \times 10^{-34}$ Js, $\varepsilon_o = 8.854 \times 10^{-12}$F/m

1. Solve any three. **15**

a) With the help of well labelled diagrams explain the use of phasors for determining intensity in Fraunhofer diffraction due to single slit and obtain an expression for intensity variation.

b) Show that the fringes obtained due to interference in a wedge shaped thin film are of equal in width. Give reason for the apperance of dark fringe at the apex.

c) Describe the process of production and detection of elliptically polarized light.

d) Find an expression for deflection of an electron

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due to transverse magnetic field acting over a small region. Discuss the effect of velocity of electron on deflection sensitivity.

2. Solve any three. 15

a) Write down the Fermi Dirac equation for probability of occupation of an energy level E by an electron. Show that the probability of its accupancy is zero if $E > E_F$ and unity if $E < E_F$ AT 0 K. How does it changes with temperature?

b) Derive an expression for conductivity of an intrinsic semiconductor. Find conductivity of an intrinsic Germanium at 300 K. (Given: $n_i = 2.5 \times 10^{19}/m^3$, $\mu_e = 0.39$ and $\mu_h = 0.19\ m^2/Vs$)

c) Define and explain significance of following terms in production of LASERs.
(i) Metastable State & (ii) Stimulated emission

d) Derive an expression for internal field in one dimensional monoatomic solid with atoms having polarizability α_e.

3. Solve any three. 15

a) Show that energy of an electron confined to one dimensional infinite potential well is qunatized.

b) State Heisenberg's Uncertainty Principle. If an electron is travelling with a speed of 220 m/s measured to an accuracy of 0.065%, calculate uncertainty in its position. ($\hbar = 1.05 \times 10^{-34}$ Js, $m_e = 9.11 \times 10^{-31}$kg)

c) Derive an expression for the numerical aperture of step index optical fibre.

d) Draw a well labelled block diagram of Cathod Ray Oscilloscope and explain the need of trigger circuit.

4. Solve any three. 9

a) Describe in brief antiferromagnetism.

b) Describe Meissner effect observed in superconductors and give its significance.

c) With the help of a well labelled schematic diagram explain the principle and working of electrostatic lens.

d) Calculate the thickness of a quarter wave plate when the wavelength of light to be used is 5890AU. (Given: $\mu_o = 1.55$ & $\mu_e = 1.54$)

5. Solve the following. 6

a) If an ionic crystal is placed in an electric field of 500 V/m and the resulting polarization is 3×10^{-8} C/m^2 calculate its relative permittivity. ($\varepsilon_0 = 8.85 \times 10^{-12}$ F/m)

b) A plane diffraction grating has the value of a grating constant equal to 15×10^{-4}cm. Calculate the position of third order maximum for $\lambda = 2.4 \times 10^{-4}$cm.

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech.

Winter – 2014

Course Code: SHU102

Course Name: Applied Physics

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given: $e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$kg, $m_p = 1.67 \times 10^{-27}$kg, $N_A = 6.023 \times 10^{26}$/k mol, $\varepsilon_o = 8.854 \times 10^{-12}$F/m, $h = 6.63 \times 10^{-34}$ Js

1. Solve any three. **12**

A) With the help of well labelled diagram explain the interference in plane parallel thin film.

B) Obtain an expression for relative intensity in single slit diffraction by using phasors.

C) Define double refraction. Draw a well labeled diagram indicating the propogation of light in negative birefringent crystal when incident perpendicular to optic axis.

D) A diffraction grating 20.00mm wide has 15000 rulings. (a) Calculate the distance d between adjacent rulings. (b) At what angles θ

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will intensity maxima occur on a viewing screen if the radiation incident on the grating has a wavelength of 589nm?

2. Solve any three. 12

A) Define intrinsic semiconductor and deduce an expression for intrinsic conductivity at temperature T.

B) Draw well labelled energy band diagrams of pn junction in forward and reversed biased condition.

C) With the help of suitable energy band diagram illustrate the variation of Fermi Energy level with temperature in n-type semiconductor.

D) An optical fibre has core of refractive index 1.6025 and NA 0.20. Determine the refractive index of cladding material. Also calculate the acceptance angle for the fibre in water. (given: refractive index of water 1.33)

3. Solve any three. 12

A) Explain the strcuture and properties of antiferromangetic material.

B) With the help of suitable example explain at least two characteristics features of ferroelectric material.

C) The atomic weight and density of Sulphur are 32 and 2.08 gm/cm^2 respectively. Electronic polarizability of Sulphur atom is $3.28 \times 10^{-40} Fm^2$. Find the value of relative permittivity assuming that Sulphur has cubical symmetry.

D) The critical field for lead is 4×10^4 A/m at 7.08K and 8×10^5 A/m at 0K. Calculate the transition temperature of the element.

4. Solve any two. 12

A) Show that energy possessed by an electron confined to a 1D infinite pontential well is quantized. Also obtain the wave function for the electron.

B) Give definitions of the followings:

(i) Stimulated Emission

(ii) Acceptance angle

(iii) Hall effect

C) With the help of well labelled energy level diagram explain the construction and working of He-Ne gas LASER. Which type of pumping scheme is used in this LASER?

5. Solve the following.

A) How an electron microscope overcomes the inherent limitation of an optical microscope? Explain with neat diagram the construction and working of an electron microscope. 6

B) An electron beam of velocity 1.7×10^7 m/s passes through magnetic field of 0.002 T and an electric field of strength 3.4×10^4 V/m both acting simultaneously at the same point in opposite directions. Describe the motion of electron. If electric field is switched off, what will be the radius of circular path? 3

C) Compare the uncertainties in the velocities of an electron and a proton confined to a 1.00 nm box. 3

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech. (All Branches)

Winter – 2012

Course Code: SHU102 **Course Name: Applied Physics**

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted
5) Figures to the right indicate full marks.
6) Given: $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.602 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J.s.

1. Solve any three

a) Discuss salient features of the interference pattern obtained in Newton's rings experiment. 5

b) Explain qualitatively the intensity distribution in single slit diffraction pattern using phasor diagram. 5

c) In a Newton's rings experiment the diameter of the 4^{th} and 12^{th} dark rings are 0.4 cm and 0.7 cm respectively. Find the radius of 20^{th} dark ring. 5

$$\Delta R = \frac{D_{12}^2 - D_4^2}{4PRS} = \frac{D_{20}^2 - D_{12}^2}{8}$$

$$D_{20}^2 = 0.49 + 0.49 - 0.16$$

$$= 0.9056 \text{ cm}$$

d) Calculate the thickness of quarter wave plate and half wave plate. Given that $\mu_e = 1.553$, $\mu_o = 1.544$ and $\lambda = 5000$ Å. 5

2. Solve any three

a) Explain in detail the energy level splitting and energy band configuration in silicon crystal with reference to inter atomic distance. 5

b) Discuss the energy band diagram for P-type and N-type semiconductor material. 5

c) Differentiate between conductor, semiconductor and insulator. 5

d) Calculate the mobility of charge carriers in a doped silicon whose conductivity is 100 per Ω-m and the Hall coefficient is 3.6×10^{-4} m^3 /coulomb. 5

3. Solve any three

a) What do you mean by polarization of a substance? Discuss different types of polarization. 5

b) Explain the types of superconductors. 5

c) What is a wave packet? How is it represented analytically and diagrammatically? 5

d) Explain the principle, construction and working of the Bain bridge mass spectrograph. 5

4. a) Explain the principle and working of He-Ne gas LASER. 4

b) Describe the motion of an electron subjected to a 4

uniform magnetic field acting at an angle.

c) Derive an expression for e/m of an electron using crossed electric and magnetic fields in a cathode ray tube. 4

5. Solve any one

a) In an optical fiber, the core material has refractive index 1.6 and refractive index of cladding material is 1.3. What is the value of critical angle? Also calculate the value of angle of acceptance cone. 3

b) Calculate the frequency of the fundamental note emitted by a quartz crystal. Given, thickness of the quartz plate = 5.5×10^{-3} m, Young's modulus of quartz = 8×10^{10} N/m^2 and density of the crystal = 2.65×10^3 kg/m^3. 3

$$f = \frac{n}{2t}\left[\frac{Y}{\rho}\right]^{1/2} \quad (n = 1)$$

$$= \frac{1}{2 \times 5.5 \times 10^{-3}\,m}\left[\frac{8 \times 10^{10}\,N/m^2}{2.65 \times 10^3\,kg/m^3}\right]^{1/2}$$

$$= 499\ kHz.$$

5 a Show that the deflection produced in the path of electron is proportional to ratio of deflecting voltage (V_D) and accelerating voltage (V_A) in transverse electric field. 5

b Describe working of electron microscope and explain why resolving power of electron microscope is higher than optical microscope? 4

c The electric field between plates of velocity selector in Bainbridge mass spectrograph is 175 V/cm and magnetic field is 0.45T. If source contains two singly charged ions of isotopes of magnesium Mg^{24} Mg^{25} Find distance between lines formed by isotopes on photographic plate. 3
(Use 1amu= 1.66×10^{-27} kg)

OR

d An electron is accelerated through a potential difference of 5 kV enters in uniform magnetic field 0.02 wb/m2 acting perpendicular to direction of electron motion determine radius of path . 3

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

First / Second Semester B. Tech.

Summer - 2011

Course Code: SHU102 **Course Name: Applied Physics**

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1 a In Newton's ring experiment explain why? 4

i. Radius of Plano convex lens should be larger?
ii. The rings get closer away from the centre?
iii. Central fringe is dark in reflected light?
iv. Fringes are circular?

b Define diffraction grating and obtain condition for absent spectra in plane diffraction grating. 4

c Calculate the angles at which the first dark band and next bright band formed in Fraunhoffers diffraction pattern of single slit with width 0.2 mm if wavelength of light used is 5890 A° 4

OR

Contd.

	d	Two plane glass surfaces in contact along one edge are separated by a thin wire at other end. If 20 interference fringes are observed between these edges using sodium light (λ= 5893 A°) at normal incidence calculate thickness of wire.	4
2	a	Give difference between quarter wave plate and half wave plate.	4
	b	Explain with energy band diagram working of PN junction when connected in forward and reverse bias mode.	4
	c	A copper strip of 2.0 cm wide and 0.1 mm thick is placed in transverse magnetic field (B= 1.5 wb/m^2). If 200 Amp current is set up in the strip calculate Hall voltage developed across the strip. Assume Hall coefficient R_H= 6.0 x10^{-7} m^3/C.	4
		OR	
	d	A Sample of intrinsic Germanium at room temperature has carrier concentration of 2.4x10^{19} /m^3. It is doped with antimony at the rate of 1 atom of antimony in one million atoms of Germanium. If Germanium atom concentration is 4x10^{28} /m^3 calculate the hole concentration.	4
3	a	Describe any four applications of superconductivity	4
	b	Define electronic polarization and show that electronic polarizabilty (α_e) for dielectric material is $\alpha_e = \frac{\varepsilon 0(\varepsilon r-1)}{N}$ Where- ε_0 - permittivity of free space, ε_r - relative permittivity and N number of atoms per unit	4

volume of given dielectric material.

c Explain soft magnetic materials and give its applications related to computer. 4

OR

d Define Phase velocity and Group velocity and obtain relation between them. 4

4 a Describe quantum mechanical tunneling effect and state any two devices working on this effect. 5

b Explain with neat diagram and energy level diagram construction and working of He-Ne laser. 4

c Show that the acceptance angle for optical fiber is given by $\theta_a = \sin^{-1}(\sqrt{\mu 1^2} - \sqrt{\mu 2^2})$ 3

OR

d Explain how an optical fiber can be used as temperature sensor. 3

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Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

I Sem. B. Tech.

Summer Term - 2011

Course Code: SHU102 **Course Name: Applied Physics**

Time: 2 hr. 30 min **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given data : $e = 1.602 * 10^{-19}$ C, $m_e = 9.1 * 10^{-31}$ kg.
$h = 6.62 * 10^{-34}$ J.sec.

1	a	Obtain an expression for fringe width interference pattern obtained in a wedge shaped thin film with a well labeled diagram.	4
	b	Derive the condition for the appearance of minima in fraunhofer diffraction at single slit.	4
	c	Plane polarized light is incident on a piece of quartz cut parallel to the axis. Find the least thickness for which the ordinary & extraordinary rays combine to form plane polarized light. Given data $\lambda = 5*10^{-5}$ cm , $\mu_e = 1.5533$, $\mu_o = 1.5442$	4

Cont.

2 Attempt any THREE

a	In a Hall coefficient experiment a current of 0.25 A is sent through a metal strip having thickness 0.2 mm and width 5 mm. The Hall voltage is found to be 0.15 mV, when a magnetic file of 0.2 T is used. Find (i) the carrier concentration & (ii) the drift velocity of carrier concentration	4	
b	Draw the energy band diagram for symmetrically doped PN junction when it is (i) Unbiased & (ii) Reverse biased.	4	
c	What is meant by dielectric polarization of a substance? Explain electronic polarization.	4	
d	What is orientation polarization? How is dielectric loss utilized in cooking food in a microwave oven?	4	5

3 Attempt any THREE

a	Explain the classification of hard & soft magnetic materials on the basis of coercivity.	4	
b	Describe the salient features of paramagnetic materials.	4	
c	What are DC & AC Josephson effect.	4	
d	The critical field for Niobium is $1*19^5$ A/m at 8° K & $2*10^5$ A/m at 0° K. Calculate the transition temperature of the element.	4	

4 **Attempt any THREE**

4 a With the help of a simple thought experiment arrive at Heisenbergs Uncertainty principle 4

b Derive Schroedinger time independent wave equation 4

c Calculate the refractive indices of the core & the cladding material of a fibre from the following data. 4
Numerical aperture = 0.22 , fractional refractive index change $\Delta = 0.012$

4 d Explain the working of He-Ne laser with a well labelled diagram. 4

4 5 **Attempt any THREE**

a Explain the bunching of light waves in graded index fibre with a diagram of refractive index profile. 4

b A charge of mass m moving with velocity is subjected to a perpendicular magnetic field. Show that its period of revolution is independent of its velocity. 4

4

4 c An electron beam passes through magnetic field $2*10^{-3}$ wb/m^2 & electric field of $3.4*10^4$ V/m both acting simultaneously at the same point. The path of electrons remains unchanged. Calculate the electron speed, if the electric field is switched off. What will be the radius of circular path? 4

4

4

d Explain the tunneling effect with a proper diagram. 4

Cont.

5 a Show that the deflection produced in the path of electron is proportional to ratio of deflecting voltage (V_D) and accelerating voltage (V_A) in transverse electric field. 5

b Describe working of electron microscope and explain why resolving power of electron microscope is higher than optical microscope? 4

c The electric field between plates of velocity selector in Bainbridge mass spectrograph is 175 V/cm and magnetic field is 0.45T. If source contains two singly charged ions of isotopes of magnesium Mg^{24} Mg^{25} Find distance between lines formed by isotopes on photographic plate.
(Use 1amu= 1.66×10^{-27} kg)

OR

d An electron is accelerated through a potential difference of 5 kV enters in uniform magnetic field 0.02 wb/m2 acting perpendicular to direction of electron motion determine radius of path . 3

NKP612

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

I Sem. B. Tech.

Winter - 2010

Course Code: SHU102 **Course Name: Applied Physics**

Time: 2 hr. 30 min **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Give data: $e = 1.602 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.62 \times 10^{-34}$ J. sec.

1. (a) Explain the working of electrostatic lens. State its advantage over a glass lens. **6**

   (b) Explain principle of antireflection coatings. Derive the amplitude and phase conditions for the determination of thickness of film and refractive index of material. **6**

2. (a) Draw energy band diagram for pn-junction diode in an unbiased condition and show that the barrier potential across the junction depends on concentration of impurities in p and n regions. **4**

   (b) Draw intensity distribution curve for single slit **4**

Cont.

diffraction. Show how it can be used to determine the width of a slit.

(c) A particle is confined in a one dimensional potential well of width 0.2×10^{-9} m. When the energy of the particle is 230 eV its eigen function have 5 antinodes. Find the mass of the particle. 4

3. **Attempt any two**

(a) Describe the process of production and detection of elliptically polarized light. 6

(b) Explain ferromagnetic hysteresis on the basis of Weiss theory of domains. 6

(c) An electron enters a uniform magnetic field B = 0.23 wb/m^2 at 45^0 angle to B. Determine radius and pitch of helical path assuming electron speed to be 3×10^7 m/s. 6

4. **Attempt any two**

(a) Write Fermi-Dirac distribution function. Explain with the help of diagram how it varies with change of temperature. 6

(b) Write down expression for total polarization P. Explain how permanent dipole moment of molecules can be determined if P is known at different temperature. 6

(c) A plane transmission grating having 6000 lines per cm is used to obtain a spectrum of light from sodium light in the second order. Find angular separation between two sodium lines of wavelength 5890 A^0 and 5896 A^0 respectively. 6

5. **Attempt any two**

(a) State the advantages of optical communications over conventional type of communication? 6

(b) Derive the expression for phase difference between o-ray and e-ray. Show that when linearly polarized light incident on a uniaxial crystal, it produces elliptically polarized light in most general case. 6

(c) The resistivity of a doped silicon sample is 8.9×10^{-3} Ω.m. The Hall coefficient was measured to be 3.6×10^{-4} m^3/C. Assuming single carrier conduction, find the mobility and density of charge carriers. 6

PFN6f2

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6/12/11

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

I Sem. B. Tech.

Winter - 2010

Course Code: FE102 Course Name: Applied Physics- I

Time: 2.00 hr. **Max. Marks: 30**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Physical constants.
   i. electronic charge e = 1.6×10^{-19} C
   ii. Planks constant h= 6.63×10^{-34} j.sec
   iii. Mass of electron me= 9.1×10^{-31} kg
   iv. 1 atomic unit (1amu)= 1.67×10^{-27} kg
   v. Avogadro number N_A= 6.02×10^{26} /k.mol
   vi. 1 electron volt = 1.6×10^{-19} J

1. (a) Define Hall effect; Write an expression for Hall Voltage with meaning of each term and give two important applications of Hall effect. 4

OR

Cont.

(b) If 'a' is lattice constant, show that the inter planer spacing between planes in cubic lattice is given by relation $d_{hkl}=\frac{a}{\sqrt{h^2+k^2+l^2}}$ 4

(c) An electron is bound in one dimensional potential well of width 10 nm and of infinite height. Find its energy values in the ground state and also in the first two excited states. 4

(d) Explain applications of optical fibers with respect to communication systems and medical field. 2

2. (a) Define Heisenberg's principle and explain the same with the help of suitable thought experiment. 4

OR

(b) Explain role of following terms in LASER Production. 4

i Stimulated emission
ii Population inversion
iii Meta-stable state
iv Optical resonator

(c) A cubic crystal with BCC structure has density 10.2×10^3 kg/m^3 and its atomic weight is 95.94, 4

determine the radius 'R' of an atom of BCC structure. 4

(d) What are Ferro-electric substances give their applications 2

(a) Explain meaning of internal field in solids and obtain Classius–Mosotti equation for elemental dielectric solids. 4

(b) Determine the position of Fermi level in silicon Semiconductor at 300°K, if band gap(E_g) is 1.12 eV ,effective mass of free electron(m_e^*)is 0.12 m and effective mass of hole(m_h^*)is 0.28 m (use Boltzmann constant K =1.3776 x10^{-23}J/°K) 4

(c) Define mobility. How it is related with conductivity of intrinsic semiconductor? 2

Setting -- VS Kakade.

(12)

SVX10

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

I Semester B. Tech.

Summer - 2010

Course Code : FE102

Course Name : Applied Physics-I

Time : 2 hr. **Max. Marks : 30**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Give data: $k = 8.6 \times 10^{-5}$ eV/K $= 1.38 \times 10^{-23}$ J/K
   $m_e = 9.1 \times 10^{-31}$ kg,
   $h = 6.62 \times 10^{-34}$ J.sec.

1. **Attempt any three**

(a) Explain Fermi-Dirac distribution function. Explain with the help of diagram how it varies with change of temperature. 4

(b) What do you understand by packing density? Calculate packing density for BCC and FCC lattice. 4

Cont.

(c) i) Find the lowest energy of an electron confined to move in one dimensional potential box of length $0.5A^0$ 2

ii) If a effective mass of a electron is equal to twice the effective mass of hole, determine the position of Fermi level in an intrinsic semiconductor from the center of forbidden gap at room temperature. 2

(d) Define dielectric susceptibility and polarizability of a dielectric. Explain the concept of polarization. 4

Attempt any three

(a) What do you understand by intrinsic density. Derive expression for intrinsic conductivity and show that it depends on the energy gap E_g. 4

(b) Explain different applications of the dielectric materials. 4

(c) Define space lattice and basis. Explain how different lattice parameters form a unit cell. 4

(d) Explain the concept of wave packet. What do you mean by phase velocity and group velocity? 4

Attempt any two

(a) What is population inversion? How it is achieved 3

by four level pumping scheme?

(b) An FCC lattice has an atomic radius of 1.246 A^0. Calculate the d_{220} and d_{111} spacing. 3

(c) There are 10^{27} HCl molecules per cubic meter in a vapour. Determine the orientation polarizability and orientation polarization at room temperature of 300 K if the vapour is subjected to an electric field of 10^6 volt/m. The permanent dipole moment of HCl molecule is 3.463×10^{-30} C.m. 3

Cont.

3. (e) Why Time base circuit is necessary in Cathode Ray Oscilloscope (CRO)? 2

Paper Solution for SHU 102 Applied Physics

SHU102

Q. 1

a) Circular 1 mark; equal thickness 2 mark ; dark spot 2 mark ;

b) Location of minima explanation 2 mark ; diagram 1 mark ; curve diagram 2 mark

c) plane of incidence 2.5 mark (diagram 1 mark explanation 1.5)
parallel to crystal surface 2.5 mark (diagram 1 mark explanation 1.5)

d) Resolving power of grating is given by $\frac{\lambda}{d\lambda} = n \times N$ 1 mark

Total no of lines on grating $N = 2 \times 15000 = 30000$

When $\lambda = 5000$ Å $d\lambda = \frac{\lambda}{n \times N}$; for $n = 2$ $d\lambda = \frac{5000 \times 10^{-10}}{2 \times 30000} = 8.33 \times 10^{-12}$m 1 mark

for $n = 3$ $d\lambda = \frac{5000 \times 10^{-10}}{3 \times 30000} = 5.55 \times 10^{-12}$m 1 mark

When $\lambda = 7000$ Å $d\lambda = \frac{\lambda}{n \times N}$; for $n = 2$ $d\lambda = \frac{7000 \times 10^{-10}}{2 \times 30000} = 1.16 \times 10^{-11}$m 1 mark

for $n = 3$ $d\lambda = \frac{7000 \times 10^{-10}}{3 \times 30000} = 7.77 \times 10^{-12}$m 1 mark

Q. 2

a) Discussion 2 marks ; derivation 3 marks

b) Diagram 1.5 marks ; Cause 2.5 marks ; why 1 mark

c) Diagram 1 mark ; explanation 2 marks ; derivation 2 marks

d) Each difference 1mark

Q. 3

a) Diagram 1 mark ; explanation 4 marks

b) Construction: diagram 1 mark ; explanation 1.5 marks
Working : diagram 1 mark ; explanation 1.5 marks

c) Diagram 2 mark ; explanation 3 marks

d) $E_n = \frac{n^2 h^2}{8mL^2}$ 1 mark ;

$E_1 = \frac{1^2 \times (6.63 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (2.5 \times 10^{-10})^2} = 9.66 \times 10^{-19} J = \frac{9.66 \times 10^{-19}}{1.602 \times 10^{-19}} = 6.029eV$ 1 mark

$E_2 = \frac{2^2 \times (6.63 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (2.5 \times 10^{-10})^2} = 4 \times 9.66 \times 10^{-19} J = \frac{4 \times 9.66 \times 10^{-19}}{1.602 \times 10^{-19}} = 24.11eV$ 1 mark

3815

$E_3 = \frac{3^2 \times (6.63 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (2.5 \times 10^{-10})^2} = 9 \times 9.66 \times 10^{-19} J = \frac{9 \times 9.66 \times 10^{-19}}{1.602 \times 10^{-19}} = 54.26eV$ 1 mark

86.94

$E_4 = \frac{4^2 \times (6.63 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (2.5 \times 10^{-10})^2} = 16 \times 9.66 \times 10^{-19} J = \frac{16 \times 9.66 \times 10^{-19}}{1.602 \times 10^{-19}} = 96.47eV$ 1mark

157.56

Q. 4

a) Each feature 1 mark

b) Principle & explanation 2 marks ; experimental proof 2 marks

c) Diagram 1 mark ; explanation 3 marks

Q. 5

a) $NA = \sqrt{n_1^2 - n_2^2}$ 1 mark

$\therefore NA^2 = n_1^2 - n_2^2$

$n_2 = \sqrt{n_1^2 - NA^2} = \sqrt{1.48^2 - 0.649^2} = 1.33$ 1 mark

So refractive index of clad-glass is 1.33

Max Acceptance angle $\theta_a = \sin^{-1}[NA] = \sin^{-1}[0.649] = 40.46^0$ 1 mark

b) $h\nu = E_{ul} - E_{ll} = \frac{hc}{\lambda}$ 1 mark

Energy difference between involved levels

$$E_{ul} - E_{ll} = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{632.8 \times 10^{-9}} = \frac{3.143 \times 10^{-19}}{1.602 \times 10^{-19}} = 1.96eV$$ 1 mark

Frequency of photon emitted

$$\nu = \frac{c}{\lambda} = \frac{3 \times 10^8}{632.8 \times 10^{-9}} = 4.74 \times 10^{14}\ Hz$$ 1 mark

Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)

First Year B. Tech. (All Branches)

Summer – 2017

Course Code: SHU102 **Course Name: Applied Physics**

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) Given: $m_p = 1.67 \times 10^{-27}$ kg , $m_e = 9.1 \times 10^{-31}$ kg. $e = 1.602 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J.s., $c = 3 \times 10^8$ m/s

1. Solve any three.

a) Discuss salient features of the interference pattern obtained in Newton's rings experiment. 5

b) Obtain general expression for location of minima in single slit Fraunhofer's diffraction pattern. 5

c) Plane polarized light of wavelength 5800 Å is incident on a thin quartz plate cut with faces parallel to the optic axis. Calculate: (i) the minimum thickness of plate which introduces a phase difference of $\pi/3$ between O and E-rays. (ii) the minimum thickness of the plate for which the O and E waves will combine to produce plane polarized light. (Given $\mu_o = 1.544$ & $\mu_e = 1.553$) 5

d) The refractive index of a thin soap film is 1.33 and is illuminated by white light. In the reflected pattern, two consecutive dark fringes of wavelength 550 and 540 nm are found overlapping. Calculate the thickness of the film if the angle of incidence is 45°. 5

2. Solve any three.

a) Using Fermi-Dirac probability distribution function, derive the position of Fermi level in intrinsic semiconductors. 5

b) Define electric dipole moment, and classify dielectric materials on its basis. Illustrate your answer with suitable examples. 5

c) Describe the difference between Type I and Type II superconductors. 5

d) A *n*-type germanium sample has a donor density of 10^{21} /m^3. It is arranged in a Hall experiment having magnetic field of 0.5 T and the current density is 500 A/m^2. Find the Hall voltage if the sample is 3 mm wide. 5

3. Solve any three.

a) Explain the important magnetic properties of paramagnetic materials. 5

b) What is a wave function? Derive three dimensional time dependent Schrödinger's wave equation. 5

c) Compare spontaneous and stimulated emission in their mechanism and characteristics. Which of them is maximized in a LASER operation & why? 5

d) Describe how light is propagated through a optical fiber and thus obtain expression for acceptance angle. 5

4. a) An excited state of a hydrogen atom has a lifetime of 2.5×10^{-15} s. What is the minimum error possible in the measurement of energy of this state? 4

b) A laser system has metastable state at 1.79 eV from which stimulated emission produces laser light. Calculate the wavelength of light. At room temperature when population inversion is not achieved, calculate the ratio of the population of the atom in the metastable state to that in the ground state. 4

c) Electrons accelerated by a potential of 300 V enter the electric field at an angle of incidence of 60° and get refracted through an angle of 35°. Find the potential difference between the two regions. 4

5. Solve any one.

a) Write short note on Lorentz force. 3

b) Draw block diagram of a cathode ray oscilloscope (CRO) with neat labeling. 3