1E3102

Roll No. _____ Total No. of Pages: 3

1E3102

B. Tech. I - Sem. (Main / Back) Exam., - 2023

1FY2 – 02 Engineering Physics

Time: 3 Hours **Maximum Marks: 70**

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

[10×2=20]

(Answer should be given up to 25 words only)

All questions are compulsory

Q.1 Excessively thin film appears dark why?

Q.2 What do you mean by resolving power of an optical instrument?

Q.3 What is normalized and orthogonal wave function?

Q.4 Explain total internal reflection.

Q.5 What are the relation between Einstein's Coefficients? Explain them.

Q.6 What is Hall effect?

Q.7 What is scalar and vector field?

Q.8 Define curl and divergence of a vector.

Q.9 What do you mean by spectral purity?

Q.10 What will be the effect on diameters in Newton's ring experiment if film is of μ refractive index?

PART – B

[5×4=20]

(Analytical/Problem solving questions)

Attempt any five questions

Q.1 Two coherent sources of intensity ratio α interfere. Prove that in the interference pattern $\frac{Imax - Imin}{Imax + Imin} = \frac{2\sqrt{\alpha}}{1+\alpha}$

Q.2 A single slit is illuminated by light composed of two wavelengths λ_1 and λ_2. One observes that due to diffraction, the first minima obtained for λ_1 coincides with the second diffraction minima of λ_2. What will be the relation between λ_1 and λ_2?

Q.3 A laser beam has a power of 50 mw. It was an aperture of 5×10^{-3}m and wavelength 7000 Å. A beam is focused with a tens of focal length 0.2 m. Calculate the area spread and intensity of the image.

Q.4 An optical fibre has a numerical aperture of 0.2 and cladding refractive index of 1.59. Determine the acceptance angle for the fiber in water which has a refractive index of 1.33.

Q.5 An electric field of 100 V/M is applied to a sample of n-type semi conductor whose Hall coefficient is $-0.0125m^2$/ Coulomb. Determine the current density in the sample assuming mobility of electrons is $0.36m^2/V/S$.

Q.6 Derive Laplace's and Poisson's equations starting from the differential form of Gauss's Law.

Q.7 Find the probability that a particle is in one dimensional box of length l can be found between 0.45 l and 0.55 l for the ground and first excited states.

PART – C

[3×10=30]

(Descriptive/Analytical/Problem Solving/Design Questions)

Attempt any three questions

Q.1 Describe and explain the formation of Newton's rings in reflected monochromatic light. How can these be used to determine the wavelength of light? Derive the formula used. [6+4=10]

Q.2 (a) Derive the Schrodinger time dependent equation and explain the physical meaning of wave function ψ. [8]

(b) What do you mean by degeneracy? [2]

Q.3 (a) Discuss the formation of energy bands in solids. [5]

(b) Classify the solids on the basis of energy bands and discuss the conductivity in semiconductors. [3+2=5]

Q.4 Derive the formula for curl and divergence for electrostatic field and static magnetic field. [5+5=10]

Q.5 (a) What is an optical fibre? Obtain an expression for numerical aperture of step index optical fibre. [5]

(b) Explain visibility of fringes as a measure of coherence. [5]

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B.Tech. I Sem. (Main) Examination, April / May - 2022
1FY2-02 Engineering Physics

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

Attempt all ten questions From Part A, five Questions out of seven questions from Part B and three questions out of five questions from Part C .

Schematic diagram must be shown wherever necessary. Any data you feel missing suitably be assumed and states clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

PART - A

(Answers should be given up to 25 words only)

All questions are compulsory. **(10×2=20)**

1. What will be the effect on Newton's rings if a plane mirror is placed instead of the glass plate below the plano convex lens?
2. What is the role of compensatory plate in Michelson interferometer?
3. Define optical fiber. What is the working principle of optical fiber?
4. Define coherence length and coherence time.
5. What are the essential requirements for producing laser action?
6. What are intrinsic and extrinsic semiconductors?
7. What is zero point energy for a particle trapped in one dimensional box?
8. Define divergence of electrostatic field and its physical significance.
9. Why visible light cannot be used in diffraction by a crystal?
10. What are the necessary conditions of physically acceptable wave function?

PART - B

(Analytical/Problem solving questions)

Attempt any five questions: **(5×4=20)**

1. Light containing two wavelengths λ_1 and λ_2 falls normally on a plano-convex lens radius of Curvature R, resting on a glass plate. If the n^{th} dark ring due to λ_1 coincides with the $(n+1)^{th}$ dark ring due to λ_2. Prove that the radius of the n^{th} dark ring of λ_1 is $\sqrt{\frac{(\lambda_1\lambda_2 R)}{(\lambda_1-\lambda_2)}}$.

2. LASER action occurs by stimulated emission from an excited state to a state of energy 30.5eV. If the wavelength of LASER light emitted is 690 nm, what is the energy of the excited one?

3. For intrinsic silicon, at room temperature the electrical conductivity is $4\times10^{-4}\Omega^{-1}m^{-1}$. The electron and hole mobilities are $0.14 m^2V^{-1}s^{-1}$ and $0.040\, m^2V^{-1}s^{-1}$ respectively. Compute the intrinsic charge carrier density at room temperature.

4. A diffraction grating has total ruled width 5 cm for normal incidence. It is found that a line of wavelength $6000\,\mathring{A}$ in a certain order superimposed on another line of wavelength $4500\,\mathring{A}$ of the next highest order. If the angle of diffraction is 30°, how many lines are there in the grating? https://www.rtuonline.com

5. Define numerical aperture of an optical fiber. Prove that the numerical aperture of a step index optical fiber is given by-

   $N.A. = \mu_{core}\sqrt{2\Delta}$, where symbols have their usual meanings.

6. Find the probability that a particle in a box of width a can be found between $x=0$ and $x=a/n$ when it is in the n^{th} state.

7. Derive an expression for resolving power of a grating.

PART - C

(Descriptive/Analytical/Problem solving/Design Questions)

Attempt any three questions. ***(3×10=30)***

1. Derive an expression for the intensity of diffracted light in the Fraunhofer's diffraction due to a single slit and show that the relative intensities of successive maxima are in the ratio:

   $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}:\frac{4}{49\pi^2}$ **(5+5)**

2. Solve the schrodinger's equation for a free electron in 3-Dimensional box and find the energy eigen value and eigen functions of free electron. Find the lowest energy of the following states:

   i) Non-degenerate

   ii) Triply degenerate for 3-Dimensional cubical box. **(6+2+2)**

3. With the help of suitable diagram, explain the principle, construction and working of He Ne laser. **(2+4+4)**

4. a) What is Hall effect? Show that for a n-type semiconductor the Hall coefficient is $R_H = \frac{-1}{ne}$. **(5)**

   b) Classify conductor, semiconductor, and Insulator based on energy band theory. **(5)**

5. a) Define poynting vector and derive poynting theorem. **(5)**

   b) State Ampere's circuital law and using Maxwell's correction, derive fourth Maxwell's equation. **(5)**

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B. Tech. II - Sem. (Main / Back) Exam., March – 2021

BSC

2FY2-02 Engineering Physics

Time: 2 Hours **[To be converted as per scheme]**

Max. Marks: 110

Min. Marks: 39

Instructions to Candidates:

Attempt all five questions from Part A, four questions out of seven questions from Part B and two questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×3=30]**

All questions are compulsory

Q.1 What is interference of light?

Q.2 Explain Bragg's law.

Q.3 Explain temporal and spatial coherence.

Q.4 Explain normalized and orthogonal wave functions.

Q.5 Write the basic postulates of wave function.

Q.6 Explain the meaning of resolving power.

Q.7 What is X-ray diffraction?

Q.8 Explain Bio-Savart law.

Q.9 Why are Newton's rings circular in shape?

Q.10 What is the meaning of acceptance angle?

PART – B

(Analytical/Problem solving questions) **[4×10=40]**

Attempt any four questions

Q.1 What are Newton's rings? Explain the formation of Newton's ring in reflected light. Prove that in reflected light the diameters of the dark rings are proportional to the square root of the natural numbers.

Q.2 A diffraction grating has 5000 lines per cm and the total ruled width is 5 cm. Calculate dispersion for a wavelength of 5000 Å in the second order.

Q.3 Find the lowest energy of an electron confined to move in a one dimensional potential box of width 1 Å. https://www.rtuonline.com

Q.4 A particle is in cubical box of length 'a' in its ground state. Find the probability that a particle will be found in a volume defined by –

$0 \leq x \leq \frac{a}{2}, 0 \leq y \leq \frac{a}{2}, 0 \leq z \leq \frac{a}{2}$

Q.5 Calculate the coherence time and coherence length of white light of wavelength range from 3500 Å to 6500 Å.

Q.6 Distinguish between spontaneous and induced emissions. How does induced emission dominate in He – Ne laser?

Q.7 Write short notes on the following –

(a) Divergence and Curl of static magnetic field

(b) Covalent and Metallic bonding

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[2×20=40]**

Attempt any two questions

Q.1 (a) Describe the construction and working of Michelson's interferometer.

(b) Find the difference between Newton's rings and Michelson's interferometer.

Q.2 Write Schrodinger's equation for a particle of mass 'm' trapped in one dimensional box of size 'a'. Write an expression for its energy eigen values. How would solutions get modified if the particles were in a three-dimensional cubical box of side 'a'?

Q.3 What is an optical fibre? Describe the construction and working of an optical fibre. Find an expression for the numerical aperture of a step index optical fibre.

Q.4 (a) Draw a neat labelled diagram of semiconductor laser and explain its working.

(b) Explain the reasons for the following properties of laser –

(i) High directionality

(ii) High intensity

Q.5 (a) Derive Maxwell equation in differential form.

(b) Write a short note on Poynting vector.

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