I B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018
APPLIED PHYSICS
(Com. to ECE, CSE, IT, EIE, ECom E)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is Compulsory
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) What is an interferometer? (2M)

b) How can you accomplish Fraunhofer diffraction in laboratory environment? (2M)

c) A 15 cm tube containing cane sugar solution shows optical rotation of 7^0. The specific rotation of the solution is 66^0. Calculate the strength of the solution. (2M)

d) What is a scalar and scalar field? Give two examples. (2M)

e) Why the de-Broglie wave associated with a moving car is not observable? (2M)

f) What is Fermi energy? (2M)

g) Depict the position of Fermi level in Intrinsic semiconductor at temperature $T = 0$ K and $T > 0$ K. (2M)

PART -B

2. a) Describe and explain the formation of Newton's rings in reflected monochromatic light. Prove that in reflected light, diameters of bright rings are proportional to the square-roots of odd natural numbers. (10M)

b) Find the minimum thickness of a film with refractive index 1.33 for which light with wavelength 0.64 μm experiences maximum reflection while light with wavelength 0.40 μm is not reflected at all. The angle of incidence is equal to 30^0. (4M)

3. a) Explain what is a plane transmission grating? With a neat diagram explain how diffraction pattern is obtained in the case of a plane transmission grating illuminated with monochromatic light. (10M)

b) The first order maximum for light of wavelength 6×10^{-5} cm occurs at an angle of 20^o when the light is incident normally on the grating. Calculate the number of lines / cm. (4M)

4. a) Explain the principle, construction and working of Helium-Neon laser with the help of energy level diagram. (10M)

b) Differentiate laser light from the ordinary light. (4M)

5. a) State and prove Gauss' theorem. (10M)

b) State the basic laws of electromagnetism in their integral form. (4M)

6. a) Discuss de Broglie's hypothesis of duality for material particles. Enumerate properties of matter waves. (10M)

b) Explain any four assumptions of quantum free electron theory. (4M)

7. a) Show that for intrinsic semiconductors the Fermi level lies midway between the conduction band and valence band. (10M)

b) What is effective mass? Why is the effective mass of holes more than the effective mass of electrons? (4M)
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PART –A

1. a) State the superposition theorem. (2M)
b) Explain Rayleigh's criterion for resolving power (2M)
c) Define the terms (i) Population Inversion (ii) Pumping (2M)
d) What is the difference between light waves and matter waves? (2M)
e) Define the gradient. What is the physical meaning of gradient? (2M)
f) What is the normalization condition for a wave function? (2M)
g) What is Fermi level? Describe its importance. (2M)

PART -B

2. a) With a neat diagram explain the working principle of Michelson's interferometer and discuss how it can be used to determine the Wave length. (10M)
b) In Michelson's interferometer, when a transparent thin glass plate of refractive index 1.52 is introduced in the path of one of the beams, 100 fringes cross the field of view at a given point. The wavelength of light used is 5000Å. Find the thickness of the plate. (4M)
3. a) Obtain conditions for maxima and minima in Fraunhofer diffraction due to a single slit. Calculate width of the central maxima. (10M)
b) A plane wave of light with wavelength 500 nm falls on a slit of width 10^{-5} cm at an angle 30^0 to its normal. Find the angular position of first minima located on both sides of central maximum. (4M)
4. a) What is the principle of working of a Nicol prism? Describe the construction of a Nicol prism. (10M)
b) Calculate the minimum thickness of a double refracting crystal required to introduce a phase difference of 60^0 between the ordinary and extraordinary rays. Given that the wavelength of light used is 600 nm and refractive indices of the crystal for ordinary and extra ordinary rays are 1.54 and 1.55 respectively. (4M)
5. a) State and prove Stokes theorem. (10M)
b) What do you mean by irrotational vector field? Explain with an example. (4M)
6. a) What is Fermi funtion? Discuss its variation with temperature. (10M)
b) Explain the drawbacks of classical free electron theory. (4M)
7. a) What is Hall effect? Deduce an expression for Hall coefficient. How mobility can be determined by using Hall effect? (10M)
b) A 2 cm wide and 0.2 cm thick semiconductor strip with Hall coefficient 145 cm^3/C and carrying a current of 150 mA is subjected to a magnetic field induction of 2T along its smaller dimension. Calculate the current density and Hall voltage. (4M)
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Code No: R161104 **R16** SET - 3

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APPLIED PHYSICS
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2. Answering the question in **Part-A** is Compulsory
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Write the conditions for which two light waves interfere constructively and destructively. (2M)
   b) How can diffraction be explained on the basis of wave theory? (2M)
   c) Define the phenomenon of optical activity in polarization (2M)
   d) What is a vector and vector field? Give two examples. (2M)
   e) What is a wave function? (2M)
   f) Define an energy band. (2M)
   g) Depict the position of Fermi level in P-type semiconductor at temperature T = 0 K and T > 0 K. (2M)

PART -B

2. a) Obtain the conditions for a thin film to appear bright and dark in reflected light. (10M)
   b) A parallel beam of light with wavelengh 5896Å, is incident on a glass plate of refractive index 1.5 such that angle of refraction into the plate is 60^0. Calculate the smallest thickness of the plate which will make it appear dark by reflection. (4M)
3. a) Define resolving power of a microscope. Obtain an expression for the same with necessary ray diagrams. (10M)
   b) The smallest object detail that can be resolved with a certain microscope with light of 589 nm wavelength is 3.5 x 10^{-7} m. Calculate the resolving power of the microscope. (4M)
4. a) What are the essential requirements for producing laser? Explain how population inversion is achieved in a four level energy scheme. (10M)
   b) Explain spontaneous and stimulated emission processes. (4M)
5. a) Obtain an expression for speed of propagation of EM waves through dielectric medium. (10M)
   b) Discuss the physical meaning of divergence. (4M)
6. a) Solve the Schrodinger equation for a particle confined in a one-dimensional box of width (L). Draw the first few energy levels and the corresponding eigen functions. (10M)
   b) Find the lowest energy of a neutron confined to a nucleus of size 10^{-14} m. Given mass of the neutron is 1.67 x 10^{-27} kg. (4M)
7. a) With the help of energy band diagram classify solids on the basis of band theory. (10M)
   b) Explain the concepts of drift and diffusion currents in the case of semiconductors. (4M)

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Code No: R161104 **R16** SET - 4

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Time: 3 hours Max. Marks: 70

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2. Answering the question in **Part-A** is Compulsory **A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Show that the spacing between the Newton's rings decreases with increase in order. (2M)
   b) What is Fraunhofer diffraction? (2M)
   c) How do you achieve lasing action to produce laser beam? (2M)
   d) State the stokes theorem. (2M)
   e) Calculate the wave length associated with an electron accelerated by a potential of 150V. (2M)
   f) Describe any two failures of classical free electron theory. (2M)
   g) Depict the position of Fermi level in N-type semiconductor at temperature T = 0 K and T > 0 K. (2M)

PART -B

2. a) Derive an expression for the radius of curvature of a plano convex lens by using newton's rings experiment. (10M)
   b) For Michelson's interferometer, calculate the distance between two successive positions of the movable mirror giving well defined fringes in the case of sodium source of wavelength of 589.0 nm and 589.6 nm. (4M)
3. a) Derive an expression for the resolving power of a grating and explain how the resolving power depends on the wavelength of the light used. (10M)
   b) In a Fraunhofer diffraction pattern due to a circular aperture, the screen is at a distance of 1 m from the aperture and the aperture is illuminated by monochromatic light of 589.3 nm wavelength. The diameter of the aperture is 0.1×10^{-3} m. Calculate the width of the central maximum. (4M)
4. a) With a neat diagram explain the principle and working of a half shade polarimeter used for finding the specific rotation of sugar solution. (10M)
   b) Explain the construction of a quarter wave plate. (4M)
5. a) State and explain basic laws of electromagnetism in their differential form. (10M)
   b) Define electric potential. Derive it from electric field. (4M)
6. a) What are matter waves? Obtain an expression for Schrodinger's time independent wave equation. (10M)
   b) Define Fermi energy. Write down the expression for Fermi-Dirac distribution law. (4M)
7. a) Obtain an expression for the concentration of holes in valence band of an intrinsic semiconductor. (10M)
   b) Distinguish between intrinsic and extrinsic semiconductors. (4M)

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