APPLIED PHYSICS

(Common to ECE, EEE, CSE, CSE (AI & ML), CSE(DS) and IT)

Course Code: 22BP1101

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Course Outcomes: At the end of the Course the student shall be able to

CO1: apply the principles of optics in analysing the optical devices. (L3)

CO2: apply the knowledge of basic principles of dielectrics and magnetism to describe electrical and storage devices. (L3)

CO3: analyze the electromagnetic wave behaviour in different guided media. (L4)

CO4: explain the conductivity of semiconducting materials. (L2)

CO5: distinguish between normal conductors and superconductors and explain the applications of nanomaterials. (L4)

UNIT-I: **11 Lectures**

WAVE OPTICS:

Interference of light-Principle of Superposition-Interference in thin films (reflected light)-Newton's Rings- Determination of Wavelength- Applications of Interference, Diffraction-Fraunhofer Diffraction-Single slit Diffraction -Diffraction Grating – Grating Spectrum - Polarization-Polarization by reflection, refraction and double refraction-Nicol's Prism-Half wave and Quarter wave plate- applications of Polarization.

Text Book 1: Sec.:8.2, 8.8.1, 8.8.2, 8.11.(1 - 4), 8.12.(1, 4), 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.8.1, 10.2, 10.6.1, 10.6.1.1, 10.6.2, 10.6.5, 11.5, 11.9.1, 11.9.2, 10.10.(i, ii)

Learning Outcomes: The students will be able to

1. apply the phenomena of interference in anti reflection coatings and filters (L3)
2. compare interference and diffraction (L2)
3. explain the concept of polarization of light and its applications (L2)

UNIT-II: **10 Lectures**

DIELECTRICS AND MAGNETICS:

Introduction to Dielectrics-Electric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations, mathematical derivation for electronic polarizability -Frequency dependence of polarization-Lorentz(internal) field- Claussius -Mossotti equation-Applications of Dielectrics.

Introduction to Magnetics-Magnetic dipole moment-Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment -Classification of Magnetic materials-Weiss theory of ferromagnetism (qualitative)-Hysteresis-soft and hard magnetic materials-Ferrites-Magnetic device applications (transformer core and hard disc).

Text Book 1: Sec : 40.1, 40.2, 40.4, 40.5, 40.9, 40.13, 40.13.1, 40.15, 40.17, 40.18, 40.21(i, ii), 41.1, 41.2, 41.4, 41.8.1, 41.14.1, 41.14.2, 41.12, 41.16 (i, iia) and Table 41.1

Learning Outcomes: The students will be able to

1. explain the concept of dielectric constant and polarization in dielectric materials (L2)
2. interpret Lorentz field in Clausius- Mossotti relation (L2)
3. classify the magnetic materials based on susceptibility and their temperature dependence (L2)
4. summarize the applications of dielectric and magnetic materials (L2)

UNIT-III: **11 Lectures**

ELECTROMAGNETIC WAVES AND FIBER OPTICS :

Divergence and Curl of Electric and Magnetic Fields -Maxwell's Equations-Electromagnetic wave propagation in free space- Poynting Theorem.

Introduction to Optical Fiber-Total Internal Reflection-Propagation of electromagnetic waves through optical fiber-Critical angle of propagation-Acceptance angle -Numerical Aperture-Classification of fibers based on Refractive index profile, modes-importance of V number-Medical Application (endoscopy) -Fiber optic Sensors- Block Diagram of Fiber optic Communication and its advantages.

Text Book 2: Sec: 11.4, 11.5

Text Book 1: Sec:6.13, 6.14, 7.4, 7.7, 47.1, 47.2, 47.3, 47.4, 47.4.1, 47.4.2, 47.6, 47.10 (i, ii), 47.11 (1, 2, 3), 47.13, 47.19.1, 47.22.(1a, 2), 47.20, 47.21

Learning Outcomes: The students will be able to

1. apply the Gauss Theorem for divergence and Stokes Theorem for curl (L3)
2. explain the working principle of optical fiber and its classification based on refractive index profile and mode of propagation (L2)
3. outline the applications of optical fibers in medical, communication and other fields (L2)

UNIT-IV: **09 Lectures**

SEMICONDUCTORS :

Classification of solids based on energy bands – Intrinsic semiconductors –Electrical conductivity-derivation of density of charge carriers (electron) -Fermi energy - extrinsic semiconductors - N-type, P-type - Density of charge carriers (Qualitative)- Dependence of Fermi energy on temperature and carrier concentration -Hall effect- Hall coefficient - Applications of Hall effect - Applications of Semiconductors.

Text Book 1: Sec: 36.7, 36.8, 37.3, 37.7, 37.8.1, 37.11, 37.15, 37.16.2, 37.17.1, 37.23, 37.24, 37.28.(1 - 4), 37.28.13

Learning Outcomes: The students will be able to

1. outline the properties of n-type and p-type semiconductors (L2)
2. classify the type of semiconductor using Hall effect (L2)
3. explain the applications of semiconductors in electronic devices (L2)

UNIT-V: **09 Lectures**

SUPERCONDUCTORS AND NANOMATERIALS:

Superconductors-Properties: Zero resistance, Critical temperature, Critical magnetic field, Critical current density, Meissner effect- Type-I and type-II Superconductors -BCS Theory- Josephson effect (AC & DC)-High T_C Superconductors- Applications of superconductors: transformers and electrical machines, magLev trains, SQUID.

Basics of Nanomaterials – Top-down and bottom-up approaches, Preparation (ball milling & sol-gel) – Carbon Nanotubes- Applications of Nano materials (better insulating materials, elimination of pollutants, high energy density batteries, nanomachines and nanodevices).

Text Book 1: Sec: : 42.2, 42.4.1, 42.4.3, 42.4.4, 42.4.5, 42.4.6, 42.6, 42.7, 42.8, 42.10 (ii, vii, viii), 49.3, 49.5.1(iii), 49.5.2 (iv), 49.9, 49.17(ii, v, vii, xiv)

Learning Outcomes: The students will be able to

1. classify superconductors based on Meissner effect (L2)
2. explain BCS theory, Josephson effect and high T_C Superconductors (L2)
3. illustrate the basic preparation methods of nanomaterials (L2)
4. identify the applications of nanomaterials in various fields (L3)

Text Books:

1. M. N. Avadhanulu, P. G. Khirsagar, and T. V. S. Arun Murthy, *A textbook of Engineering Physics*, Revised edition (11edition), S. Chand and Company Ltd., 2019.
2. H. K. Malik and A. K. Singh, *Engineering Physics*, Second Edition, McGraw Hill Education PvtLtd., 2018.

Reference Books:

1. D. J.Griffiths, *Introduction to Electrodynamics*, 4th Edition, Pearson Education, 2014.
2. G. Keiser, *Optical Fiber Communications*, 4th Edition, Tata Mcgraw Hill, 2008.
3. C. Kittel, *Introduction to Solid State Physics*, Wiley Publications, 2011.
4. S. M. Sze, *Semiconductor devices-Physics and Technology*, Wiley, 2008.
5. T. Pradeep, *A Textbook of NanoScience and NanoTechnology*, Tata Mcgraw Hill, 2013.

Web References:

1. https://nptel.ac.in/courses/115/102/115102103/
2. https://nptel.ac.in/courses/115/106/115106122/
3. https://nptel.ac.in/courses/115/103/115103108/
4. https://nptel.ac.in/courses/115/107/115107095/
5. https://nptel.ac.in/courses/115/101/115101012/
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