MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHH 454: CONDENSED MATTER PHYSICS and ELECTRONICS

[52 hrs]

Course outcome

CO1 Student will have the knowledge of elements of crystallography and use of X-ray diffraction method in crystallography.

CO2 Student will gain the basic idea of band theory of solids and the need of band theory to understand

the properties of solids.

CO3 Students will gain the knowledge of phasors in the analysis of AC circuits. Have an

understanding on the use of Laplace and Fourier transforms in circuit analysis.

CO4 Acquire basic knowledge on bipolar and Field effect transistors, operational amplifier and digital electronics.

Unit I Elementary Crystallography and X-ray diffraction Elementary Crystallography**:** Concept of Crystallography, unit cell, primitive and non-primitive, base, Bravais lattice in two and three dimension, crystal structure, coordination numbers, Miller indices, Crystal structures of NaCl, CsCl, diamond, zinc blende and copper. Close packing system.

X ray diffraction**:** Scattering of X rays by an electron, by an atom and by a crystal. Atomic scattering factor, Bragg law. Geometric structure factor. Systematic absences. Reciprocal lattice - its properties, Ewald's sphere - its construction. Laue and powder experimental methods.

Lattice Vibration**:** Properties of lattice waves, chain of identical atoms and a diatomic linear chain, quantisation of lattice vibrations, phonon, phonon momentum, elastic scattering by phonon, phonon-phonon interaction, anharmonicity and thermal expansion, problems. [13 Hrs]

Unit II Free Electron Theory and Band Theory of Solid Free electron, Free electron in one dimensional potential well, three dimensional potential well, quantum state and degeneracy, density of states, Fermi Dirac Statistics and distribution with temperature, free electron theory of metals, Fermi energy above 0 K, Electronic

specific heat. Electrical conductivity of metal,. Relaxation time and mean free path, Wiedemann-Franz law. Failures of free electron model. Kronig-Penney mode and Effective mass.

Classification of solids - metal, semiconductors, insulators. intrinsic and extrinsic semiconductors. Carrier concentration in intrinsic semiconductors, impurity states-donor states, acdeptor states, thermal ionisation of donors and acceptors, temperature effects of mobility, Electrical conductivity of semiconductor. [13 Hrs]

Unit III Phasors and devices

Phasors - Phasor relations for R, L and C - Sinusoidal steady state response of a series RLC circuit. Fourier series - trigonometric form of Fourier series - complex form of Fourier series. Application of Fourier and Laplace transforms in circuit analysis. BJT, JFET and MOSFET devices. Voltage divider bias. Small signal analysis of BJT and FET amplifiers in CE/CS configuration. UJT characteristics and its use in a relaxation oscillator. SCR characteristics and its use in ac power control

[13 hrs]

Unit IV Operational amplifiers and Digital electronics

BJT differential amplifier. Operational amplifier - voltage/current feedback concepts (series & parallel). Inverting and noninverting configurations. Basic applications of opamps - comparator and Schmitt trigger. IC555 timer - monostable and astablemultivibrators. Crystal oscillator using opamp. Voltage regulators – three terminal and SIMPS Tristate devices. Decoders and encoders. Multiplexers and demultiplexers with applications. Digital to analog conversion with R/2R network. Analog to digital conversion using flash technique.

[13 hrs]

Text Books:

1. Hayt W H, Kemmerly J E & Durbin S M, 'Engineering Circuit Analysis', VI Edn. (McGraw-Hill, 2002).
2. Boylestad R L, 'Introductory Circuit Analysis', VIII Edn. (Prentice Hall, 1997)
3. Boylestad R L &Nashelsky L, 'Electronic Devices & Circuit Theory', VIII Edn. (Prentice Hall, 2002).
4. Floyd T L, 'Electronic Devices', V Edn. (Pearson Education Asia, 2001).
5. Gayakwad R A, 'Opamps and Linear Integrated Circuits', III Edn. (PHI, 1993).
6. Floyd T L, 'Digital Fundamentals', VII Edn. (Pearson Education Asia, 2002).
7. Cullity B D and Stock S R, 'Elements of X-ray diffraction', III Edn. (PH, 2001)
8. Ashcroft F W &Mermin N D, 'Solid State Physics' (Harcourt, 1976)
9. Verma A R and Srivastava O N, 'Crystallography Applied to Solid State Physics', II Edn. (New Age, 1991)
10. Kittel C, 'Introduction to Solid State Physics', IV Edn. (Wiley Eastern, 1974)

11. Cullity B D and Stock S R, 'Elements of X-ray diffraction', III Edn. (Prentice-Hall, 2001)
12. Ashcroft F W &Mermin N D, 'Solid State Physics' (Harcourt, 1976)
13. Verma A R and Srivastava O N, 'Crystallography Applied to Solid State Physics', II Edn. (New Age, 1991)
14. McKelvey J P 'Solid State and Semiconductor Physics' (Robert E. Kreiger, 1982)
15. Kittel C, 'Introduction to Solid State Physics', IV Edn. (Wiley Eastern, 1974)
16. Omar M A, 'Elementary Solid State Physics' (Addison Wesley, 1975)
17. Dekker A J, 'Solid State Physics' (Macmillan, 1971).
18. Singh J, 'Semiconductor Devices' (John Wiley, 2001)
19. M A Wahab " Solid State Physics" Narosa Publication, second edition 2005

Reference Books:

1. Alexander C K and Sadiku M N O, 'Fundamentals of Electric Circuits' (McGraw Hill International Edition, 2000)
2. Donald Neamen, 'Electronic Circuit Analysis and Design' II Edn. (Tata McGraw Hill, 2002)
3. Sedra A & Smith K C, 'Microelectronics', IV Edn. (Oxford University Press, India, 1998)
4. Horenstein M N, 'Microelectronic Circuits and Devices', II Edn. (PHI, 1996).