JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: V**

PHYSICS PAPER VI
ASTROPHYSICS, SOLID STATE PHYSICS AND SEMICONDUCTOR PHYSICS

Course Code: 18VPH6 **No. of Hours: 45**

COURSE OBJECTIVES:

- To learn Topics in the history of astronomy stars and their properties, stellar formation and brown dwarf objects.
- To develop basic knowledge of solid state physics and classical and quantum mechanical theories needed to understand the physical properties of solids and to learn how solid state theory is applied to describe physical behavior of solids and electronic devices.
- To give knowledge about semiconductor physics and discus working and applications of basic devices, including p-n junctions, LEDs and FETs.

LEARNING OUTCOMES:

- Students will be able to analyze the formation of our sun and other stars, their properties, and to interpret the information received from radiation from the stars. Also learn the process of stellar evolution to explain red giants, neutron stars, black holes, and white dwarf stars.
- Students will understand the origin of energy bands, and how they influence electronic behavior• and will be able to apply models to describe semiconductor devices
- They will have knowledge about the physics of semiconductor materials and will be able describe• the physical characteristics such as electronic structure and optical and transport properties, and current-voltage characteristics of semiconductors.

UNIT-I

ASTROPHYSICS

Parallax and distance: Helio-centric parallax, Definition of parsec (pc), Astronomical unit (AU), light year (ly) and their relations.

Luminosity of stars: Apparent brightness, Apparent magnitude - scale of Hipparchus. Absolute magnitude - distance - modulus relationship. Distinction between visual and bolometric magnitudes, Radius of a star. **03 HRS**

Stellar classification: Pickering classification and Yerke's luminosity classification. H-R diagram, Main sequence stars and their general characteristics.

Gravitational potential energy or self energy of a star based on the linear density model, Statement and explanation of Virial theorem.

Surface or effective temperature and color of a star : Wien's displacement law. Expressions for - average temperature, core temperature, hydrostatic equilibrium, core pressure of a star based on the linear density model of a star-(No derivation). Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star. **06 HRS**

Evolution of stars: Stages of star formation (GMC – Protostar- T-Tauri) and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion-

its types, Chandrasekhar limit. Event Horizon,Singularity,Schwarzchildradius(qualitative) **06 HRS**

UNIT-II

SOLID STATE PHYSICS

Crystal systems and X-rays: Crystal systems-Bravais lattice; Miller indices– Spacing between lattice planes of cubic crystals, Continuous and characteristic X-ray spectra; Moseley's law, Scattering of X-rays - Compton effect, Bragg's law. **06 HRS**

Free electron theory of metals : Electrical conductivity- classical theory (Drude-Lorentz model); Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons (with derivation); Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero(derivation). Hall Effect in metals **06 HRS**

Superconductivity : Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect, Type I and type II superconductors– BCS Theory (qualitative); Applications - SQUIDs. **03 HRS**

UNIT-III

SEMICONDUCTOR PHYSICS

Distinction between metals, semiconductors and insulators based on band theory. Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration(derivation for both holes and electrons) and electrical conductivity – extrinsic semiconductors – mention of expressions for carrier concentrations and conductivity – impurity states in energy band diagram and the Fermi level. Review-Formation of P-N junction. Drift and diffusion current –expression for diode current. **06 HRS**

Special Diodes: Zener diode – characteristics and its use as a voltage regulator. Photo diodes, Solar cells and LED (principle, working and applications). **04 HRS**

Transistors: Transistor action, Characteristics (CE mode), DC Biasing - Voltage divider bias, Load line analysis - operating Point, saturation-cut off . Transistor as an amplifier h-parameters and their use in CE amplifier analysis; current gain, voltage gain, input impedance and output impedance. **05 HRS**

REFERENCES :

1. Astronomy : Fundamentals and Frontiers – **Jastrow & Thompson,**

   John Wileyand Sons 4th Revised ed (**1984**)
2. Chandrashekhar and his limit – **G. Venkataraman,** University press, reprint (**1997**)
3. An introduction to Astrophysics – **Baidyanath Basu,** PHI 2nd ed (**2010**)
4. Astrophysics Concepts, ***M. Herwit***: John Wiley, (**1990**)**.**
5. Astrophysics. ***Krishnaswamy*** (ed)New Age Publishers,(**1996**)
6. Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
7. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (**2000**)
8. Elementary Solid State Physic, **J P Srivastava**,PHI,(**2008**)
9. Essential of crystallography**, M A Wahab**, Narosa Publications (**2009)**
10. Solid State Physics-**F W Ashcroft and A D Mermin**-Saunders College (**1976**)

11. Solid State Physics-**S O Pillai**-New Age Int. Publishers (**2001**)

PHYSICS PRACTICAL
PHYSICS – 5(B)

1. Parallax Method – Distance of objects using trigonometric parallax.
2. Analysis of stellar spectra.
3. Determination of temperature of a star (artificial) using filters.
4. Analysis of sunspot photographs & solar rotation period.
5. Mass luminosity curve – Estimation of mass of a star.
6. Mass of binary stars.
7. Resistivity of a material by four probe method.
8. Determination of Lorentz Number
9. Semiconductor temperature sensor.
10. Temperature coefficient of resistance and energy gap of thermistor.
11. LED characteristics and spectral response.
12. LDR characteristics – dark resistance – saturation resistance.
13. Solar cell characteristics – Open circuit voltage – short circuit current – efficiency.
14. Study of Hall effect in a metal.
15. Characteristics of LASER diode.
16. Spectral response of a photodiode and its I – V characteristics.
17. Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.
18. Determination of Fermi energy of a metal.
19. Determination of thermal conductivity of a metal by Forbe's method.
20. Measurement of heat capacity of metals.

Note: A minimum of EIGHT experiments must be performed.

REFERENCES :

1. IGNOU : Practical Physics Manual IGNOU publications
2. Saraf : Experiment in Physics Vikas publicatios
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics.
5. Misra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
6. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
7. Ramalingom & Raghuopalan : A Lab. Course in Electronics
8. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)
9. HR Diagram & the physiMisra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
10. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
11. Ramalingom & Raghuopalan : A Lab. Course in Electronics
12. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)cal properties of stars.