

St. Xavier's College – Autonomous Mumbai

Syllabus For 3<sup>rd</sup> Semester Courses in PHYSICS (June 2015 onwards)

Contents: Theory Syllabus for Courses: S.PHY.3.01 - **Physical and Quantum Optics** S.PHY.3.02 -**Relativity, Astronomy and Cosmology** S.PHY.3.03 - **Electronics** Practical Course Syllabus for: S. PHY.3. PR

### S.Y. B.Sc. PHYSICS

## Course: S.PHY.3.01

**Title: Physical and Quantum Optics** 

**Learning Objectives:** To understand the interaction of light with matter. **Number of lectures: 45** 

#### **<u>Unit I</u>:Interferometry and Resolving power 1.** Michelson Interferometer :

Principle, Construction, Working.Circular fringes, Localized fringes, White light Fringes, Visibility of Fringes.

Applications of Michelson Interferometer: a) Measurement of wavelength,

b)Determination of the difference in the wavelength of the two waves,c) Thickness of a thin transparent sheet, d) Standardization of the meter scale.

## 2.Fabry –Perot Interferometer &Etalon :

Formation of fringes, Determination of Wavelength, Measurement of difference in wavelength.

## 3.Resolving Power:-

Introduction, Rayleigh's criterion, Resolving Power of optical instruments, Criterion for resolution according to Lord Rayleigh, Resolving Power of a telescope, microscope, prism, plane transmission grating.

## **UnitII** :Diffraction

## 1. Fresnel's Diffraction:

Introduction, Huygens-Fresnel's theory, Fresnel's assumptions, Distinction between Interference and diffraction, Fresnel and Fraunhoffer diffractions, Diffraction due to straight edge,Position of maximum and minimum intensity, Intensity at a point inside a geometrical shadow, Diffraction due to narrow slit & due to narrow wire (qualitative), Diffraction at a circular aperture and qualitative discussion of opaque circular disc.

## 2.Fraunhoffer diffraction :

Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to single slit (Review), Fraunhoffer diffraction at a double slit, Distinction between single slit and double slit diffraction patterns, Plane diffraction grating, Theory of plane transmission grating, Width of principal maxima, Prism and grating spectra.

# <u>Unit III</u> :

## **1.**Polarization:

Introduction, Polarization by reflection, Polarization by double refraction, Malus' law Superposition of two disturbances, mathematical analysis, Phenomenon of double Refraction, Quarter wave plates and half wave plates. LCD , 3D TV.

## 2.Lasers:

Properties of Laser, Different types of Laser (History), Semiconductor GaAs Laser, Application of Lasers to Holography, DVDs, Laser printer .

## List Of Recommended Reference Books

A text book of Optics -Subramanyam, BrijLal,Avadhanulu

Fundamentals of Optics - Jenkins and White

- Lasers Avadhanalu
- Lasers Freeman, Sears & Zemanski
- Lasers Ghatak
- Optics Eugene Hecht

C.I.A.: Problem Solving / Multiple Choice Questions, Assignments, Presentations.

# (15 Lectures)

# (15 Lectures)

(15 Lectures)

## S.Y. B.Sc. PHYSICS

#### Course: S.PHY.3.02

# Title: Relativity, Astronomy and Cosmology Learning Objective:

1)To understand the concept of change in the paradigm: from Newtonian Mechanics to Relativistic Mechanics.

2)To understand physics of stellar astronomy and cosmology. **No. of Lectures:45** 

## **<u>Unit I</u>**: Special Theory of Relativity (15 Lectures)

The Michelson- Morley experiment, The Principle of Relativity, The Lorentz transformation, Transformation of time, The Lorentz contraction, Simultaneity, Four – vectors, Relativistic dynamics, Equivalence of mass and energy, Transformation of velocities, Relativistic mass, Relativistic energy, The twin paradox, Geometric representation of Space and Time. Ref: The Feynman Lectures on Physics Vol-I- R. P. Feynman, R.B Leighton, M. Sands Add. Ref: R. Resnick - Introduction to Special Theory of Relativity.

#### **Unit II: An Introduction to Stellar Astronomy**

#### (15 Lectures)

Basic Properties of a Star: The brightness of the star, Star colour, magnitude, Effective temp of a star, its size, mass, and luminosity.

Internal Structure of a star: The Hydrostatic Equilibrium, The Radiative transfer, The Thermal Equilibrium, Energy Generation in Stars, The Sun as a Star.

**Evolution of Stars** 

Proto stars, The Main Sequence (HR Diagrams), End stages of a star: White Dwarf, Neutron Stars and Black Holes.

Ref: The Physical Universe, An Introduction to Astrophysics by Frank Shu,

Introduction to Stellar Astrophysics: Volume 1 and 3, By Erika Bohm-Vitense, Cambridge University Press.

Additional References: Website of NASA, Wikipedia and other sources on the internet.

#### <u>Unit</u> III: Cosmology

#### (15 Lectures)

The large scale structure of the Universe, Types of galaxies, Radiation background, Doppler shift of galaxies and the Hubble's Law, The expanding Universe.

From Relativity to cosmology, Newtonian Cosmology, Weyl's Postulates, Cosmological Principal, Red Shift, Introduction to cosmological models.

The Big Bang Hypothesis: Relics of the big bang, Inflation, Radiation dominated universe, matter versus radiation, neutrino decoupling of neutrinos, Synthesis of light nuclei, Microwave background, The Dark Matter.

Ref: An Introduction to Cosmology, By J. V. Narlikar, Cambridge University Press.

Elements of Cosmology: By J. V. Narlikar, Cambridge University Press.

Additional References: Website of NASA, Wikipedia and other sources on the internet.

## C.I.A.: Problem Solving / Multiple Choice Questions, Assignments, Presentations.

#### S.Y. B.Sc. PHYSICS

**Title: Electronics** Learning Objectives: Understandingworking of basic electronic gadgets. **Number of Lectures: 45** 

### **<u>UNIT I</u>: Analog Electronics**

**1.Transistor in CE mode:**Review of CE configuration, load line, operating point, Transistor biasing ,dc& ac analysis, load line, Inherent variations of transistor parameters, Essentials of transistor biasing circuits , stability factor, Various methods of transistor biasing, Silicon versus Germanium.

## 2.General Amplifier Characteristics :

Concept of Amplification, Amplifier notations, Current gain, Voltage gain, Power gain, Input and Output resistance, Frequency Response, Decibels. Classification of Amplifiers Class A, B, AB, C and Push-pull

### **Unit II** :OPAMPs and linear circuits

## 1. Feedback and its applications.

Introduction to feedback:Positive and negative feedback, Oscillators (loop gain, Barkhausen Criterion ) Collpitts Oscillator, Wein Bridge Oscillator, RC Phase Shift Oscillator .

# 2. Differential Amplifier and OP AMP

Differential Amplifier, Introduction to OP AMP, Inverting mode, Non inverting mode, Voltage Follower mode, OP AMP with positive feedback: comparator, square wave generator.

## **<u>Unit III</u>: Digital Electronics**

## 1. Number System:

Binary Arithmetic: Addition and subtraction using 2's complement Half adder and Full adder

## 2. Logic circuits

Implementation ofLogic circuit from truth tables, Sum of Product method, Product of sum method.

## 3. Flip Flops and their Applications

Flip Flops and Counters, R-S flip flop, Clocked R- S flip flop, D flip flop, Edge triggered J-K flip flop, Master Slave flip flop, T flip flop, 4-bit binary ripple counter (up - down mode)

Shift Register : Serial in Serial out , Serial in Parallel out , Parallel in Serial out, Parallel in Parallel out and Universal.

## List Of Recommended Reference Books

- 1. Digital Principles and Aplications (4<sup>th</sup> Ed) Malvino and Leach
- 2. Modern Digital Electronics R.P. Jain
- 3. OPAMP and Applications RamakantGayakwad.
- 4. Operational amplifiers and Linear integrated Circuits -Coughlin and Driscoll
- 5. Electronics Devices and Circuits Allan Mottershead
- 6. A text book of electronics SantanuChattopadhyay
- 7. Electonic Principles -7<sup>th</sup> Edition A.P.Malvino
- 8. Electronics devices and circuit theory Boylestad ,Nashelsky

## C.I.A.: Problem Solving / Multiple Choice Questions, Assignments, Presentations.

# (15 Lectures)

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Course: S.PHY.3.03

## Practicals S.Y. B.Sc. PHYSICS COURSE : S.PHY.3.PR

#### Group I

- 1) Constant Volume Air Thermometer.
- 2) Thermocouple
- 3) 'J' by Electrical Method.
- 4) Bifilar pendulum
- 5) Y- By Koenig's Method

### **Group II**

- 1) Optical lever: Determination of  $\mu$ .
- 2) Determination of Cauchy's constants.
- 3) Cylindrical obstacle Determination of  $\lambda$ .
- 4) Resolving Power of Telescope.
- 5) Diffraction Grating: Determination of  $\lambda$ .

### Group –III

- 1) CE Amplifier: DC load line, AC load Line.
- 2) CE Amplifier: Determination of Bandwidth, Variation of Gain with Load.
- 3) CE Amplifier:  $R_i$  and  $R_o$ .
- 4) Collpitts' Oscillator.
- 5) OP AMP: Inverting Amplifier, Non inverting Amplifier, Voltage Follower.

#### **Demonstration Experiments:**

- 1) Proto-lab.
- 2) Optical fiber communications.
- 3) Diffraction experiments with Laser.

#### **Skill Experiments:**

- 1) Component testing
- 2) Spectrometer- Schuster's method.
- 3) Transistor as a switch.

## **REFERENCES:**

- 1. Advanced Practical Physics Worsnop & Flint .
- 2. Advanced course in Practical Physics D. Chattopadhyay, P.C. Rakshit & B. Saha.
- 3. B.Sc. Practical Physics C.L. Arora

NOTE: Minimum Four experiments from each group, two demos and all the skills have to be performed per semester and written in journal to appear for the practical examination.