St. Xavier’s College – Autonomous
Mumbai

Syllabus
For 3rd 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  

Title: Physical and Quantum Optics  

Course: S.PHY.3.01  

Learning Objectives: To understand the interaction of light with matter.  

Number of lectures: 45  

Unit I: Interferometry and Resolving power  

(15 Lectures)  

1. Michelson Interferometer:  
   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.  

Unit II: Diffraction  

(15 Lectures)  

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.  

Unit III:  

(15 Lectures)  

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, Brij Lal, 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.
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  

Unit I: Special Theory of Relativity (15 Lectures)  

Ref: The Feynman Lectures on Physics Vol-I - R. P. Feynman, R.B Leighton, M. Sands  

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.  
Evolution of Stars  

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

C.I.A.: Problem Solving / Multiple Choice Questions, Assignments, Presentations.
S.Y. B.Sc. PHYSICS

Course: S.PHY.3.03

Title: Electronics

Learning Objectives: Understanding working of basic electronic gadgets.

Number of Lectures: 45

UNIT I: Analog Electronics (15 Lectures)

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 (15 Lectures)

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.

UNIT III: Digital Electronics (15 Lectures)

1. Number System:
   - Binary Arithmetic: Addition and subtraction using 2’s complement
   - Half adder and Full adder

2. Logic circuits
   - Implementation of Logic 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 Applications (4th Ed) - Malvino and Leach
2. Modern Digital Electronics - R.P. Jain
3. OPAMP and Applications - Ramakant Gayakwad.
4. Operational amplifiers and Linear integrated Circuits - Coughlin and Driscoll
5. Electronics Devices and Circuits - Allan Mottershead
6. A text book of electronics - Santanu Chattopadhyay
8. Electronics devices and circuit theory - Boylestad, Nashelsky

C.I.A.: Problem Solving / Multiple Choice Questions, Assignments, Presentations.
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 µ.
2) Determination of Cauchy’s constants.
3) Cylindrical obstacle – Determination of λ.
4) Resolving Power of Telescope.
5) Diffraction Grating: Determination of λ.

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:
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.