ST.JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

VIII SEMESTER **PHYSICS** TIME:3Hrs/week
PH8405(4) **MODERN OPTICS (Skill Oriented)** Max.Marks:100
w.e.f. 20AH Batch **SYLLABUS**

Course Objectives:

- *To provide students with the knowledge of the interaction of radiation with matter, working principles of lasers and their applications, non-linear optics, holography, Fourier optics, fiber optics, and their applications in modern optics.*

Course Outcomes:

- *Upon the successful completion of the course, students will be able to:*
- *CO1: Explain the interaction of radiation with matter through time-dependent perturbation theory, Quantum electrodynamics, and creation and annihilation operators.*
- *CO2: Describe various concepts of lasers, threshold conditions for laser oscillation, working of various lasers and applications.*
- *CO3: Outline basic principles of non-linear optics, optical mixing, and self-focusing of light guided wave optics and pulse compression.*
- *CO4: Discuss recording and reconstruction of holograms, basics of Fourier optics, and Fraunhofer diffraction.*
- *CO5: Summarize the principles, modes and configuration of optical fibers, fiber materials and fabrication, properties, and applications of optical fibers in communication and medicine.*

SYLLABUS

UNIT– I: Interaction of Radiation with Matter **8Hrs**

Time dependent Perturbation Theory, Electric Dipole interaction-Quantum electrodynamics, - creation and annihilation operators- Fock states-Quantation of the field-Zero Point Energy- Coherent-state description of the electromagnetic field-interaction of radiation with matter.

UNIT–II: Lasers **7 Hrs**

Introduction to lasers – Spontaneous and stimulated emission – Laser beam properties – Einstein coefficients – Population inversion – Pumping schemes – Losses in laser radiation – Threshold condition for laser oscillation – Laser cavity - Q factor– different experimental methods – Ruby laser- He-Ne laser– Argon ion laser– CO2 laser–Laser applications.

UNIT-III: Non-Linear Optics **7 Hrs**

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation–Phase matching condition–Third harmonic generation– Optical mixing–Parametric generation of light – Parametric light oscillator – Frequency up conversion – Self focusing of light–Guided wave optics-Pulse compression -Optical solutions.

UNIT–IV: Holography and Fourier Optics **8Hrs**

Introduction to Holography- Recording and reconstruction of Hologram– Speckle pattern–Frenel and Fourier transform Holography– Applications of Holography- Introduction to Fourier optics – Two-dimensional Fourier transforms – Transforms of Dirac-delta function- Fraunhouffer diffraction

UNIT–V: Fiber Optics **8 Hrs**

Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication – Mechanical properties of fibers – Attenuation - Erbium doped fiber amplifiers – Solitons in optical fibers - Block diagram of fiber optic communication system –Applications of optical fibers in communication and medicine.

List of Activities:

1. Assignments
2. Student Seminars
3. Applications related to theory

Recommended Books

1. Lasers and Non-Linear Optics, B. B. Laud, Wiley Eastern Ltd.,1983
2. Optics,E.Hecht,AddisonWiley,1974

3. Laser Fundamentals –By William T. Silfvast. , Cambridge University Press

Reference Books

1. Introduction to Modern Optics, G.R. Fowels,2012

2. LasersandtheirApplications,M.J.Beesly,TaylorandFrancis,1976

3. Optical Fiber Communications,G.Keiser,McGrawHillBook,2000

4. Optical Physics by Stephen G Lipson, Ariel Lipson, Henry Lipson, Cambridge University Press