INTERNSHIP PROGRAMME FOR UG DEGREE (SEMESTER-V)

(For the students admitted under New Curriculum and Credit Framework from the academic session 2023-24)

Course Title: Soliton-Based Fiber Optic Communication	
Internship Providing Organization (IPO):	**Department of Physics Bankura Sammilani College**
Category of Course:	**For UG DEGREE (SEM-V)**
Duration:	**60 Hours**
Course Coordinator and Contact Details:	**Mr. Chakradhar Rajowar Mob: 7797123239**
Mentors:	**Mr. Uttam Mandal Dr. Priyam Das Dr. Pradipta Chakraborty Mr. Narendranath Pal Mr. Surajit Bosu**
Intake Capacity:	**25 Students**
Course Fees:	**Rs. 100/- (Students from Host Institution) Rs. 400/- (Students from Other Institution)**

SYLLABUS

Course Title: Soliton-Based Fiber Optic Communication [50 Marks/2 Credits/60 Hours]

Learning Outcomes (LO)

- Understand the fundamental principles of soliton formation
- Analyze the role of dispersion and nonlinearity in optical fiber systems
- Model and simulate soliton pulse dynamics
- Design soliton-based communication systems
- Assess practical challenges in soliton communication
- Implement dispersion and loss management techniques
- Explore advanced soliton concepts and current research trends
- Critically evaluate research literature in nonlinear fiber optics

Unit -1: Introduction to Optical Fiber Communication **[5 hours]**

- Overview of optical fiber systems
- History and evolution of fiber optic communication
- Advantages and limitations
- System components: Transmitters, fibers, receivers, amplifiers

Unit -2: Fundamentals of Nonlinear Optics **[10 hours]**

- Linear vs nonlinear effects in fibers
- Self-phase modulation (SPM)
- Cross-phase modulation (XPM)
- Four-wave mixing (FWM)
- Raman and Brillouin scattering

Unit-3: Pulse Propagation in Optical Fibers **[5 hours]**

- Group velocity dispersion (GVD)
- Dispersion length and nonlinear length
- Combined effects of dispersion and nonlinearity

Unit-4: Optical Solitons – Basics **[5 hours]**

- Soliton concept and history
- Derivation of Nonlinear Schrödinger Equation (NLSE)
- Fundamental solitons and higher-order solitons
- Soliton solutions of the NLSE

Unit-5: Soliton Propagation in Optical Fibers **[5 hours]**

- Conditions for soliton propagation
- Role of dispersion and nonlinearity balance

- Soliton self-frequency shift
- Soliton collisions and interactions

Unit-6: Soliton in Communication Systems [20 hours]

- Soliton generation techniques,
- Soliton-based system architectures
- Bit rate limitations and time-division multiplexing
- Optical amplifiers and loss management
- Dispersion management and sliding-frequency guiding filters
- Amplifier noise and timing jitter (Gordon-Haus effect)
- Polarization mode dispersion
- Soliton-soliton interactions
- Effects of fiber non-idealities
- Dark solitons vs bright solitons
- Dissipative solitons
- Chirped solitons

Hands-on-training/Assignment/ Problem solving skills [10 hours]

Textbooks and References:

- G. P. Agrawal, *Nonlinear Fiber Optics*, 6th Edition, Academic Press.
- Govind P. Agrawal, *Applications of Nonlinear Fiber Optics*
- Linn F. Mollenauer & James P. Gordon, *Solitons in Optical Fibers: Fundamentals and Applications*
- A. Hasegawa & M. Matsumoto, *Optical Solitons in Fibers*