Devi Ahilya University, Indore, India Institute of Engineering & Technology				**IV Year B.E. (Electronics & Instrumentation Engg.)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
8EIRC3	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
OPTICAL INSTRUMENTATION	**3**	**1**	**0**	**3**	**1**	**0**	**4**
Duration of Theory Paper: 3 Hours							

Course Objective:

The course is designed:

1 To demonstrate fiber fabrication methods, principle of light energy propagation, signal attenuation and dispersion effects in optical fiber.

2 To identify the types of optical sources, coupling and optical receivers in fiber optic sensor system.

3 To build an optical sensing system for measurement of different parameters using different types of optical fibers.

4 To develop distributed sensing system using Bragg grating, back scatter and forward scatter method, and sensing system with special optical techniques.

Prerequisites: Basic knowledge of electromagnetic theory

COURSE CONTENTS

Unit I

Introduction to optical fiber communication system, Advantages of optical fiber communication over conventional electrical communication, review of optical fiber fundamentals, ray theory transmission, electromagnetic mode theory for optical propagation in optical waveguides, Types of optical fibers: step index fibers, graded index fibers, single mode fibers etc., polarization maintaining fibers, cut off wavelength.

Unit II

Transmission characteristics: fiber attenuation, absorption and scattering losses, fiber bend loss, fiber dispersion, intermodal and intra-modal dispersion, overall fiber dispersion, dispersion shifted fibers, dispersion flattened fibers, Wavelength division multiplexing.

Unit III

Optical sources: Lasers and LEDs: basic concepts, injection laser, characteristics, temperature dependence, dynamic response, noise, reliability, Optical detection

principle, absorption, quantum efficiency, responsivity, large wavelength cut off, pin photodiode, avalanche photodiode, receiver: basic concepts and types of noise, basic concepts of optical networking and devices.

Unit IV

Fiber Optic Sensors: Basics of Optical fiber as sensing device, its advantages/disadvantages vis a vis other sensors, classification of fiber sensors, intensity, phase, frequency, wavelength modulated sensors, measurement of temperature, pressure, liquid level, displacement, flow, electric and magnetic fields.

Unit V

Characteristics of lasers, concepts of coherence, coherence length, directionality, application of laser in metrology: measurement of length, displacement, deformation, angle, profile, laser doppler and particle velocimetry, holography, Non-destructive testing using holography, Optical coherence tomography: biomedical applications.

Course Outcome:

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Describe the fundamental principles of light, wave optics, and how they apply to optical instruments.	PO-1,PO-2,PO-3 PO-4
CO2	Identify and explain the working principles and components of various optical instruments such as microscopes, telescopes, spectroscopes, and interferometers.	PO-1,PO-2,PO-3, PO-4, PO-5
CO3	Perform experiments using optical instruments, measure key parameters (e.g., focal length, resolution, refractive index), and analyze the experimental data.	PO-1,PO-2,PO-3, PO-4, PO-5
CO4	Apply knowledge of optical principles to solve engineering problems related to system design, measurement, and error analysis in optical instrumentation.	PO-1,PO-2,PO-3, PO-4, PO-5 PO-6
CO5	Select appropriate optical instruments and techniques for specific industrial or research applications and understand their	PO-1,PO-2,PO-3, PO-4, PO-5, PO-6,

	limitations.	PO-7

CO-PO Relationship

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	3	2	1	1								
CO2	3	2	2	2	1							
CO3	2	3	2	3	2							
CO4	3	3	3	2	2	1						
CO5	2	2	2	2	2	2	1					

BOOKS RECOMMENDED:

[1] John M Senior, Optical fiber Communication: Principles and Practice, Pearson Education -2006

[2] Gerd Keiser, Optical fiber communication, Fifth Edition McGraw Hill Education (India), 2013

[3] Eugene Hecht and A.R. Ganesan, Optics, Pearson Education, Twelfth Impression 2013

[4] Optical Metrology, Gasvik, John Wiley & Sons, Ltd, 2003

[5] Digital Holography, Jun-chang Li, Pascal Picart, John Wiley & Sons, Ltd, 2013

[6] Handbook of Fiber optics: Theory and applications, Chai Yeh, Academic Press