Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NPHD507	Optics and Optical Instrumentation	3	0	0	3

Prerequisite: Electricity and Magnetism

Course Objective

To teach students about basics of Optical devices and applications of optical tools in imaging, interferometry, phase measuring techniques and uses of laser in speckle based measurements and HOEs.

Learning Outcomes

After attending this course, students will learn the following different type of prisms, detectors and their uses, different types of imaging systems, interferometric based measurements and their uses in testing optical components and Holography and hololens & holomirror.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Modern Optical Elements-Imaging by Lenses of varying diameters, thick and thin lenses, overview of optical aberrations produced by lenses, GRIN lenses, Blazed and Ronchi Grating, Different types of Prisms-Right Angle, Porro, Dove Prism, Penta Prism, Constant deviation prisms - Abbe and Pellin-Broca Prism	9	This will familiarize students mainly about thick lenses and imaging applications of prisms.
2	Optoelectronic devices-Detectors, Thermal and Quantum detectors, Efficiency, Different types of Thermal and Quantum detectors, Photodiodes, PMT, Electro- and acusto-optic effects and modulators, Charge Couple Device (CCD) and Complementary Metal-Oxide Semiconductor (CMOS) device	7	This unit will help students in understanding basics behind Detectors, Modulators and CCD/CMOS camera.
3	Specialized Interferometry-Interferometer principles, Path different introduced by thin film, Young's fringes, Newton, Michelson and Twyman-Green Interferometer and their applications, lateral shearing interferometer, Radial, rotational and reversal shear interferometer, Multi-beam, multi-pass and multi-wavelength interferometer and their applications, Common path interferometer.	9	This will help students to understand starting from classical interferometry to nearly a dozen of different interferometric techniques and their applications including Michelson and Fabry-Perot interferometer.
4	Phase measuring Techniques-Temporal and spatial phase shifting using Phase shifting Interferometry (PSI), Advantages and disadvantages of PSI over conventional interferometry, Fast Fourier Transform	3	This will highlight how to measure phase variation using interferometry.
5	Imaging Systems-Ordinary Microscopy and their limitation for use in study of biological specimen, BF, DF and PL-Microscopy, Interference microscopy- Differential Interference Contrast (DIC) its pros and cons, Photoluminiscence-Fluorescence and Phosphorescence, emission and absorption spectra, measurement of fluorescence using fluorimeter and spectrofluorometer, confocal microscopy	7	Through this part, students will learn different types of microscopes and their uses, basics of Fluorescence and Phosphorescence with confocal microscopy.
6	Basics of Holography and its applications in recording different types of holograms, Speckle and its use in speckle photography and speckle shearing interferometry, Holographic Optical Element (HOE)-Hololens and holomirror, Computer generated hologram (CGH).	7	This unit highlights about 3D photography i.e. holography and speckle based measurements apart from the basics of HOEs.
	Total	**42**	

Text Books:

1 Optical Shop Testing; D. Malakara, Wiley and Sons Inc., 2007.
2 Optics and Optical Instrumentations; B.K. Johnson, Dover Publications Inc., 2003.
3 Principles of Optics; M. Born and E. Wolf; Cambridge University Press, 1999.
4 Optical Metrology, Kjell J. Gåsvik, John Wiley and Sons Ltd., 2002.

Reference Books:

1 Fundamental of Optics, Jenkins and White, 2001.
2 Optics, A. Ghatak, Tata McGraw Hill, 2005.
3 Optics, E. Hecht, Addison-Wesley, 2001.
4 Introduction to Applied Optics, P. Banerjee and T.C. Poon, CRC Press, 2003.
5 Fourier Optics, J. W. Goodman, Viva Books Pvt. Ltd., New Delhi, 2007.
6 Modern Optical Engineering, W.J. Smith, McGraw-Hill, 1966.
7 Fundamental of Photonics, B. E. A. Saleh, M. C. Teich, Wiley, 2007.
8 Elements of Modern Optical Design, Donal C O 'Shea, Wiley Interscience, 1985.

9 Advanced Light Microscopy, Vols. 1-2, M. Pluta, Elsevier, 1988