INDIAN INSTITUTE OF INFORMATION
TECHNOLOGY DESIGN AND MANUFACTURING
(IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

<table>
<tr><td>Course Title</td><td>Introduction to Biomedical Optics</td><td>Course Code</td><td colspan="4"></td></tr>
<tr><td>Dept./ Specialization</td><td>Science and Humanities</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>To be offered for</td><td>UG, PG/DD and PhD</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ▬</td></tr>
<tr><td>Faculty Proposing the course</td><td>Dr. Pal Uttam Mrinal</td><td>Type</td><td colspan="2">New ▬</td><td colspan="2">Modification</td></tr>
<tr><td colspan="2">Recommendation from the DAC</td><td>Date of DAC</td><td colspan="4"></td></tr>
<tr><td>External Expert(s)</td><td colspan="6">1) Dr. Arun K. Thittai, Department of Applied Mechanics, Biomedical Group, Indian Institute of Technology Madras
2) Dr. Hari Varma, Department of Biosciences and Bioengineering, Indian Institute of Technology Bombay</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="2">48th Senate</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The key objectives of this course are to:
▪ Detailed understanding on optics fundamentals, light-tissue interaction, molecular spectroscopy.
▪ Understand phenomena such as scattering, absorption, fluorescence, and polarization, and how these properties can be utilized in biomedical diagnostics and imaging.
▪ Learn photon transport equation in turbid media, diffusion theory approximation, and Monte Carlo methods for solving inverse problems. Different configurations of near- infrared spectroscopy, such as continuous wave, frequency domain, and time-domain.
▪ Provide hands-on experience in optical instrumentation and characterization of optical tissue phantom that mimics optical properties of biological tissues.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">On successful completion of the course, the student will be able to:
▪ Acquire fundamental understanding of the optical instruments (optical components, source, and detectors).
▪ Analyze the underlying mathematical model of the light-tissue interaction and the optical techniques to quantify tissue physiological attributes.
▪ Design and analyze optical systems and its instrumentation to apply in the field of biomedical engineering.
▪ Perform the experiment, acquire data, and interpret the parameters related to light- tissue interaction.
▪ Independently develop optical phantom tissue, perform the optical experiment, acquire data, and troubleshoot practical problems related to light-tissue interaction.</td></tr>
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*** See rationale at the end Contents of the course *(With approximate break-up of hours for L/T/P)*	**Module 1: Physics of Biomedical Optics (L8+P2)**: Introduction to Wave Optics, Fundamentals of Spectroscopy, Light Sources: Working principle of LASERs and LEDs. **Module 2: Light-Tissue Interaction (L8+P4)**: Scattering Theory: Rayleigh and Mie Scattering. Absorption Theory using Beer Lambert and Modified Beer Lambert Law. **Module 3: Light Transport Theory in Turbid Media (L8+P2)**: Boltzmann transport equation and Light Transport Modeling and Simulation **Module 4: Optical Instrumentation and Fabrication (L10+P4):** Fabrication using Optical Lithography process. Experimental methods and instrumentation for continuous-wave, frequency-domain, and time-domain tissue spectroscopy. Diffused reflectance and Doppler spectroscopy. Working principal of Light Detectors and Fiber optics **Module 5**: **Experimental Methods and Multimodal Imaging Techniques (L8+P2)**: Forward and inverse method for diffuse optical imaging and tomography. Multimodal Imaging Techniques such as Opto-acoustics, opto-thermo, and opto-thermo-acoustic (OTA) modality.
Textbooks	1. "Quantitative Biomedical Optics Theory, Methods, and Applications", Irving J. Bigio and Sergio Fantini, Cambridge Texts in Biomedical Engineering (2016). 2. "Biomedical Optics: Principles and Imaging" Lihong V. Wang and Hsin-i Wu, Wiley (2007).
Reference Books	1. "An Introduction to Biomedical Optics" Robert Splinter and Brett A. Hooper, CR Press (2007). 2. "Tissue Optics: Light Scattering Methods and Instruments for Medical Diagnosis" Valery Tuchin, SPIE press book (2006).