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

INTRODUCTION OF NEW COURSE

<table>
<tr><td>Course Title</td><td colspan="2">Advanced Functional Material Devices</td><td>Course Code
(will be assigned)</td><td colspan="4">PHY5XXX</td></tr>
<tr><td>Dept./ Specialization</td><td colspan="2">Physics</td><td>Structure (LTPC)</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>To be offered for</td><td colspan="2">PG/PhD</td><td>Status</td><td colspan="2">Core ☒</td><td colspan="2">Elective ▣</td></tr>
<tr><td>Faculty Proposing the Course</td><td colspan="2">Dr. Sadhu Sai Pavan Prashanth</td><td>Type</td><td colspan="2">New ▣</td><td colspan="2">Modification ☒</td></tr>
<tr><td colspan="3">Recommendation from the DAC</td><td>Date of DAC</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>External Expert(s)</td><td colspan="7">Prof. K. Sethupathi, IIT Madras and Prof. Anbarasu M., IIT Madras.</td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Consent of the Teacher (COT)</td><td>Submitted for Approval</td><td colspan="4"></td></tr>
<tr><td>Learning Objectives</td><td colspan="7">This course focuses on the fundamental physical principles and device concepts pertaining to multifunctional materials with special emphasis on ferroic material systems and their relevance in sensors, actuators, transducers, energy harvesting and energy storage devices.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="7">The student will get familiarized with the processing strategies, property measurement techniques, device design architectures and operational conditions of multifunctional materials. This course also equips the students to design/simulate, fabricate and test the engineering devices based on functional materials.</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="7">General Overview of Functional Materials (8Hrs):
Brief introduction, Structural aspects, Symmetry requirements, Neumann’s principle, Anisotropy and Tensor nature of physical properties, Structure-property correlations. (L6+T2)
Fundamentals of Multifunctional Materials: Origins, Modelling and Effects (10Hrs)
Microscopic origins of Multifunctionality, Heckmann diagram, Coupled order parameters; Thermodynamic relationships, Mathematical framework and Phenomenological models; Electro-magneto-optical coupling effects (L8+T2)
Functional Ferroics: Properties, Figures of Merit and Measurement Techniques (10Hrs)
Classification of ferroic materials and Venn diagram; Piezoelectrics, Pyroelectrics and Ferroelectrics: Phenomena, Properties, Characterization and Application specific figures of merit; Ferromagnetic materials, Multiferroic order, Magnetoelectric and Magneto-dielectric coupling in ferroics. (L7+T3)
Material Configurations and Processing Strategies (10Hrs)
Single crystal, Nano, Bulk and Thin film configurations; Oriented grain growth, Textured ceramics; Multiphase composites, Multilayer heterostructures and Superlattices; Single crystal growth techniques, Physical and Chemical methods, Thin-film growth techniques. (L8+T2)
Applications of Functional materials and their relevance for Robotics, AI and IoT (14Hrs)
Ultrasonic sensors and transducers, Infrared sensors, Thermal imaging and Night-vision, Piezoelectric and Pyroelectric energy harvesting, Biomedical applications, Ferroelectric energy storage, memory and logic devices, Electro-optic devices, Magnetoelectric sensors and tunable RF/Microwave devices. (L10+T4)</td></tr>
<tr><td>Text Books</td><td colspan="7">1. Properties of Materials: Anisotropy, Symmetry, Structure, Newnham, R.E., Oxford University Press Inc., 2005.
2. Ferroelectric Devices, Kenji Uchino, CRC Press, Taylor and Francis Group, 2nd ed., 2010.</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. Ferroic Materials for Smart Systems: From Fundamentals to Device Applications, Jiyan Dai, John Wiley and Sons, 2020.
2. Ferroelectrics: Principles and Applications, A. K. Bain and Prem Chand, John Wiley and Sons, 2017.
3. Introduction to Ferroic Materials, Vinod Wadhawan, CRC Press, 2000.</td></tr>
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