

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

INTRODUCTION OF NEW COURSE

Course Title	<b>Materials Science in Energy Technology</b>	Course No	<b>PHY5XXX</b>			
Specialization	Materials Science	Structure (LTPC)	3	0	0	3
To be offered for	UG / PG / Ph.D.	Status	Core <input type="checkbox"/>		Elective <input checked="" type="checkbox"/>	
Faculty Proposing the course	Dr. Anushree P Khandale	Type	New <input checked="" type="checkbox"/>		Modification <input type="checkbox"/>	
Date of DAC	05/09/2018	Members Present	All Faculty Members of the Dept.			
Pre-requisite	None	Submitted for approval	<b>38<sup>th</sup> Senate</b>			
Learning Objectives	<ul style="list-style-type: none"> <li>To acquaint with fundamental properties of materials relevant to energy technology.</li> <li>To understand behavior of Solids using solid-state physics/chemistry for the development of new functional materials in areas such as energy, catalysis and electronic materials.</li> <li>To use expertise in materials science to solve energy related problems and to bring the product into realization.</li> </ul>					
Learning Outcomes	<ul style="list-style-type: none"> <li>This course will help students to understand materials aspects of energy production, conversion and storage.</li> <li>The fundamental knowledge can be used to upgrade the current energy devices in terms of efficiency.</li> </ul>					
Contents of the course (With approximate break-up of hours)	<p><b>Diffusion in solids:</b> Fick's laws and solutions, Kirkendall effect, diffusion, temperature dependence, self-diffusion, interstitial diffusion, the Snoek effect in diffusion, diffusion in ionic crystals, diffusion path, thermal vibrations and activation energy. (8)</p> <p><b>Solid State Ionics:</b> Definition, classification and characteristic properties of solid electrolytes. Complex impedance spectroscopy, Arrhenius theory (5)</p> <p><b>Chemical sensors:</b> Nernst equation, potentiometer and amperometric sensors for various gases, electrochemical redox-reaction, advantages of electrochemical sensors. (5)</p> <p><b>Solid-state energy devices:</b> Background, Primary and secondary solid-state cells, advantages of lithium batteries, ion intercalation compounds for secondary cell, open circuit voltage and short circuit current, Energy density, power density. (8)</p> <p><b>Fuel cells/Electrolysers:</b> Advantages and disadvantages, classification, efficiency, emf, hydrogen/oxygen and reversible (electrolysis) fuel cells, criteria for selection of electrode and electrolyte, other fuel cells such as methanol, solid oxide, phosphoric acid, molten carbonate, proton exchange membrane and biochemical fuel cells. (8)</p> <p><b>Hydrogen storage materials:</b> Brief discussion of various storage processes, special features of solid-state hydrogen storage materials, structural and electronic characteristics of storage materials, metal hydrides - types of hydrides - evaluation of hydrogen storage capacity - potential applications. (8)</p>					
Text Books	<ol style="list-style-type: none"> <li>Materials Science and Engineering: A first course, Sixth edition (April 2015), V. Raghavan, ISBN-978-81-203-5092-2.</li> <li>Solid-State Chemistry and its applications, 2<sup>nd</sup> Edition, Anthony R West, John Wiley &amp; Sons, (Mar 2014) ISBN- 978-1-119-94294-8</li> </ol>					
Reference Books	<ol style="list-style-type: none"> <li>Chemistry of Advance Materials-An overview, Leonard V. Interrante and Mark J. Hampden-Smith (Ed) Wiley-VCH,1998, Digitized 2007, ISBN-0471185906, 978047118590.</li> <li>New Directions in Solid State Chemistry, C.N.R Rao and J. Gopalkrishnan, Cambridge University Press, Cambridge, (1997) ISBN- 0 521 49559 8.</li> <li>Materials Science in Energy Technology, G. G. Libowitz and M. S. Whittingham, Academic Press, INC.London (1979) ISBN 978-0-12-447550-2</li> <li>Electrochemistry, Carl H. Hamann, Andrew Hamnett, and Wolf Veilstich, Wiley VCH Verlag GmbH and Co KGaA (2007) ISBN-978-3-527-31069-2</li> <li>Fuel Cells - A. Mcdougall, Macmillan, (1976) Ch 3,5,7,8 and 11.</li> </ol>					