

PHOTOCATALYSIS – ADVANCEMENT AND APPLICATIONS ESE-907

Background

1. Give brief rundown of the existing program.
 - a. Photo catalysis now days have key importance for chemical processes, from the academic research lab through the industrial large-scale reactor to the essence of life.
 - b. The importance of photo catalysis as a key technology in energy production, in chemical and petrochemical industry and for the protection of the environment.
 - c. The course of “Photo catalysis-Advancement and Applications” will emphasis the important principles and methods of photo catalysis for energy production.

Rationale

2. Rationale for offering/launching the new course.
 - a. It is essential to produce scientists who will make significant contributions in the field of application of photo catalyst for energy production.
 - b. To design and develop efficient, stable and active photo catalyst for energy systems.

Educational Objectives

3. Objectives of the program under which the proposed course will be conducted.
The objectives of this Photo catalysis-Advancement and Applications course are:
 - a. To understand the fundamentals of photo catalysis
 - b. To discuss on the advantages and disadvantages of photo catalysis
 - c. To discuss methods of photo catalysts preparation
 - d. Design of practical photo catalytic reaction systems
 - e. To evaluate the photo catalytic activity enhancement.
 - f. To recognize the key factors of reactions occurring at interfaces.
 - g. To evaluate the sustainability of a photo catalytic process
 - h. To discuss the stability and selectivity of the photo catalyst

- i. To describe and discuss the use of photo catalytic processes in the industry.

International Practice

- 4. Specify the universities of repute where the proposed course is being conducted.
 - a. University of Oulu, Finland.
 - b. Hokkaido University, Sapporo, Japan

Proposed Timeframe of Commencement

- 5. Specifying semester with year. Fall 2015

Course Contents

- 6. Give details of the course, on the following lines:

- a. Course Code ESE- 907
- b. Title Photocatalysis-Advancement and Applications
- c. Credit Hours 3
- d. Outcomes

- (1) The students will be able comprehend the advancements of Photocatalysis.
- (2) The students will be able to differentiate between different types of catalysis and next generation energy production systems.
- (3) The students will be familiar about the catalyst requirements and advancement in biofuel production.
- (4) The course will provide knowledge about BTL, CTL technologies and catalysis.
- (5) The topic of artificial photosynthesis and photocatalysis will be important for the advance energy production technologies.

- f. Contents with suggested contact hours

No.	Topics	Book	Contact Hours
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1	Photocatalysis <ul style="list-style-type: none"> • Photochemistry • Photolysis • Principle of photocatalytic reaction • Fundamentals of photocatalysis • Light and molecules • Photon field • Excited state • Quantum yield 	A	10
2	Photoprocesses at metals, oxides and semiconductors <ul style="list-style-type: none"> • Concepts • Discoveries and applications • Sensitization of photocatalysts 	B	6
3	Advances in design, preparation and characterization of photocatalysts <ul style="list-style-type: none"> • Oxides • Chalcogenides • Semiconductors • Layered materials • Porous materials 	B	6
4	Kinetic Rate equations for photocatalysis <ul style="list-style-type: none"> • Parallel • Series • Reactions • Intensity • Turnover rate 	C	6
5	Artificial photosynthesis <ul style="list-style-type: none"> • Photochemical hydrogen production • Photochemical carbon dioxide reduction 	D	6
6	Photoelectrochemistry <ul style="list-style-type: none"> • Concepts 	E	6

	<ul style="list-style-type: none"> • Discoveries and applications • Storage and synthetic cells • Energy generation • Cell design • Diagnosis and characterization of photoprocesses at electrodes 		
7	Photocatalysis and the environment <ul style="list-style-type: none"> • Detoxification by Photocatalysis. • Photocatalysis in aqueous streams. • Photocatalysis for gaseous effluents. • Self cleaning photocatalysts 	B	5
Total			45

g. Recommended Reading (including Textbooks and Reference books).

S. No.	Title	Author(s)	Assigned Code	Books
1.	Photocatalytic Reaction Engineering, Springer 2005.	H. De Lasa, B. Serrano and M. Salaices,	A	Reference
2.	Handbook of Photocatalysts, Nova Science Publishers, 2009	Geri K. Castello	B	Text
	Photoelectrochemistry, Photocatalysis and Photoreactors Fundamentals and Developments	Mario Schiavello	C	Reference
3	TiO ₂ Photocatalysis: Fundamentals and Applications, BKC, 1999	Akira Fujishima, Kazuhito Hashimoto, Toshiya Watanabe	D	Reference