KIE 358/3 – Current Topics in Industrial Chemistry

Course Objective： To introduce current topics in industrial chemistry and chemical processes and production.

Topic	**Contents**	**Number of lecture hours**	**Expected outcome – upon completion of this course, the student should be able to:**
1. Lignin and Its Applications	• Introduction to palm oil tree including empty fruit bunch, black liquor and lignin • Application of Taguchi method as a design experiment in lignin extraction • Comparison between AQ-lignin and soda lignin • Application of lignin: Formulation of ferum-tannin-lignin complex as a drilling mud thinner and its potential of a rust inhibitor • Application of lignin as a rust converter • Formulation of lignin as a wood adhesive and lignin polymerization • Potential of lignin as a heavy metal adsorbent • Separation of vanillin from lignin and lignin as emulsifiers agent	12	• Appreciate the usefulness of oil palm tree. • Understand the correct way to dispose of waste from palm oil process (empty fruit bunch) and pulping waste and its implication to the surroundings. • Design an experiment using Taguchi Method compared to the trial and error method. • Understand the mechanism of pulping reaction and the comparison of physical & chemical properties between soda lignin and AQ- lignin. • Know the basic petroleum engineering concept. • Know the application of lignin in drilling oil & gas process. • Understand the applications of lignin in other fields such as food industry, construction industry, furniture industry, cosmetic industry and in wastewater treatment.
2. Material Processing in General	• Powder preparation • Characterization • Densification	1	• Understand the basic concept on powder preparation. • Prepare powder by tradisional and chemical methods. • Know characterization and densification of powder.
3. Sol-Gel Process	• Sol-gel concept. • Process parameters • Application	1	• Know the type of sol-gel process, reaction involved and processing steps. • Know the controlling parameters. • Know the application in general, advantages and disadvantages.
4. Dense Monolithic Materials and Aerogel	• Monolithic ceramics and aerogel. • Preparation steps • Discussion on published papers from the journals	2	• Prepare monolithic materials and aerogel.

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5. Spherical and Nanoparticles	• Preparation by sol-gel • Preparation steps • Discussion on published papers from the journals	2	• Prepare spherical and nanoparticles by sol-gel.
6. Thin Films	• Current techniques in preparation of thin films • Preparation by sol-gel	2	• Prepare thin films by sol-gel. • Compare different techniques with sol-gel. • Know application of thin films in optical coating.
7. Hybrids	• Introduction and classification of hybrids • Organic-inorganic hybrids	2	• Know the classification methods of hybrids. • Understand the types of hybrids, research and applications.
8. Polymer Electrolytes (PE)	• Ideas, scientific progress, related value and technology innovations; current trend; demand, and challenges • Nature of polymer-ion interactions in solid PE; dissociation and dissolution of metal salts, Lewis acid-base interactions, coordination and de-coordination • Ionic transport and conductivity in polymer matrix; factors and mechanism • Fundamental properties of polymer electrolytes, PEO as a base example • Fundamental properties of metal salts; Li-based salts • Processability, stability, performance properties of PE; crucial and critical factors • Methods of preparation and techniques of characterization	1 3 2 2	• Articulate rationale and motivation of the scientific pursuit, innovations, and applications. • Comprehend the underlying principles governing polymer-ion interactions and properties. • Explain the mechanism of cationic transport, conductivity. • Differentiate the fundamental and distinctive features of polymers crucial for PE applications. • Recognize and explain properties of metal salts crucial for PE applications. • Able to generalize criteria as the basis to choose and decide new salt-polymer pairs as potential polymer electrolytes. • Recognize factors critical to performance properties of PE that affect processability and stability. • Prepare polymer electrolytes • Understand the equipment and related principles used for PE characterization and property measurement.

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9. Polymer Nanocomposites	• Ideas, scientific progress, value and technology innovations • Types of polymers that attract interest; related fundamental properties • Types of nano particles based on organic, inorganic, and metallic; related fundamental properties, e.g. optical, electronic, conductivity, thermal and mechanical • Properties of polymer nanocomposites, e.g. optical, electronic, thermal, chemical, mechanical and physical barrier • Morphologies, structures, and properties and their relationships. • Methods reparation and techniques of characterization • Current trend; demands and challenges	1 4 1	• Articulate rationale and motivation of scientific pursuit, innovations, benefits and applications. • Understand the fundamental features polymers and molecular criteria as effective matrix in composites. • Appreciate unique properties of nano particles and the underlying quantum effect. • Comprehend the underlying principles governing polymer-filler interactions, effect on structures, morphologies and properties. • Apply acquired knowledge to choose and decide filler-polymer pairs giving unique properties. • Prepare polymer nanocomposite • Understand the equipment and related principles used for PE characterization and property measurement. • Articulate outlook, demands and challenges
	TOTAL	**40**	