



## Course Plan

# Characterization of Nanomaterials

2 credit hours

### Course Outcome:

After finishing this course, students are able to:

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CO-1	Explain the characterizations of nanomaterials via spectroscopies and image processing methods
CO-2	Explain the equipment diagrams of various characterization methods
CO-3	Analyze the specific use of various characterization methods
CO-4	Analyze the characterizations of graphene and its derivatives with suitable characterization methods
CO-5	Analyze the characterizations of C-dots with suitable characterization methods

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Relations between course outcome and program learning outcomes are as follows:

Course Outcome (CO)	Program Learning Outcome (PLO)				
	1	2	3	4	5
CO-1				√	
CO-2				√	
CO-3				√	
CO-4		√		√	
CO-5		√		√	

### Program Learning Outcome

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PLO-1	Able to identify various Indonesia's typical natural resources for sustainable nanomaterials based on their physical and biochemical properties.
PLO-2	Able to classify various Indonesia's typical natural resources for sustainable nanomaterials based on their physical and biochemical properties.
PLO-3	Able to prepare carbon-based nanomaterials.
PLO-4	Able to analyze the physical structure of carbon-based nanomaterials.
PLO-5	Able to disseminate various technological applications of nanomaterials produced from Indonesia's typical natural resources.

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### Description:

This course **aims** to equip students to be able to explain and analyze characterizations of nanomaterials. The nanomaterials that are focused on in this course are graphene and its derivatives, as well as carbon nanodots (Cdots). Students are provided with descriptions of various characterizations of graphene nanomaterials and their derivatives, and also C-dots, via spectroscopies and image processing. In addition, the specific purposes of these various

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characterizations toward the nanomaterials under consideration are emphasized. **The implementation** of the lectures involves students being active in the lecture activities and also contributes in making assignments, discussions, and presentations using scientific approaches and cooperative learning in order to enrich their learning experience. **The assessment** is determined by using a non-test assessment in the form of an assignment. The non-test assessment is in the form of assignments in the form of writing papers on the characterizations of graphene nanomaterials and their derivatives, and/or C-dots using specific methods.

### Textbooks and Suggested Readings:

1. Wei Gao (Editor). 2015. *Graphene Oxide: Reduction Recipes, Spectroscopy, and Applications*. Springer International Publishing
2. Sekhar Ray. 2015. *Applications of Graphene and Graphene-Oxide based Nanomaterials*. William Andrew.
3. Raz Jelinek. 2017. *Carbon Quantum Dots: Synthesis, Properties and Applications*. Springer.
4. Ya-Ping Sun. 2020. *Carbon Dots: Exploring Carbon at Zero-Dimension*. Springer.
5. Handout and lecture notes

### Instructors:

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### Evaluation:

Course evaluation will be carried out through (1) weekly assignments, (2) midterm exam (written), and (3) final exam (written). Determination of final grade is as follows:

$$\text{Final score} = 35\% \text{ assignments} + 35\% \text{ midterm exam} + 30\% \text{ final exam}$$

The final score then converted into the grade as follows:

Final score	Conversion	
	Grade	Points
86 – 100	A	4.00
81 – 85	A-	3.67
76 – 80	B+	3.33
71 – 75	B	3.00
66 – 70	B-	2.67
61 – 65	C+	3.33



56 – 60	C	2.00
41 – 55	D	1.00
0 – 40	E	0.00

For passing this course, students must obtain grade C or higher.

### Lecture Plan:

Week	Date and Time	Topics	Notes
1-2	Tba	Introduction to spectroscopic methods for carbon-based nanomaterials	
3-4	Tba	Physics behind spectroscopic methods for carbon-based nanomaterials	Assignment 1 due
5-6	Tba	Introduction to microscopic methods for carbon-based nanomaterials	
7-8	Tba	Physics behind microscopic methods for carbon-based nanomaterials	Assignment 2 due
9	Tba	Midterm	
10-11	Tba	How to choose an appropriate characterization method	
12	Tba	How to characterize graphene materials and its derivatives using spectroscopic methods	
13	Tba	How to characterize graphene materials using microscopic methods	Assignment 3 due
14	Tba	How to characterize C-dots materials and its derivatives using spectroscopic methods	
15	Tba	How to characterize C-dots materials using microscopic methods	Assignment 4 due
16	Tba	Final exam	

Course Coordinator

Wipsar Sunu Brams Dwandaru, Ph. D.