SEMESTER LEARNING ACTIVITY PLANS (SLAP)
SEMESTER ODD 2022/2023

Microwave Theory and Applications

MFF5841 / 2 Credits

Lecturer Coordinator:

Dr. Mitrayana, S.Si., M.Si.

UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE

2022

	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Study Program Master Physics Semester Odd 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5841	*Microwave Theory and Applications*	*2*	*Odd*	*Elective*	*None*

Short Description	Microwave Theory and Applications course is Elective course 2 credits (Theory) in the 2022 Curriculum Master Physics Study Program, Faculty of Mathematics and Natural Science UGM. The syllabus of this course is as follows: Transmission Line Theory, Principles of microwave measurement, Microwave generating sources, Microwave signal analysis, Network analysis, Microwave application; ESC, modern communication, Radar system, and PAT. The courses are held in class for 14 weeks, each week's session last for 2 x 50 minutes. Four weeks of course period is used for Midterm Exam and Final Exam, each held for two weeks as scheduled. Student evaluation for course assessments is performed summative and formative. The summative evaluation is implemented as written exams, both Midterm and Final Exam, which take a maximum of 120 minutes. The formative evaluation is implemented as individual assignments for each student in the form of completing an assignment individually. Monitoring is carried out by observing student activities during the course, such as attendance, Q&A and discussion about the material presented, and student performance in completing individual assignments.

Program Learning Outcomes (PLO) Imposed on the Course

PLO 3	Mastering further knowledge of classical and modern physics theory, and its relationship with other disciplines, and has mastered an advanced field of physics specialization that allows him to keep up with the latest international research developments.
PLO 4	Mastering various mathematical disciplines related to an advanced field of physics, and able to develop physical models using various mathematical and computational tools with an inter or multidisciplinary approach to solving problems related to an advanced field of physics.
PLO 6	Able to apply knowledge to analyze, synthesize, formulate problems and solve problems comprehensively in one of advanced field of physics, through experimental or theoretical research, then be able to classify and draw conclusions about their findings for the development of science and technology.

Upon completion of this course, students should be able to:

CO1	Describe the development and advancement of microwave devices.

Course Outcomes (CO)	***CO2***	Describe the reduction of TE and TM Variations in square wave monitors, cylinders, and able to convert microwave output power from mW to dBm or otherwise.		
	CO3	Calculate the loss of microwave energy as it passes through the inhibiting component, the increase in microwave energy as it passes through the amplifying component, and the portion of the reflected microwave energy as it passes through the reflecting component.		
	CO4	Explain the working principle of microwave signal control components.		
	CO5	Describe the characteristics of microwave detectors and some microwave generators, such as semiconductors, klystrons, and Magnetrons.		
	CO6	Explain the application of tomographic thermoacoustic systems.		
	CO7			
	CO8			
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Introduction: Lecture contract, survey of microwave (GM) equipment and systems, GM's relationship with other electronic equipment, GM systems, GM spectrum, why GM devices are needed, basic design of GM systems.	Lecture, discussion	2 x 50 minutes
	CO1	GM transmission forms, signal control components, semiconductor amplifiers and insulators, GM tubes, GM low-noise receivers, GM antennas.	Lecture, discussion	2 x 50 minutes
	CO1	Microwave Fields: electric and magnetic fields, electromagnetic waves, maxwell equations, solving simple maxwell equations, microwave power, characteristics of electromagnetic waves, microwaves in transmission wires, skin depth.	Lecture, discussion	2 x 50 minutes
	CO2	Waveguide: rectangular waveguide, cylindrical waveguide.	Lecture, discussion	2 x 50 minutes
	CO2	Cylindrical waveguide, influence of conductivity in waveguide, parabolic waveguide.	Lecture, discussion	2 x 50 minutes
	CO2	Insertion loss, Gain, and Return Loss: insertion loss and return loss, insertion loss of consecutively arranged components, gain.	Lecture, discussion	2 x 50 minutes
	CO2	Flowchart of insertion loss and gain, mismatch and return loss, another way to determine reflected power, S parameter, tools for	Lecture, discussion	2 x 50 minutes

		measuring insertion loss and return loss.		
	CO3	Smith chart tuning: derivation from smith chart, potting mismatch on smith chart, matching calculations with smith chart, moving towards load, grouping inductances in series, matching elements in parallel, piece matching, quarter wave transformers, element groups in combination, selection the best matching technique.	Lecture, discussion	2 x 50 minutes
	CO3	Microwave Transmission Lines: comparison of transmission lines, guide wavelength and characteristic impedance, coaxial cable, waveguide, stripline and microstrip, connectors and adapters.	Lecture, discussion	2 x 50 minutes
	CO3	Microwave Signal Control Components: GM semiconductor, GM ferrite, termination, guide couple, combiner, insulator and circulator, filter, attenuator, switch, phase variable, detector.	Lecture, discussion	2 x 50 minutes
	CO4	Microwave Equipment: GM generator, GM detector, frequency meter, cavity quality factor measurement.	Lecture, discussion	2 x 50 minutes
	CO4	Application of Microwave Thermoacoustic Tomography (TAT) 1.	Lecture, discussion	2 x 50 minutes
	CO4	Application of Microwave Thermoacoustic Tomography (TAT) 2.	Lecture, discussion	2 x 50 minutes
	CO4	Application of Microwave Thermoacoustic Tomography (TAT) 3.	Lecture, discussion	2 x 50 minutes
	Final Exam/ Project Task Results/ Case Analysis Results			
Learning Methods	Lecture, discussion			
Student Learning Experience	Learn to analyze and review: Introduction: Lecture contract, survey of microwave (GM) equipment and systems, GM's relationship with other electronic equipment, GM systems, GM spectrum, why GM devices are needed, basic design of GM systems., GM transmission forms, signal control components, semiconductor amplifiers and insulators, GM tubes, GM low-noise receivers, GM antennas., Microwave Fields: electric and magnetic fields, electromagnetic waves, maxwell equations, solving simple maxwell equations, microwave power, characteristics of electromagnetic waves, microwaves in transmission wires, skin depth., Waveguide: rectangular waveguide, cylindrical waveguide., Cylindrical waveguide, influence of conductivity in waveguide, parabolic waveguide., Insertion loss, Gain, and Return Loss: insertion loss and return loss, insertion loss of consecutively arranged components, gain., Flowchart of insertion loss and gain, mismatch and return loss, another way to determine reflected power, S parameter, tools for measuring insertion loss and return loss., Smith chart tuning: derivation from smith chart,			

<table>
<tr><td></td><td>potting mismatch on smith chart, matching calculations with smith chart, moving towards load, grouping inductances in series, matching elements in parallel, piece matching, quarter wave transformers, element groups in combination, selection the best matching technique., Microwave Transmission Lines: comparison of transmission lines, guide wavelength and characteristic impedance, coaxial cable, waveguide, stripline and microstrip, connectors and adapters., Microwave Signal Control Components: GM semiconductor, GM ferrite, termination, guide couple, combiner, insulator and circulator, filter, attenuator, switch, phase variable, detector., Microwave Equipment: GM generator, GM detector, frequency meter, cavity quality factor measurement., Application of Microwave Thermoacoustic Tomography (TAT) 1., Application of Microwave Thermoacoustic Tomography (TAT) 2., Application of Microwave Thermoacoustic Tomography (TAT) 3..</td></tr>
<tr><td>Access to Learning Media/ LMS and Offline and Online Percentage</td><td>Google meet and Google classroom</td></tr>
<tr><td>Assessment Methods and Synchronization with CO</td><td>
<table>
<tr><th>Assessment Methods</th><th>Assessment Percentage</th><th>Criteria/Indicators</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Participatory Activity*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project Results/ Case Study Results/ PBL Results*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Cognitive</td></tr>
<tr><td>Assignment</td><td>30%</td><td></td><td>7,5%</td><td>7,5%</td><td>7,5%</td><td>7,5%</td></tr>
<tr><td>Quiz</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Midterm Exam</td><td>35%</td><td></td><td>17,5%</td><td>17,5%</td><td></td><td></td></tr>
<tr><td>Final Exam</td><td>35%</td><td></td><td></td><td></td><td>17,5%</td><td>17,5%</td></tr>
<tr><td colspan="7">*) can also be obtained from the Midterm or Final Exam as the result of participatory activities or project/ case study results. According to IKU 7, the percentage of project results/ case study/ PBL results is at least 50%.</td></tr>
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</td></tr>
<tr><td>References</td><td>Main references:
1. Stephen dan Packard, 2008, Microwave Theory and Applications.
2. Mitrayana., 2016, Microwave Theory and Application and Its Applications, GamaPress UGM.
3. Allan W. Scott, 1993, Understanding Microwaves, John Wiley & Sons.</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td>1. Dr. Mitrayana, S.Si., M.Si.
2.
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4.</td></tr>
<tr><td>Authorization</td><td>
<table><tr><th>Date of Drafting</th><th>Lecturer Coordinator</th><th>Head of Curriculum Committee</th><th>Head of Study Program</th></tr></table>
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		Dr. Mitrayana, S.Si., M.Si.	Dr.Ing. Ari Setiawan	Mirza Satriawan, M.Si., Ph.D