TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

SPECTROSCOPY 2

by

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PREFACE

The Learning Design Book (BRP) for the Spectroscopy 2 course contains a learning plan for one semester and is compiled as a reference for learning the Spectroscopy 2 course in the Undergraduate Program at the Department of Physics, FMIPA UI.

The Spectroscopy 2 course is a compulsory subject for students of the Bachelor of Physics program who major in Condensed Matter Physics. The requirements needed by students to be able to take this course are already taking Basic Physics 3 and Modern Physics courses.

The Spectroscopy 2 lecture which is held in one semester is designed to give students a deeper description of the theory of several spectroscopic techniques and their applications. The first unit contains techniques and instrumentation from NMR (Nuclear Magnetic Resonance) spectroscopy, followed by NQR (Nuclear Quadrupole Resonance) spectroscopy which is loaded in the second unit. The next spectroscopic technique and instrumentation studied were EPR (Electron Paramagnetic Resonance) and ENDOR (Electron Nuclear Double Resonance) which were loaded in the third and fourth units. The fifth unit contains Mossbauer spectroscopy, and the sixth unit contains CFS (Crystal Field Spectroscopy). STS (Scanning Tunneling Spectroscopy) and RAS (Resonance Acoustic Spectroscopy) techniques were loaded on the seventh and eighth units.

The implementation of the Spectroscopy 2 lecture was carried out using a student-centered learning approach. Students independently study the material and explore the material more deeply to be delivered in the form of presentations to other lecturers and teachers. Students are expected to be able to convey their understanding and understanding effectively, sequentially, and systematically and be able to argue in discussions with other lecture participants and teachers.

Jakarta, September 2016

Prof. Dr. Rosari Saleh

I. General Information

1.	Name of Program / Study Level	:	Physics / Undergraduate
2.	Course Name	:	Spectroscopy 2
3.	Course Code	:	SCFI604611
4.	Semester	:	7
5.	Credit	:	3 Credits
6.	Teaching Method(s)	:	Interactive lecture
7.	Prerequisite course(s)	:	Modern Physics, Vibration and Waves, Electromagnetic Fields, Classical Mechanics
8.	Requisite for course(s)	:	-
9.	Integration Between Other Courses	:	Basic Physics 3, Modern Physics, **Spectroscopy 1**
10.	Lecturer(s)	:	Prof. Dr. Rosari Saleh
11.	Course Description	:	In the Spectroscopy 2 course, students will study Resonance Spectroscopy (NMR, NQR, EPR, ENDOR and Moesbauer), Crystal Field Spectroscopy, Scanning Tunneling Spectroscopy, and Resonance Acoustic Spectroscopy.

II. Course Learning Outcome (CLO) and Sub-CLOs

A. CLO

After completing this lecture, students are expected to be capable of explaining the equipment components of each spectroscopic technique studied, to describe how the spectrum is generated, and explaining the information that can be obtained from the spectroscopic measurement results. Students are expected to be able to understand their understanding in reading articles in scientific journals, especially experimental chapters, and experimental results. Students are expected to choose the appropriate spectroscopic technique to identify the structure of the material, know the limitations and advantages of each technique, and be ready to operate the spectroscopic equipment that has been studied. (ELO 3,5,6 and 7)

B. Sub-CLOs

1. Describes the basic components of the NMR spectroscopy instrument. (C4)
2. Describes the use of NMR spectroscopy. (C4)
3. Interprets the results of NMR spectroscopic measurements. (C2)
4. Operates NMR spectroscopy equipment. (C3)
5. Describes the basic components of the NQR spectroscopy instrument. (C4)
6. Describes the use of NQR spectroscopy. (C4)
7. Interprets the results of NQR spectroscopy measurements. (C2)
8. Operates NQR spectroscopy equipment. (C3)
9. Describes the basic components of the EPR spectroscopy instrument. (C4)
10. Describes the use of EPR spectroscopy. (C4)
11. Interprets EPR (C2) spectroscopic measurements
12. Operates the EPR spectroscopy equipment. (C3)
13. Describes the basic components of the ENDOR (C4) spectroscopy instrument.
14. Describes the use of ENDOR spectroscopy. (C4)
15. Interprets ENDOR spectroscopic measurements. (C2)
16. Operates ENDOR spectroscopy equipment. (C3)
17. Describes the basic components of the Mossbauer spectroscopy instrument. (C4)
18. Describes the use of Mossbauer (C4) spectroscopy
19. Interprets the results of Mossbauer spectroscopic measurements (C2)
20. Operates the Mossbauer spectroscopy equipment. (C3)
21. Describes the basic components of the Crystal Field spectroscopy instrument. (C4)

22. Describes the use of Crystal Field spectroscopy. (C4)
23. Interprets Crystal Field (C2) spectroscopic measurements
24. Operates Crystal Field Spectroscopy Equipment (C3)
25. Describes the basic components of the STS instrument. (C4)
26. Describes the use of STS. (C4)
27. Interprets the STS measurement results. (C2)
28. Operates STS equipment. (C3)
29. Describes the basic components of the Resonance Acoustic spectroscopy instrument. (C4)
30. Describes the use of Resonance Acoustic (C4) spectroscopy
31. Interprets resonance acoustic (C2) spectroscopic measurements
32. Operates the Resonance Acoustic spectroscopy equipment. (C3)

III. Lesson Plan

Week	Sub-CLO	Study Materials	Teaching Method	Time Required	Learning Experiences (*O-E-F)	Sub-CLO Weight on Course (%)	Sub-CLO Achievement Indicator	References
1	1,2	NMR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Describes the basic components of the NMR spectroscopy instrument, use of NMR spectroscopy	[1] Chapter 1 [2] Chapter 7
2	3,4	NMR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Interprets NMR spectroscopic measurements, Operates NMR spectroscopy equipment	[1] Chapter 1 [2] Chapter 7
3	5,6	NQR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Describes the basic components of the NQR spectroscopy instrument, the use of NQR spectroscopy	[1] Chapter 2
4	7,8	NQR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Interprets NQR spectroscopic measurements, Operates NQR spectroscopy equipment	[1] Chapter 2
5	9,10	EPR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Describes the basic components of the EPR spectroscopy instrument, the use of EPR spectroscopy	[1] Chapter 3 [2] Chapter 7
6	11,12	EPR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Interprets EPR spectroscopic measurement results, Operates EPR spectroscopy equipment	[1] Chapter 3 [2] Chapter 7
7	13,14,15,16	ENDOR Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	8	Describes the basic components of the ENDOR spectroscopy instrument, use of ENDOR spectroscopy,	[1] Chapter 4

							Interprets ENDOR spectroscopic measurements, Operates ENDOR spectroscopy equipment	
8	**Midterm Exam**							
9	17,18	Mossbauer Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Describes the basic components of the Mossbauer spectroscopy instrument, the use of Mossbauer spectroscopy	[1] Chapter 5 [2] Chapter 8
10	19,20	Mossbauer Spectroscopy	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Interprets Mossbauer spectroscopic measurements, Operates the Mossbauer spectroscopy equipment	[[1] Chapter 5 [2] Chapter 8
11	21,22	*Crystal Field Spectroscopy*	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Describes the basic components of the Crystal Field Spectroscopy Instrument, using Crystal Field Spectroscopy	[1] Chapter 6
12	23,24	*Crystal Field Spectroscopy*	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Interprets Crystal Field Spectroscopic Measurement Results, Operating Crystal Field Spectroscopy Equipment	[1] Chapter 6
13	25,26	*Scanning Tunneling Spectroscopy*	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Describes the basic components of the STS spectroscopy instrument, the use of STS spectroscopy	[1] Chapter 7
14	27,28	*Scanning Tunneling Spectroscopy*	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	7	Interprets the results of STS spectroscopy measurements, Operates the STS spectroscopy equipment	[1] Chapter 7

15	29,30,31,32	*Resonance Acoustic Spectroscopy*	Interactive Lecture	150 minutes	O : Preface (20%) E : Presentation (40%) U : Discussion and Q&A (40%)	8	Describes the basic components of the Resonance Acoustic spectroscopy instrument, the use of Resonance Acoustic spectroscopy, Interprets the measurement results of Resonance Acoustic spectroscopy, Operates the Resonance Acoustic spectroscopy equipment	[1] Chapter 8
16	**Final Exam**							

*) O : Orientation
E : Exercise
F : Feedback

References:

1. DR Vij, Handbook of Applied Solid State Spectroscopy, Springer, New York, 2006
2. Collin N Banwell and Elaine M McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., McGraw-Hill Book Co.,Singapore, 1994.

IV. Rancangan Tugas dan Latihan

Week	Assignment Name	Sub-CLO	Assignment	Scope	Working Procedure	Deadline	Outcome
1-2	Discussion and Q&A	1-8	Question(s)	1. Basic components, use, interpretation of measurement results and application of NMR spectroscopy 2. Basic components, use, interpretation of measurement results and application of NQR spectroscopy	In class	100 minutes	Notes on discussion results
3-6	Presentation	9-16	Presentation	1. Basic components, use, interpretation of measurement results and application of EPR spectroscopy 2. Basic components, use, interpretation of measurement results and application of ENDOR spectroscopy	Individual/by group and in class	100 minutes	Student powerpoints, results of presentations and discussions
7	Midterm Exam						
5-11	Presentation	17-24	Presentation	1. Basic components, use, interpretation of measurement results and application of Moessbauer spectroscopy 2. Basic components, use, interpretation of measurement results and application of Crystal Field spectroscopy	Individual/by group and in class	100 minutes	Student powerpoints, results of presentations and discussions
12-15	Discussion and Q&A	25-32	Question(s)	1. Basic components, use, interpretation of measurement results and application of STS spectroscopy 2. Basic components, use, interpretation of measurement results and application of Resonance Acoustic spectroscopy	Individual/by group and in class	100 minutes	Notes on discussion results
16	Final Exam						

V. Assessment Criteria (Evaluation of Learning Outcomes)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Presentation Assignment	4-8, 9-23	Assessment Sheet	2	30
Discussion and Q&A	1-3, 24-29	Assessment Sheet	2	40
Midterm Exam	1-8	Individual Assignment Evaluation	1	15
Final Exam	9-29	Individual Assignment Evaluation	1	15
Total				**100**

VI. Rubric

A. Criteria of Presentation Assessment

Score	Presentation Delivery
85-90	The groups are proficient to convey explanations logically, smoothly, and on time and competent in answering questions from fellow students and lecturers.
75-84	The groups are proficient to convey explanations logically and smoothly and can answer questions from fellow students and lecturer, but cannot manage time well.
65-74	The groups are proficient to convey explanations fluently but cannot convey the logic of their reasoning.
55-64	The groups are less proficient to convey explanations well and on time, and are less able to convey the logic of their reasoning.
<55	

B. Criteria of Essay Assessment

Score	Answers Quality
100	Answers are very precise and all the concept and main component are explained completely
76-99	Answers are fairly precise and the concept and main component are explained fairly complete
51-75	Answers are less precise and the concept and main component are explained less complete
26-50	Answers are poorly precise and the concept and main component are explained poorly complete
<25	Answers are wrong

VII. Attachment: Sample of Examination Papers

UJIAN SPEKTROSKOPI 2

Waktu: 100 menit

Dosen: Prof.Dr. Rosari Saleh

Dilarang bekerja sama, menyalin sebagian/seluruh hasil kerja/tulisan orang lain

1. Spektroskopi Mössbauer berdasarkan pada efek Mössbauer yang ditemukan oleh RL Mössbauer pada tahun 1958. Apa yang Anda ketahui tentang efek ini? Bagaimana percobaan yang dilakukan oleh RL Mössbauer? Jelaskan!

2. Interaksi spin nuklir berhubungan dengan karakteristik nuklir (magnetik & listrik) dan kondisi eksperimen. Interaksi spin nuklir dikelompokkan menjadi dua yakni interaksi eksternal dan interaksi internal. Jelaskan tentang kedua interaksi ini!

3. Sebutkan jenis-jenis *EPR* yang Anda ketahui! Jelaskan karakteristik dan kegunaannya masing-masing!

4. Bagaimana prinsip kerja dari STM? Besaran apa yang diukur? Bagaimana mengukurnya dan apa yang dapat diketahui dari hasil pengukuran STM? Jelaskan!