هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	Metrology and Data Analysis
Course Code:	PHYS 0203
Program:	BSc in Physics and BSc in Physics of Renewable Energy and Environment
Department:	Physics
College:	Science
Institution:	Majmaah University
Version:	2
Last Revision Date:	9/12/2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 2 (2, 0, 0)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (3)					
4. Course General Description:					
Metrology and Data Analysis is a course that provides a comprehensive understanding of metrology principles, data analysis techniques, and their applications in various fields, including engineering, manufacturing, and scientific research. It equips students with the knowledge and skills necessary to ensure accurate and reliable measurements, analyze data effectively, and make informed decisions.					
5. Pre-requirements for this course (if any)**:**					
PHYS 0101 General Physics 1					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
• **Develop a strong foundation in metrology principles and concepts.** • **Master data acquisition, processing, and analysis techniques.** • **Understand the application of metrology in various industries.** • **Develop critical thinking and problem-solving skills related to measurement and data analysis.** • **Learn to use specialized software tools for data analysis and visualization.**					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100 %
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		**30**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define key metrological terms such as accuracy, precision, uncertainty, and traceability.	K1	Lecture	Homework Quizzes exam
1.2	Understand the concept of measurement uncertainty and its propagation.	K1	Lecture	Homework Quizzes exam
1.3	Identify various types of measurement instruments and their applications	K1	Lecture	Homework Quizzes exam
2.0	**Skills**			
2.1	Explain the principles of measurement and the SI system of units.	S1, S2	Lecture	Homework Quizzes exam

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Select appropriate measurement instruments for specific tasks. Calibrate and verify the accuracy	S1	Lecture	Homework Quizzes exam
2.3	Implement quality assurance procedures to ensure accurate and reliable measurements.	S1	Lecture	Homework Quizzes exam
2.4	Visualize data using appropriate method	S3	Lecture	Homework Quizzes exam
2.5	Evaluate the uncertainty associated with measurement results.	S1	Lecture	Homework Quizzes exam
2.6	Apply statistical methods to analyze measurement data	S2	Lecture	Homework Quizzes exam
2.7	Interpret data to establish conclusions	S4	Lecture Group Discussion	Homework Quizzes exam
3.0	**Values, autonomy, and responsibility**			
3.1	Respect empirical evidence on which conclusions are drawn	V1	Lecture Group Discussion	Homework Classwork
3.2	Acquisition of critical thinking skills to evaluate data, identify potential errors	V1	Lecture Group Discussion	Homework Classwork
3.3	Involving student in independent research, data analysis, and report	V2	Lecture	Homework Classwork

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	writing, fostering self-directed learning skills			
3.4	Maintaining data integrity, ensuring accurate and reliable data collection	V1	Lecture Group Discussion	Homework Classwork
3.5	Awareness of eventual social implication due to inaccurate measurement	V1, V2, V3	Lecture Group Discussion	Homework Classwork

C. Course Content

No	List of Topics	Contact Hours
1.	**Fundamentals of Metrology:** Definition and importance of metrology, Units of measurement and their standards, Uncertainty analysis and error propagation, Calibration and traceability of measurement instruments	6
2.	**Measurement Systems and Sensors:** Types of sensors (mechanical, electrical, optical), Sensor calibration and characterization, Signal conditioning and noise reduction	6
3.	**Data Acquisition and Processing**: Data acquisition techniques (manual, automatic), Data types and formats (analog, digital), Data cleaning and preprocessing, Statistical analysis techniques (descriptive statistics, hypothesis testing, regression analysis)	6
4.	**Data Visualization and its tools:** Charts, Bar Charts, Plots, Histograms, Diagrams, Heat Maps, Scatter Plots, Parallel Coordinates	6
5.	**Data Analysis and Interpretation:** Data mining and machine learning techniques, Uncertainty analysis and propagation, Data quality and integrity	6
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm exam 1	7th	15 %
2.	Midterm exam 2	13th	15 %
3.	Homework/presentation	--	10 %
4.	Quizzes	4th and 10th	20 %
5.	Final exam	16th	40 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	**Measurement Systems: Analysis and Design**, Ernest O. Doebelin, McGraw-Hill Higher Education, 2005, 2nd edition
Supportive References	**Introduction to Statistics in Metrology,** Stephen Crowder, Collin Delker, Eric Forrest, Nevin Martin, Springer 2021
Electronic Materials	- Saudi Digital Library (SDL) - https://www.wikipedia.org/ - https://www.bipm.org/en/
Other Learning Materials	- Excel software for drawing graphs. - MS Office for writing reports and presentations.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with at least 25 seats. Auditorium of a capacity of not less than 100 seats for large lecture format classes.
Technology equipment (projector, smart board, software)	A smart board to write on and computer.
Other equipment (depending on the nature of the specialty)	Library, Seminar Room, and Wi-Fi internet connections.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Internal Reviewer committee	Direct
Effectiveness of Students assessment	Students	indirect

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	Qiyas center, stockholder and others	Direct
The extent to which CLOs have been achieved	Peer Reviewer	Direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**16**
DATE	**30/12/2024**