هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	Analytical Mechanics
Course Code:	351PHYS
Program:	Physics
Department:	Physics
College:	Science
Institution:	Jazan University
Version:	**V2022**
Last Revision Date:	23/03/2023

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	3				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered: Level 8/ Year 3					
4. Course general Description The course covers the topics of: the dynamics of systems of particles, the elastic and inelastic collisions in center of mass and laboratory coordinates, the mechanics of rigid bodies, and finally the Lagrangian and Hamiltonian mechanics.					
5. Pre-requirements for this course (if any): 251 PHYS					
6. Co- requirements for this course (if any):					
7. Course Main Objective(s) The course is designed to provide students with 1. A full description for the dynamics of discrete and continuous systems of particles 2. A deep understanding for the collisions and scattering of the particles in both of the center of mass and lab coordinates 3. Mathematical skills to calculate the center of mass and moment of inertial of different rigid bodies shapes 4. Theoretical description to the rotation of rigid bodies around a fixed and rotated axis 5. The use of variational principle to derive the Euler- Lagrange equation 6. Apply the Euler-Lagrange equation to describe the mechanics of particular physical systems in the generalized coordinates 7. The use of the Hamiltonian equations in different physical problems					

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	**30**	**90%**

No	Mode of Instruction	Contact Hours	Percentage
2.	Blended	**3**	**10%**
3.	E-learning		
4.	Hybrid • Traditional classroom • E-learning		
5.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	**30**
2.	Laboratory/Studio	**--**
3.	Field	--
4.	Tutorial	3
5.	Others (specify)	--
	Total	**33**

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

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	**Describe:** the angular moment, the torque, and the kinetic energy of the system of particles. The elastic and inelastic collisions, the impulse, the reduced mass of the colloidal particles. The center of mass, the product of inertia, and the moment of inertial tensor of rigid body, the variation principles in the Largangian mechanics.	**PLO 1.2**	Lectures, discussion comparisons	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
1.2	State: comparison between the Lab and the center of mass coordinates. The generalized coordinates in the Largangian	**PLO 1.1**	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning,

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	mechanics, the Euler-Lagrange equation of motion and the Hamiltonian equation			quizzes, written exams **Indirect:** student survey
1.3	**Discuss** The properties of the rotation of the system of particles. The principle of conservation of linear momentum of collided particles	**PLO 1.2**	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
…				
2.0	Skills			
2.1	**Derive** the angular momentum and torque equation for the system of particles. The rotational kinetic energy of rigid bodies. The Euler-Lagrange and the Hamiltonian equations of motion	**PLO2.1**	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams. **Indirect:** student survey
2.2	Apply The conservation laws to study the collision and scattering of collided particles. The Lagrange equation and Hamiltonian equation to solve some physical problems (simple pendulum, Atwood, inclined motion, ..)	**PLO2.2**	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams. **Indirect:** student survey
2.3	**Calculate** the center of mass and moment of inertial tensor of different rigid bodies	**PLO2.2**	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.4	**Analyze** the rotation of a rigid body around the axis of symmetry and relative to a fixed	**PLO2.2**	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	coordinate system:			questioning, quizzes, written exams. **Indirect:** student survey
2.5	**Develop** communication and critical thinking competencies during interactive discussion, group assignments, essays or web-based activities	**PLO2.4**	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams. **Indirect:** student survey
3.0	Values, autonomy, and responsibility			
3.1	**Develop** skills of working in groups in group assignments and discussion and bear individual responsibility in the assigned tasks	**PLO 3.1**	Discussion, question and answer	**Direct** In class interactive questioning, quizzes, written exams. **Indirect:** student survey
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Dynamics of systems of particles** (center of mass and linear momentum of a system, Angular Momentum and Kinetic Energy of a system, Motion of two interacting bodies: The reduced Mass).	7
2.	**Collisions** (Oblique and scattering collisions).	5
3	**The Rigid bodies** mechanics (General theories and its applications on many types of motion, motion of rigid bodies in three dimensions.)	9
4	**Lagrangian Mechanics.**	**6**
5	**Hamiltonian Mechanics**	**6**
Total		33

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Assignment 1**	**2**	**2.5** (2.5%)
2.	**Assignment 2**	**4**	**2.5** (2.5%)
3.	**Quiz I**	**3**	**10** (10 %)
4.	**Mid-term exam**	**5**	**20** (20%)
5.	**Assignment 3**	**7**	**2.5** (2.5%)
6.	**Assignment 4**	**9**	**2.5** (2.5%)
7.	**Quiz II**	**11**	**10** (10%)
8.	**Final Exam**	**12**	**50** (50%)

*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	Analytical Mechanics; G. R. Fowls and G. Cassiday – 7 th edition, Brooks, Cole, publishing, 2004.
Supportive References	-Classical Mechanics; V. Barges and M. Olsson, McGraw Hill, 1995. - Classical Mechanics; T. L. Chow, John Wiley and Son Ltd, 1995.
Electronic Materials	• *e-Learning* in the School of *Physics* and Astronomy *(www.ph.ed.ac.uk/elearning)* • Physical Sciences Resource Center (PSRC) (www.psrc-online.org*)* • The Physics Homepage (*www.physics.ox.ac.uk)*
Other Learning Materials	• Mathematical packages: *Mathematica*, Math Lab, and Maple. • Software: Virtual Physics

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	
Technology equipment (projector, smart board, software)	
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	DEPARTMENT BOARD
REFERENCE NO.	PHYS2304
DATE	28/2/2023