هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	Analytical Mechanics
Course Code:	**351PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 5/ Year 3
4. Pre-requisites for this course (if any)**:251 PHYS**
5. Co-requisites for this course (if any)**: NIL**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**38**	**84%**
2	**Blended**	**7**	**16%**
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**42**
2	**Laboratory/Studio**	**--**
3	**Tutorial**	**3**
4	**Others** (specify)	
	Total	**45**

B. Course Objectives and Learning Outcomes

1. Course 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

2. Course Main Objective

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

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**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.	**PLO1.1**
1.2	**State**: comparison between the Lab and the center of mass coordinates. The generalized coordinates in the Largangian mechanics, the Euler-Lagrange equation of motion and the Hamiltonian equation	**PLO1.2**
1.3	**Discus** The properties of the rotation of the system of particles. The principal of conservation of linear momentum of collided particles	**PLO1.2**
2	**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	**PLO2.2**
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, ..)	**PLO2.1**
2.3	**Calculate** the center of mass and moment of inertial tensor of different rigid bodies	**PLO2.1**
3	**Values:**	
3.1	**Develop** skills of working in groups in group assignments and discussion and bear individual responsibility in the assigned tasks	**PLO3.1**

C. Course Content

No	List of Topics	Contact Hours
1	**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).	**9**
2	**2- Collisions** (Oblique and scattering collisions).	**6**
3	**3- The Rigid bodies** mechanics (General theories and its applications on many types of motion, motion of rigid bodies in three dimensions.)	**9**
4	**4- Lagrangian Mechanics.**	**9**
5	**5- Hamiltonian Mechanics**	**9**
6	review	3

Total	45

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	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.	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 mechanics, the Euler-Lagrange equation of motion and the Hamiltonian equation	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
1.3	**Discus** The properties of the rotation of the system of particles. The principal of conservation of linear momentum of collided particles	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	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, ..)	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	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
3.0	**Values**		
3.1	**Develop** skills of working in groups in	Discussion, question	**Direct** In class

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	group assignments and discussion and bear individual responsibility in the assigned tasks	and answer	interactive questioning, quizzes, written exams **Indirect:** student survey

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Assignment 1**	**3**	**2.5** (2.5%)
2	**Assignment 2**	**6**	**2.5** (2.5%)
3	**Quiz I**	**7**	**5** (5 %)
4	**First Mid-term exam**	**8**	**15** (15%)
5	**Assignment 3**	**11**	**2.5** (2.5%)
6	**Assignment 4**	**13**	**2.5** (2.5%)
7	**Quiz II**	**14**	**5** (5%)
8	**Second mid-term exam**	**14**	**15** (15%)
9	**Final Exam**	**16**	**50** (50%)

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

Each group of students is assigned to a staff member who will be available for help and academic guidance office hours at specific 2hr on daily basis.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Analytical Mechanics; G. R. Fowls and G. Cassiday – 7 th edition, Brooks, Cole, publishing, 2004.
Essential References Materials	-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. Facilities Required

Item	Resources

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Class room
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show- smart boar
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Assessment	Students, Program assessment committee	Direct/ Indirect
Extent of achievement of course learning outcomes	Instructor	Direct/Indirect
Quality of learning resources	Students, Faculty members	Indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Department council**
Reference No.	**8**
Date	**16/4/1442**