هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Analytical Mechanics**
Course Code:	**363 Math**
Program:	**B. Sc. in Mathematics**
Department:	**Mathematics**
College:	**Science**
Institution:	**Jazan University**

Faculty of Science Mathematics Department

Table of Contents

A. Course Identification

1. Credit hours:
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 6/Year 3
4. Pre-requisites for this course (if any)**: 362 Math**
5. Co-requisites for this course (if any)**:**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	45	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

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

B. Course Objectives and Learning Outcomes

1. Course Description

This course is designed to provide students with

- **Generalized Coordinates**: Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy).
- **Lagrange's Method and Applications**.

Hamilton's Method: Hamilton's principle, principle equation, Jacobi equation and their use in solving the harmonic oscillator, variability of the principles and the principle of minimum action.

2. Course Main Objective

After finishing the course, the student is expected to be familiar with the following:

- Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion.
- Hamilton's method: canonical momenta, Legendre transformation, phase space, the Hamiltonian,
- Hamiltonian dynamics, Liouville's theorem, canonical transformations, the Poisson

bracket, integral invariants, transformation theory, integrable systems, action-angle variables.

- Hanilton-Jacobi's method: Hamilton-Jacobi and the Schrödinger equation. Periodic and chaotic motions.

Somewhat on analytical mechanics and its relation to classical statistical mechanics and quantum mechanics

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Distinguish mathematical concepts relevant to Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	K1
1.2	Identify background science, features and structure of mathematical problem in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	K2
1.3	Explain notations and concepts required for the solution of Mathematical problem in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	K3
2	**Skills :**	
2.1	Apply theoretical, computational or practical aspect relevant to Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	S1
2.2	Compute numerical quantities for various parameters to approximate the solution in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian,	S2

CLOs		Aligned PLOs
	variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	
2.3	Apply various mathematical rules, techniques and theorems in Application in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	S3
2.4	Solve mathematical problem using critical thinking in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	S4
3	**Values:**	
3.1	Cultivate a mathematical attitude and nurture the interest.	V1
3.2	Realize the importance of responsibilities through different modes of practice, competition and related activities.	V2
3.3	Inculcating values and ethics in thought, expression and deed.	V3

C. Course Content

No	List of Topics	Contact Hours
1	Generalized Coordinates	6
2	Conservative and non-conservative force	9
3	Lagrange's Method and Applications.	6
4	Hamilton's Method	6
5	Canonical Transformations Generating Functions	6
6	Euler-Lagrange's equations	6
7	Hamilton's Lagrange's equations	6
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	Distinguish mathematical concepts relevant to Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear	Lectures, Web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.		
1.2	Identify background science, features and structure of mathematical problem in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.		
…	Explain notations and concepts required for the solution of Mathematical problem in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.		
2.0	**Skills**		
2.1	Apply theoretical, computational or practical aspect relevant to Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.		
2.2	Compute numerical quantities for various parameters to approximate the solution in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.	Lectures, problem solving, web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
2.3	Apply various mathematical rules, techniques and theorems in Application in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.		
2.4	Solve mathematical problem using critical thinking in Conservative and non-conservative groups, constraints of power, employment and the amount of motion in generalized coordinates - the principle of Drop (the amount of linear motion, angular momentum, total energy, Lagrange's method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange's equations, cyclic coordinates, constants of motion and Hamilton's.		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
3.0	**Values**		
3.1	Cultivate a mathematical attitude and nurture the interest.	Group work, problem solving, web based work	Assignments
3.2	Realize the importance of responsibilities through different modes of practice, competition and related activities.		
3.3	Inculcating values and ethics in thought, expression and deed.		

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework	3	5%
2	First exam.	6	20%
3	Second exam.	12	20%
4	Homework	14	5%
5	Final exam.	16	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 assigned to a member of staff who will be available for help and academic guidance office hours at specific hours on daily basis. At least be available 8 hours per week.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	- Lidstrm P.: Lecture Notes on Analytical Mechanics. Div. of Mechanics. Lund University. 2007.
Essential References Materials	- Goldstein, Poole & Safko: Classical Mechanics. 3rd ed. Addison Wesley. 2002.
Electronic Materials	Web sites dedicated to Analytical Mechanics available on the internet
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classroom, Computer laboratory
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show; Smart Board, Dynamics packages

Item	Resources
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (Course Evaluation Survey)- 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	**Board Of Mathematics Department**
Reference No.	**12th Meeting Of The Board Of Mathematics Department 1441-1442**
Date	**14/6/1442 A. H.; 27/1/2021 A. D.**