هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TPG-153

Course Specification
(Postgraduate)

Course Title:	**Analytical Mechanics**
Course Code:	**202517-3**
Program:	**Master of Pure Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Taif university**
Version:	1
Last Revision Date:	**20/10/2023**

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☒ Required		☐ Elective	
3. Level/year at which this course is offered: Level 1/First Year				
4. Course general Description:				

Equations of motion of rigid bodies in the space (Rate of change of vector - Centripetal force - Coriolis force - Velocity and acceleration components of a particle moving in space in cylindrical coordinates and spherical coordinates - Euler's equations of motion for a rigid body - Solutions to Euler's equations for force-free motion (symmetrical body))- Definitions (Classification of dynamical system - Virtual displacement- Principle of virtual work - Generalized force in holonomic system -D'Alembert's principle) - Lagrange's equations for a holonomic system- Harmonic oscillator – Solved problems on Lagrange's equations. Variational principle and Lagrange's equations- Hamilton's equations of motion (Derivation of Hamilton's equations of motion (USING Lagrange's equations) Hamilton's principle- Routh procedure - equation of motion – Derivation of Hamilton's equations from Hamilton's principle – principle of least action- Solved problems). Canonical transformations (Canonical coordinates and canonical transformations - The necessary and sufficient condition for a transformation to be canonical - properties of canonical transformations- Solved problems) - Hamilton's equations of motion in Poisson's bracket – Infinitesimal contact transformation - Hamilton - Jacobi equation theory- Solved problems).

5. Pre-requirements for this course (if any)**:**
None

6. Pre-requirements for this course (if any)**:**
None

7. Course Main Objective(s):
The student will be taught as follows: 1. **Preparing students to be able to write and shove the equation of motion of rigid bodies in the space.** 2. **Describing the Hamilton's equations of motion in Poisson's bracket – Infinitesimal contact transformation - Hamilton - Jacobi equation theory.**

2. Teaching Mode: (mark all that apply)

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

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	NA
3.	**Field**	NA
4.	**Tutorial**	NA
5.	**Others (specify)……**	NA
	Total	**45**

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	**Recognize** about solving dynamical problems using Lagrange and Hamilton methods.	K2	Lectures, group discussion `	Exams, Quizzes, Assignments
1.2	**Describe** the differential equation of the dynamical system.	K2	Lectures, group discussion	Exams, Quizzes, Assignments
2.0	**Skills**			
2.1	**Explain** the difference between Lagrange and Hamilton and their applications.	S2	Lectures, group discussion	Exams, Quizzes, Assignments, report
2.2	**Demonstrate** a mechanical system.	S2	Lectures, group discussion	Exams, Quizzes, Assignments, report

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.3	**Use** all forces and momentums of the mechanical system.	S2	Lectures, group discussion	Exams, Quizzes, Assignments, report
3.0	**Values, autonomy, and responsibility**			
3.1	**Participate** effectively within groups and independently.	V1	Lectures, group discussion	Exams, Quizzes, Assignments, report
3.2	**Give** responsibility for learning importance and continuing personal and professional development.	V2	Lectures, group discussion	Exams, Quizzes, Assignments, report

C. Course Content:

No	List of Topics	Contact Hours
1.	Equations of motion of rigid bodies in the different space	6
2.	Euler's equations for force-free motion	9
3.	Lagrange's equations for a holonomic system	9
4.	Solved problems on Lagrange's equations	9
5.	Hamilton's equations of motion in Poisson's bracket	9
6.	Canonical transformations	3
Total		**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Quizzes and HomeWorks**	**Continues**	**10 %**
2.	**Midterm exam**	**8^{th} -9^{th}**	**20 %**
3.	**Final exam**	**16^{th}**	**70%**

*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	Mathematical Methods of Classical Mechanics, v. I. Arnold 1978
Supportive References	**Introduction to Partial Differential Equations.** **ISBN-13: 978-0691043616**

	ISBN-10: 0691043612
Electronic Materials	https://en.wikipedia.org/wiki/Analytical_mechanics
Other Learning Materials	Calculus programming (Mathematica, Mathcad, Mathlab)

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (Projector, smart board, software)	Data show, Blackboard, Maple and MATLAB software
Other equipment (Depending on the nature of the specialty)	Wi-Fi internet connections

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Indirect**
Effectiveness of students assessment	**Students**	**Indirect**
Quality of learning resources	**Students**	**Indirect**
The extent to which CLOs have been achieved	**Peer reviewer**	**Direct**
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Department of Mathematics and Statistics**
REFERENCE NO.	
DATE	**20/10/2023**

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