Classical Mechanics II

Module Code: Phys-M2041;	**EtCTS of Course:** 5 ;	**Course Status:**	Compulsory
Course Title :	**Classical Mechanics II**		
Course Code:	Phys2042;	**Credits Hours:**	3
Mode of delivery:	Full Semester;	**Weeks required:**	16
Prerequisite(s):		**Co-requisite(s):**	
Academic Year:	20_____/_____ ;	**Year/Semester:**	II/ II
Students' College/Faculty:	_____;	**Department:**	Physics
Program:	Undergraduate	**Enrollment:**	____
Instructor's Name (Coordinator)	_____		
Address: Email: _____	Block No._____;	Rm. No. _____	
Class Hours:	_____		

Course Rationale

This course is mainly intended to apply Lagrange's and Hamilton's principles in solving classical problems constrained to oscillate over a very small distance. The approximations followed are very essential in studying physical systems perturbed from their equilibrium position by comparatively very small potential.

Learning Outcomes

At the end of this course the students will be able to:

- analyze mechanical systems applying basic conservation laws with emphasis given to central force problem and rigid body motion,
- apply advanced theoretical techniques including small oscillations and wave propagation to analyze certain mechanical systems,
- acquainted with basic theoretical methods required in contemporary classical mechanics,

Course Description

Dynamics of System of Particles, Center of Mass, Collisions, Scattering, Conservation Theorems, Rigid Body Motion, Euler Angles, Principle of Virtual Work, Small Oscillations, Coupled Systems and Normal Modes, Wave Propagation, Wave Equation, Reflection, Transmission, Interference and Polarization

Course Outline: EtCTS (5)

No	Topic	Lecture (hrs)	Tutor (hrs)	Home (hrs)	T.Load (hrs)
1)	**Dynamics of System of Particles**	11	4	18	33
2)	**Rigid Body Dynamics**	14	5	24	43
3)	**Theory of Small Oscillations**	13	4	21	38
i4)	**Wave Propagation**	7	2	12	21
	Total	45	15	75	135

Method of Teaching

Lecture, discussion, homework, tutorial and project. Online learning resources are also employed.

Tentative Time Breakdown of Lecture Topics

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 1 Week 2	**Dynamics of System of Particles** • System of particles and center of mass • Conservation of linear momentum • Conservation of angular momentum • Conservation of energy • Motion of systems with variable mass •Elastic collisions and conservation laws • Inelastic collisions	Gapped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 3	•Two body problem in center of mass coordinate system • Collision in center of mass coordinate system •Inverse square repulsive force: Rutherford scattering	Gapped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
	Assignment I			
Week 4 Week 5 Week 6	**Rigid Body Dynamics** • Introduction •Angular momentum and kinetic energy • Inertia tensor • Moments of inertia for different body system • Principal moment of inertia and principal Axes •Inertial ellipsoid	Gapped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
	Test I			

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 7 Week 8	• More about the properties of the inertial tensor •Angular velocity and Eulerian angles • Eulerian equations of motion for a rigid body •The principle of virtual work	Gapped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
	Assignment II			
Week 9 Week 10	**Theory of Small Oscillation** • Equilibrium and potential energy • Two coupled oscillators and normal coordinates • Theory of small oscillations • Small oscillations in normal coordinates • Tensor formulation for the theory of small oscillations • Weak coupling	Gapped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
Week 11 Week 12	• General problem of coupled oscillations • Sympathetic vibrations and beats • Molecular vibrations •Loaded string •Dissipative systems and forced oscillations	Gapped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, Presentation
	Test II			
Week 13 Week 14	**Wave Propagation** • Introduction • Wave equation •Reflection, •Transmission •Interference •Polarization	apped Lecture, Group discussion, Active learning methods	Lecturing, , Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work and reading assignments, **Presentation**
Week 15	**Revision and Self Study**			
Week 16	**Final Exam**			

Students should read the relevant sections in the textbook and/or reference materials and do the assignments on time. Practice with solved problems and come to office hours to get concepts clarified. Review and extra problems will be given through worksheets. Students are also expected to have worked through the problems in the worksheets before the tutorial sessions. Attendance at lectures and tutorials is expected for all students. Attendance records will be taken at all times. It is the students chance to ask questions, solve problems and

work in team.

Assessment

No	Type of Assessment	Time	Weight
1	Test I	Week 6	10%
	Test II	Week 12	10%
2	Assignment I	Week 3	10%
	Assignment II	Week 8	10%
3	Class activity and home work	All weeks	10%
4	Final exam	Final week	50%
		Total	100%

COURSE PROGRESS EVALUATION FOCUS

Course evaluation will be through feedback received from students in the lecture, tutorial programmes and test results and through an anonymous student survey which should be conducted every month.

KEY STUDENT-RELATED POLICIES

Students should read the relevant sections in the textbook and/or reference materials and do the assignments on time. Practice with solved problems and come to office hours to get concepts clarified. Review and extra problems will be given through worksheets. Students are also expected to have worked through the problems in the worksheets before the tutorial sessions. Attendance at lectures and tutorials is expected for all students. Attendance records will be taken at all times. It is the students chance to ask questions, solve problems and work in team.

Recommended References

Course Textbook

1. Walter Hauser, *Introduction to principles of mechanics*, Addison Wesley, 1966.
2. Jery Marion, *Classical Dynamics of Particles and Systems*, 1994.

References

1. Marion Thoronton, *Classical Dynamics of Particles and Systems*, 4^{th} ed., 1995
2. Murrey R. Speigle, *Schaum's Outline series: Theory and problems of theatrical mechanics*
3. Devid Morin, *Introduction to Classical Mechanics: with problems and solutions*, Cambridge University Press, 2008.
4. R. Taylor, Calassical Mechanics, Universal Science, 2005
5. H. Goldstein, *Classical Mechanics*, Addison Welsey 3^{rd} ed., 2001.
6. K. R. Symon, *Mechanics*, Addison Welsey 3^{rd} ed., 1971.