ASSAM DON BOSCO UNIVERSITY
SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES
DEPARTMENT OF MATHEMATICS
Modified Syllabus in SPRING 2019

MACL0023: CLASSICAL MECHANICS

(4 Credits - 60 Hours)

Objective*: The fundamental objective of this course to familiarize a student with the notion of classical mechanics. Moreover, this course provides a much needed framework for those who intend to pursue research in other branches of Mathematics and Physics.*

Module I (15 hours)

Introduction to the ideas of constrained motion, Different classifications of constraints of motion, Holonomic and nonholonomic constraints, rhenomic and scleronomic dynamical constraints, Concept of degree of freedom.

Introduction to generalized coordinates, generalized velocities, Total Kinetic energy of a system of particles in terms of generalized velocity. Introduction to generalized momenta and generalized force. D"Alemberts principle and Lagrangian form of equation motion of a dynamical system of N particles. Calculus of variations, Euler-Lagrange equation, application of calculus of variations in dynamical problems

Module II (12 hours)

Two dimensional motion of rigid bodies, Euler's dynamical equations of motion for a rigidbody, Motion of a rigid body about an axis, motion about revolving axis, Eulerian angles, Eulers theorem on the motion of a rigid body, infinitesimal rotations, rate of change of a vector, Coriolis force, Euler's equations of motion, force free motion of a rigid body.

Module III (18 hours)

Hamilton's principle, Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-conservative and non-holonomic systems, conservation theorems and symmetry properties. Hamilton's equations of motion, conservation theorems and physical significance of Hamiltonian, Hamilton's equations from variational principle, principle of least action.

Module IV (15 hours)

Hamilton Jacobi Method : Hamilton - Jacobi equation, Time independent Hamilton - Jacobi equation, canonical transformation generated by Hamilton characteristic function, application of Hamilton - Jacobi equation in solving problems of mechanics.

COURSE/LEARNING OUTCOMES

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

CO1: Learn and understand the fundamentals of classical mechanics (Knowledge)
CO2: Gain the conceptual understanding of such notions (Comprehension)
CO3: Apply concepts of classical mechanics to model various practical situations (Application)
CO4: Analyze various physical motion by first forming the mathematical model and then studying the properties of such model (Analysis)
CO5: Synthesize different motion possessed by rigid bodies depending upon the properties of various motions like Lagrangian and Hamiltonian (Synthesis)
CO6: Evaluate various practical situation by discussing the properties of existing models (Evaluation)

Suggested Readings

1. Classical Mechanics (3rd edition) – H. Goldstein, Addison Wesley Publications, Massachusetts, 2002.
2. Lagrangian and Hamiltonian Mechanics by M.G. Calkin, World Scientific, Singapore. 1996
3. Takwale, R. G. & Puranik, P. S. Classical Mechanics (Tata-McGraw Hill, 1979, 41st reprint, 2010).
4. Yung-Kuo, L. Problems and Solutions on Mechanics (World Scientific, 1994)

MAER0103: ELEMENTARY REAL ANALYSIS

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: *The objective of this course is to introduce to a student various algebraic properties of the real number system. Apart from that, the present course also serves as an introductory course on principles of Mathematical analysis and their application in various other discipline.*

Module I (20 + 10 hours)

Review of Algebraic and Order Properties of R, neighbourhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Module II (20+ 10 hours)

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

Module III (20 + 10 hours)

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Gauss test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

COURSE/LEARNING OUTCOMES

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

CO1: Learn and understand the basic concept associated with real number system, fundamental and principles of mathematical analysis (Knowledge)
CO2: Interpret these concepts in a practical manner apart from having conceptual understanding of the already mentioned concepts (Comprehension)
CO3: Use these concepts in various other disciplines (Application)
CO4: Analyze various possible methods to obtain the solution (Analysis)
CO5: Solve those problems by using the basic concept and logical thinking (Synthesis)
CO6: Predict which method suits a certain problem the most (Evaluation)

Suggested Readings

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1