Semester II			
Core – VII - Mechanics			
Code: 17PMAC23	**Hrs/Week:6**	**Hrs/Sem: 90**	**Credits : 5**

Objective

- To learn about the generalized coordinates, Lagrange's equations, different Variational Principles, Canonical transformations and its applications in Classical Mechanics.

Unit I

Some Definitions-Lagrange's Equations for a Holonomic System- Lagrange's Equations of Motion for Conservative, Non- Holonomic system – Physical Significance of λ_l .

(Chapter 1: Sections 1.1, 1.2,1.3,1.4)

Unit II

Variational Principle – Calculus of Variations- Hamilton's Principle – Derivation of Hamilton's Principle from Lagrange's Equations- Derivation of Lagrange's Equations from Hamilton's Principle-Extension of Hamilton's Principle- Cyclic or Ignorable Coordinates-Conservation Theorems.

(Chapter 2: Sections 2.1, 2.2,2.3,2.4,2.5,2.6,2.7,2.8)

Unit III

Equations of Motion of a Rigid Body- Generalised Coordinates of a Rigid body- Eulerian Angles – Components of Angular Velocity along the Body Set of Axes- Rate of Change of a Vector-Coriolis force-Euler's Equations of motion for a rigid body-Motion of a Heavy Symmetrical Top.

(Chapter 3: Sections 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8)

Unit IV

Derivations of Hamilton's Equations of Motion – Routh's procedure – Equations of motion – Derivation of Hamilton's equations from Hamilton's principle – Principle of least action.

(Chapter 4: Sections 4.1, 4.2,4.3,4.4)

Unit V

Canonical coordinates and canonical transformations – Hamilton's Equations of Motion in poisson's Bracket – Infinitesimal contact Transformation - Relation between Infintesimal contact Transformation and Poisson's Bracket – Hamilton – Jacobi theory.

(Chapter 5: Sections 5.1, 5.2, 5.3, 5.4 ,5.5)

Text Book:

C.R.Mondal: Classical Mechanics, Prentice Hall of India,2007.

Reference Books:

1. K. SankaraRao: Classical Mechanics, Prentice Hall of India,2005.
2. Herbert Goldstein: Classical Mechanics, Second Edition ,Narosa, 1994.

Semester I			
Core IV	**Mathematical Statistics**		
Course Code: 21PMAC14	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Course Objectives

- To enable the use of statistical techniques whenever relevant.
- To have a proper understanding of statistical applications in real life.

Course Outcome

CO.NO.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	explain the concepts of distributions and apply them.	2,8	Un
CO-2	examine the method used for analysis, including a discussion of advantages, disadvantages and necessary assumptions.	1,2	An
CO-3	apply discrete and continuous probability to evaluate the probability of real world events.	2,7	Ap
CO-4	Compare the distribution with one another.	2,8	An
CO-5	test statistical hypothesis.	2	An
CO-6	illustrate the concepts of random variable, probability distribution, distribution function, expected value, variance and higher moments, and calculate expected values and probabilities associated with the distributions of random variables	2,7,8	Ap
CO-7	define a probability generating function, a moment generating function and derive them in simple cases.	5,8	Re
CO-8	write the central limit theorem, and apply it.	1,5	Cr

Semester I			
Core IV	**Mathematical Statistics**		
Course Code: 21PMAC14	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Unit I

Distribution of Two Random Variables – Conditional Distributions and Expectations-The correlation coefficient-Independent Random Variables-Extension to Several Random Variables.

(Chapter 2: Sections 2.1, 2.2, 2.3, 2.4, 2.5)

Unit II

Some special Distributions: The Binomial and Related Distributions – The Poisson Distribution - The Gamma and Chi-square Distributions – The Normal Distribution – The Bivariate Normal Distribution.

(Chapter 3: Sections 3.1, 3.2, 3.3, 3.4, 3.5)

Unit III

Distributions of functions of Random variables: Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type – The Beta, t, and F Distributions.

(Chapter 4: Sections 4.1, 4.2, 4.3, 4.4)

Unit IV

Extensions of the Change of variable technique – Distributions of Order statistics – The Moment generating function technique – The Distributions of$\bar{X}$ and nS^2/σ^2 – Expectations of functions of random variables.

(Chapter 4: Sections 4.5, 4.6, 4.7, 4.8, 4.9)

Unit V

Limiting Distributions: Convergence in Distribution – Convergence in Probability – Limiting Moment Generating Function – The central limit theorem – Some theorems on Limiting Distributions.

(Chapter 5: Sections 5.1, 5.2, 5.3, 5.4, 5.5)

Text Book

1. Robert V. Hogg and AllenT.Craig. *Introduction to Mathematical Statistics*. Pearson Education Asia. Fifth edition, 2004.

Books for Reference

1. J.N.kapur, H.C. Saxena. *Mathematical Statistics*. S.Chand& Co, 2013.
2. Keith Knight. *Mathematical Statistics*. New York. Chapman & Hall/CRC, 2000.

Semester II			
Core VII	**Classical Mechanics**		
Course Code:21PMAC23	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Course Objectives

- To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation.
- To develop math skills as applied to physics.

Course Outcome

Co. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	analyze the dynamics of system near equilibrium and find the normal modes of oscillation.	2	An
CO-2	understand D' Alembert's Principle and simple applications of the Lagrangian formulation.	2,6	Un
CO-3	test the principle co-ordinates and the principle moment of inertia for arbitrary rigid body.	2	An
CO-4	evaluate Hamilton's equations of motion.	5	Ev
CO-5	explain Hamiltonian principles and establish the Hamiltonian equations.	2,5	Un
CO-6	write the magnitude of selected mechanical properties of materials.	2	Cr
CO-7	distinguish the concept of the Hamilton equation of motion and the Principle of least Action.	6	An
CO-8	illustrate the Canonical transformation and Hamilton Jacobi theory.	5	Ap

Semester II			
Core VII	**Classical Mechanics**		
Course Code:21PMAC23	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Unit I

Some Definitions-Lagrange's Equations for a Holonomic System- Lagrange's Equations of Motion for Conservative, Non –Holonomic system - Physical Significance of λ_l - Problems related to SET/NET.

(Chapter 1: Sections 1.1, 1.2, 1.3, 1.4)

Unit II

Variational Principle - Calculus of Variations- Hamilton's Principle - Derivation of Hamilton's Principle from Lagrange's Equations- Derivation of Lagrange's Equations from Hamilton's Principle - Extension of Hamilton's Principle - Cyclic or Ignorable Coordinates- Conservation Theorems - Problems related to SET/NET.

(Chapter 2: Sections 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8)

Unit III

Equations of Motion of a Rigid Body- Generalized Coordinates of a Rigid body- Eulerian Angles - Components of Angular Velocity along the Body Set of Axes- Rate of Change of a Vector-Coriolis force-Euler's Equations of motion for a rigid body-Motion of a Heavy Symmetrical Top.

(Chapter 3: Sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8)

Unit IV

Derivations of Hamilton's Equations of Motion - Routh's procedure - Equations of motion - Derivation of Hamilton's equations from Hamilton's principle - Principle of least action.

(Chapter 4: Sections 4.1, 4.2, 4.3, 4.4)

Unit V

Canonical coordinates and canonical transformations - Hamilton's Equations of Motion in Poisson's Bracket - Infinitesimal contact Transformation - Relation between Infintesimal contact Transformation and Poisson's Bracket - Hamilton - Jacobi theory.

(Chapter 5: Sections 5.1, 5.2, 5.3, 5.4, 5.5)

Problems related to SET/NET is only for Internal Examination.

Text Book

1. C.R.Mondal. *Classical Mechanics*. Prentice Hall of India, 2007.

Books for Reference

1. K. SankaraRao. *Classical Mechanics*. Prentice Hall of India, 2005.
2. Herbert Goldstein. *Classical Mechanics*. Narosa Second Edition, 1994.

Semester - II			
Core IX	**Stochastic Processes**		
Course Code: 21PMAC25	**Hrs/week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Course Objectives

- To acquire knowledge about stochastic process relying on the probability theory and mathematical analysis.
- To develop comprehensive knowledge of Probability Distribution, Transition Probabilities, Markov Chains, Birth – Death Process.

Course Outcome:

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	illustrate the stochastic model.	8	Ap
CO-2	explain the well known models like birth-death and queueing to reorient their knowledge of stochastic analysis.	7	Un
CO-3	list the random walk associated with real life situation to solve.	1	Re
CO-4	analyzethe transition probabilities and its classifications.	2	An
CO-5	discusserlang process and execute it.	5	Un
CO-6	compare the different stochastic models.	1,8	An
CO-7	understand the notions of stochastic process.	5	Un
CO-8	apply markov chains to practical problems	4	Ap

Semester - II			
Core IX	**Stochastic Processes**		
Course Code: 21PMAC25	**Hrs/week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit I

Generating functions - Laplace Transforms - Laplace Transforms of a Probability Distribution or of a Random variable - Difference Equations - Difference Equations in Probability Theory.

(Chapter1: Sections: 1.1 - 1.5)

Unit II

Differential- Difference Equations - Matrix analysis. Stochastic Process: Notion of Stochastic process - Specification of Stochastic Process.

(Chapter 1: Sections: 1.6, 1.7 and Chapter 2: Sections: 2.1 - 2.3)

Unit III

Higher transition probabilities and classification of states - Higher transition probabilities - Classification of states and chains - Determination of Higher transition probabilities -Stability of Markov system: Limiting Behavior.

(Chapter 3: Sections: 3.1 - 3.5)

Unit IV

Statistical inference for Markov Chains-Markov chains with continuous state space-Non-stationary or Non-homogeneous chains-Poisson process-Poisson process and Related Distributions.

(**Chapter 3: Sections: 3.6-3.8 and Chapter4: Sections: 4.1 - 4.2)**

Unit V

Generalizations of Poisson Process-Birth and Death process-Markov Processes-Discrete State Spaces-Erlang Process.

(Chapter 4: Sections: 4.3 - 4.6)

Text Book:

1. J.Medhi. *Stochastic Process*. Wiley Eastern Limited, 1982.

Books for Reference:

1. SrinivasanMehata. *Stochastic Process*. New Delhi: Tata McGraw-Hill Publishing Company Limited, 1976.
2. Tapas kumar Chandra and SreelaGangopadhyay. *Introduction to Stochastic Process*, Narosa Publishing House, 2018.

Semester II			
Elective II A	**Operations Research**		
Course Code: 21PMAE21	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

Course Objectives

- To use quantitative methods and techniques for effective decision –making; model formulation and applications that are applied to problems in business, industry and society.
- To provide a theoretical introduction and implementation of optimization techniques in order to get best results from a set of serial possible solution of different problems.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	classify and formulate integer programming problems and solve them with Cutting Plane Algorithm, Branch and Bound Algorithm.	2,4	Un
CO-2	formulate and solve classical dynamic programming problems.	2,6	Ap
CO-3	compare inventory models and other related models.	2	An
CO-4	understand and identify the generalized inventory models in real life situation	2	Un
CO-5	analyze a network of queues with Poisson external arrival, exponential service requirements and independent routing.	1,6	An
CO-6	evaluate the concept of complementary slackness and its role in solving prime and dual problems	2	Ev
CO-7	create the most optimal order quantity and minimal costs while ordering materials.	2,6	Cr
CO-8	define probabilistic inventory models that accounts for all variations in real systems.	2	Re

Semester II			
Elective II A	**Operations Research**		
Course Code: 21PMAE21	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

Unit I

Integer Programming: Some Applications of Integer Programming Solution Algorithms-Methods of Integer Programming - Cutting Plane Algorithm - Branch and Bound Algorithm.

(Chapter 8: Sections 8.1, 8.2, 8.3, 8.4)

Unit II

Dynamic Programming: Elements of DP Model - The Capital Budgeting Example - Cargo-Loading Problem- Reliability Problem - Work Force Size Problem - Forward and Backward Recursive equations.

(Chapter 9: Sections 9.1, 9.2, 9.3)

Unit III

Inventory Models: The ABC Inventory System - A generalized inventory model - Deterministic models: Single item static model and multiple item static model.

(Chapter 13: Sections 13.1, 13.2, 13.3)

Unit IV

Inventory Models: Probabilistic models– A continuous review model-Single Period Models: Instantaneous Demand, No Setup Cost and s-S Policy

(Chapter 13: Sections 13.4(13.4.1, 13.4.2))

Unit V

Queueing Theory: Elements of Queueing model - Roles of the Poisson and Exponential Distributions - Arrivals Process- Departures Process

(Chapter 15: Sections 15.1, 15.2)

Text Book

1. Hamdy A. Taha. *Operations Research an Introduction*. New York: Macmillan Publishing Company, Fourth Edition, 1987.

Books for Reference

1. J.K.Sharma. *Operations Research.* Macmillan Publishers India Ltd, 2007.
2. KantiSwarup, P.K.Kupta and Man Mohan. *Operations Research*. Sultan Chand & Sons Publications, 2013.

Semester III			
Elective III A	**Fluid Mechanics**		
Course Code: 21PMAE31	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

Course Objectives

- To introduce fundamental aspects of fluid flow behaviour and to develop steady state mechanical energy balance equation for fluid flow systems.
- To estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO Addressed	CL
CO-1	explain fundamentals of fluid mechanics, which is used in the applications of Hydraulics.	1,8	Un
CO-2	employ Archimedes principle to solve numerical examples on Buoyancy.	2,5	Ap
CO-3	develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.	2	Ap
CO-4	imbibe basic laws and equations used for analysis of static and dynamic fluids.	1,8	Un
CO-5	examine stability of submerged and floating bodies.	6	An
CO-6	differentiate horizontal motion and vertical motion.	1	An
CO-7	describe methods of implementing fluid mechanics laws and phenomena.	5,6	Re
CO-8	calculate and optimize operational parameters of hydraulic problems, systems and machines	2	Cr,Ap

Semester III			
Elective III A	**Fluid Mechanics**		
Course Code: 21PMAE31	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

Unit I

Properties of Fluids: Viscosity - Thermodynamic properties- Compressibility and Bulk modulus - Surface Tension and Capillarity - Vapour Pressure and Cavitation.

(Chapter 1: Sec 1.1 – 1.7)

Unit II

Pressure and its measurement: Fluid pressure of a point - Pascal's Law - Pressure variation in a fluid at rest - Absolute, Gauge, Atmospheric and Vacuum Pressure - Measurement of pressure - Simple manometer - Differential Manometer - Pressure at a point in Compressible fluid.

(Chapter 2: Sec 2.1 – 2.8)

Unit III

Hydrostatic forces on Surfaces: Total pressure and Centre of Pressure- Vertical Plane Surfaces submerged in liquid - Horizontal Plane Surfaces submerged in liquid -Inclined Plane Surface submerged in liquid - Curved Surface submerged in liquid

(**Chapter 3: Sec 3.1-3.6)**

Unit IV

Total Pressure and Centre of pressure on lock gates - Pressure Distribution in a liquidsubjected to Horizontal/Vertical Acceleration.

(Chapter3:Sec3.7-3.9)

Unit V

Buoyancy and flotation: Buoyancy - Centre of Buoyancy - Metacentre - Metacentric height - Conditions of Equilibrium of a Floating and Submerged bodies - Experimental Method of Determination of Meta - centric Height - Oscillation of a floating body.

(Chapter 4 Sec 4.1 – 4.9)

Text Book

1. Dr.R.K. Bansal. *A text book of Fluid Mechanics*. Laxmi Publication private limited, Tenth edition.

Books for Reference

1. Joseph H.Spurk, NuriAksel. *Fluid Mechanics*. Springer- Verlag Berlin Heidelberg, Second Edition, 2008.
2. Ranald V. Giles. *Fluid Mechanics and Hydraulics*. McGraw - Hill Book Company, Second Edition.

Semester III	
Self-Study Course **Course on Competitive Exams**	
Course Code: 21PMSS31	**Credits: 2**

Course Objectives

- To provide a platform to the students for building the fundamentals of basic mathematics for competitive examinations preparation strategy
- Establish a framework to help students acquire knowledge and expertise necessary to secure employment opportunities in the government sector

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	solve real life problems requiring interpretation and comparison of various representations of ratios.	2,6	Ap
CO-2	distinguish between proportional and non-proportional situations and when appropriate apply proportional reasoning	6	An
CO-3	solve problems applying probabilistic reasoning to make decisions	2	Ap
CO-4	evaluate claims based on empirical, theoretical and subjective probabilities	6,4	Re
CO-5	create and use visual displays of data	4	Cr
CO-6	solve problems using high speed mental calculations	6	Ap
CO-7	understand the basic concepts of logical reasoning skills.	1,4	Un
CO-8	acquire satisfactory competency in use of data analysis	7	Un

Semester III	
Self-Study Course **Course on Competitive Exams**	
Course Code: 21PMSS31	**Credits: 2**

Unit I

Number System (Including divisibility) - HCF and LCM (Including Factors, Multiples and Prime Factorization)

(Chapter: 1&2, pages 1 – 46)

Unit II

Fractions and Decimals - Square and Square roots, Cube and Cube Roots, Indices and Surds.

(Chapter: 3 &4, pages 47 – 94)

Unit III

Time, Work and Wages (Including Pipes & Cistern) - Time, Speed and Distance (Including Trains, Boats and Stream, Circular Motion, Races and Games.

(Chapter: 15 & 16, pages 317 - 374)

Unit IV

Permutations & combinations and Probability.

(Chapter: 18, pages 391 - 416)

Unit V

Set Theory (Including Venn Diagram) - Data Analysis and Data Interpretation (Including Caselet, Table, Line Graph, Bar Graph, Mixed Bar)

(Chapter: 24 & 27, pages 559 – 570, 615 – 648)

Text Book

1. Er.DeepakAgarwal and Mr.D.P.Gupta. *Rapid Quantitative Aptitude with Shortcuts and Tricks for Competitive Exam.* Disha Publication.

Books for Reference

1. Dr.R.S.Aggarwal. *Quantitative Aptitude for Competitive Examinations*. S.Chand Publication.
2. Rajesh Verma. *Fast Track Objective Arithemetic*. Arihant Publication.