Holy Cross College (Autonomous), Nagercoil-629004

Kanyakumari District, Tamil Nadu.

Nationally Re-Accredited with A$^+$ by NAAC IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF MATHEMATICS

SYLLABUS FOR UNDERGRADUATE PROGRAMME

Issued from the Deans Office

(With effect from the Academic year 2020– 2021)

DEPARTMENT OF MATHEMATICS

Vision

To empower women globally competent with human values and ethics acquiring academic and entrepreneurship skills through holistic education.

Mission

- To create opportunities which will ensure academic excellence in critical thinking, humanistic and scientific inquiry.
- To develop application oriented courses with the necessary input of values.
- To create a possible environment for innovation, team spirit and entrepreneurial leadership.
- To form young women of competence, commitment and compassion.

Programme Educational Objectives (PEO)

PEO 1	The graduates will apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO 2	The graduates pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO 3	The graduates will demonstrate the ability to utilize effectively the variety of teaching techniques and class room strategies and develop confidence to appear for competitive examinations and occupy higher levels of academic and administrative fields.

Programme Outcomes (PO)

PO	Upon completion of the B.Sc. Degree Programme, the graduates will be able to
PO - 1	equip students with hands on training through various courses to enhance entrepreneurship skills.
PO - 2	impart communicative skills and ethical values.
PO - 3	face challenging competitive examinations that offer rewarding careers in science and education.
PO - 4	apply the acquired scientific knowledge to face day to day needs and reflect upon green initiatives to build a sustainable environment.

Programme Specific Outcomes (PSO)

PSO	Upon completion of the B.Sc. Degree Programme, the graduates will be able to	PO Addressed
PSO - 1	acquire a strong foundation in various branches of mathematics to formulate real life problems into mathematical models	PO 4
PSO - 2	apply the mathematical knowledge and skills to develop problem solving skills cultivating logical thinking and face competitive examinations with confidence.	PO 3, 4
PSO - 3	develop entrepreneurial skills based on ethical values, become empowered and self-dependent in society.	PO 1,2
PSO - 4	enhance numerical ability and address problems in interdisciplinary areas which would help in project and field works.	PO 1
PSO - 5	pursue scientific research and develop new findings with global impact using latest technologies.	PO 4

Allied III - Probability Theory and Distributions

Course Code: MA2031

No. of Hours per Week	Credit	Total No. of Hours	Marks
5	5	75	100

Objectives:

1. To impart knowledge on the basic concepts of Probability theory and Probability distributions

2. To apply the theory in real life situations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the definition of probability and set functions	PSO – 1	R
CO - 2	differentiate between probability and conditional probability and compute according to the requirement	PSO –2	An
CO - 3	understand the definition of random variables, their types and related concepts	PSO – 1	U
CO - 4	detect the different probability distributions which are widely used	PSO –3	An
CO - 5	apply the techniques to prove the properties of probability and related distributions	PSO –4	Ap
CO - 6	choose the suitable probability distribution corresponding to a given data	PSO – 5	E
CO - 7	test the validity of a given data	PSO - 5	E

Unit I

Probability - Experiment - Sample space - Events - Conditional probability - Properties - independent events - Multiplication rule of probability - Baye's Theorem.

Unit II

Random Variables - Discrete and continuous random variables - Probability density function - Distribution function - Mathematical expectations - Mean and variance.

Unit III

Moment generating function - Properties - Cumulant generating function - Characteristic function - Poisson distribution - Recurrence formula for moments - Fitting of Poisson distribution.

Unit IV

Binomial distribution - Moment generating function about origin and mean Recurrence formula for moments - Mode of Binomial distribution - Fitting of Binomial distribution.

Unit V

Normal Distribution - Properties of Normal curve - Moment generating function about origin and mean - Moments - Standard Normal distribution - Fitting of Normal distribution by area method and ordinate method.

Text Book:

Arumugam, S., & others. (2006). Statistics. New Gamma Publishing House.

Chapter 11: 11.1 - 11.2;   Chapter 12: 12.1 - 12.6;   Chapter 13: 13.1 - 13.3.

Reference Books:

1. Kapur, J.N., & Saxena. (1986). Mathematical Statistics. (12th Edition). Chand & Company.

2. Pillai, R.S.N., & Bagavathi, V. (1989). Statistics. (12th Edition). Chand & Company.

3. Mangaladoss., & others. (1994). Statistics and its application. Suja Publishing House.

4. Sharma, J.N., & Goyal, J. K. (1987). Mathematical Statistics. (11th Edition). Krishna Bakashar Mandir.

5. Gupta, S.P. (2012). Statistical Methods. (42th Edition). Sultan Chand and Sons.

Allied IV - Applied Statistics

Course Code: MA2041

No. of Hours per Week	Credit	Total No. of Hours	Marks
5	5	75	100

Objectives:

1. To acquire the knowledge of correlation theory and testing hypothesis

2. To solve research and application-oriented problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	identify and demonstrate appropriate sampling processes	PSO –2	Ap
CO - 2	recall the methods of classifying and analyzing data relative to single variable	PSO –4	R
CO - 3	describe the χ^2 distribution in statistics	PSO –3	U
CO - 4	distinguish between the practical purposes of a large and a small sample	PSO –1	An
CO - 5	understand that correlation coefficient is independent of the change of origin and scale	PSO –5	U

Unit I

Correlation - Properties of correlation coefficient -Rank correlation - Regression - Equation of regression lines - Angle between regression lines.

Unit II

Test of significance -Sampling - Sampling distribution - Testing of hypothesis - Procedure for testing of hypothesis for large samples - Test of significance for proportions and percentages.

Unit III

Test of significance for means, difference of sample means, standard deviation and correlation coefficient.

Unit IV

Test of significance for small samples - Test of significance based on t-distribution - Test of significance based on F-test - Test of significance of an observed sample correlation.

Unit V

Test based on χ^2-distribution – χ^2 test for population variance, goodness of fit and independence of attributes - Yate's Correction.

Text Book:

Arumugam, S., & Thangapandi Isaac, A. (2006). Statistics. New Gamma Publishing House. Palayamkotai.

Chapters: 6, 14, 15, 16.

Reference Books:

1. Kapur, J. N., &Saxena. (1986). Mathematical Statistics. (12th Edition). Chand & Company.
2. Pillai, R. S. N., &Bagavathi, V. (1989). Statistics. (12th Edition). Chand & Company.
3. Mangaladoss., & Others. (1994). Statistics and its Application. Suja Publishing House.
4. Sharma, J. N., & J. K.Goyal. (1987). Mathematical Statistics. (11th Edition). Krishna Bakashar Mandir.
5. Robert, V., Hogg., Joseph., Mckean, W., Allen., & Craig, T. (2013). Introduction to Mathematical Statistics. (6th Edition). Dorling Kindersley (India) Pvt. Ltd.

Major Core IX- Computer Oriented Numerical Methods

Course Code: MC2053

No. of hours per week	Credits	Total No. of hours	Marks
6	**4**	90	100

Objectives:

1. To provide suitable and effective numerical methods, for computing approximate numerical values of certain raw data

2. To lay foundation of programming techniques to solve mathematical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the elementary programming language and its structure	PSO - 4	U
CO - 2	develop computer programmes for the solution of various numerical problems	PSO - 5	C
CO - 3	apply numerical methods to obtain approximate solutions to mathematical problems	PSO - 3	Ap
CO - 4	employ different methods of constructing a polynomial using various methods	PSO - 2	A
CO - 5	compare the rate of convergence of different numerical formula	PSO - 4	An
CO - 6	distinguish the advantages and disadvantages of various numerical methods	PSO - 4	An

Unit I

Basis structure of C programs – C Tokens – Keywords and Identifiers - Constants – Variables – Data Types – Operations and Expressions – Arithmetic Operators – Relational Operators – Logical Operators – Assignment Operators – Increment and Decrement Operators – Conditional Operators - Bitwise Operators - Special Operators – Managing Input and Output Operations – Formatted Input [Excluding Inputting Integer Numbers] - Formatted Output [Excluding Output of Integer Numbers].

Unit II

Decision making and Branching – Decision making with IF statement – Simple IF statement – The IF…. Else statements – Nesting of IF... Else statements- The GOTO statement - Decision making and Looping – The WHILE Statement – The DO Statement – The FOR Statement.

Unit III

Solutions of algebraic and transcendental equations. Iteration method - Newton Raphson method – programs in C for Newton Raphson method - Interpolation - Newton's Interpolation formulae – programs in C for Newton's Forward Interpolation and Backward Interpolation - Lagrange's Interpolation formula.

Unit IV

Numerical differentiation - derivatives using Newton's forward difference formula - Newton's backward difference formula - Numerical integration - Newton cote's - quadrature formula - Trapezoidal rule - programs in C for Trapezoidal rule.

Unit V

Simpson's $(1/3)^{rd}$ rule - programs in C for Simpson's one - third rule- Simpson's $(3/8)^{th}$ rule - Numerical solution of differential equation - Taylor's series method - Picard's method.

Text Book:

1. Programming in ANSI C, E. Balagurusamy, McGraw Hill Education (India) private Limited. (Eighth Edition)

   Chapter: 2; page: 28; Chapter: 3; pages: 41-42, 45-47; Chapter: 4; pages: 68-77

   Chapter: 5; pages: 105, 113-114; Chapter: 6; pages: 131-133,135-140, 153-154,

   Chapter: 7; pages: 173-179

   In all the chapters worked –out problems are excluded.

2. Arumugam, S., Thangapandi Issac, A., &Somasundaram, A. (2002). Numerical Methods. Scitech Publications Pvt. Ltd.

   Chapter 3: Sections 3.0, 3.2 & 3.5; Chapter 7: Sections 7.1, 7.3;

   Chapter 8: Sections 8.1, 8.2 & 8.5 (except Weddle's rule, Boole's rule & Romberg's method) & Chapter 10: Sections 10.1 &10.2.

   Chapter 12: Sections 12.6, 12.13, 12.14, 12.19, 12.20

   Practical: Topics in Italics from Unit III to Unit V.

Reference Books:

1. Sastry, S.S. (2003). Introduction methods of numerical analysis. (3rd Edition). Prentice Hall of India.

2. Scar Borough, J.N. (1966). Numerical mathematical analysis. (6th Edition). Oxford and IBH Publishing Co.

3. Gupta, P. P., G.S. Malik., & Sanjay Gupta. (1992). Calculus of finite differences and numerical analysis. (16th Edition). KRISHNA Prakashan Mandir.

4. Devi Prasad. (2010). An Introduction to Numerical Anaysis. Narosa Publishing House.

5. Bhupendra Singh. (2012). Numerical Analysis. (2nd Edition). Pragati Prakashan Educational Publishers.

Semester VI

Major Core XI- Mechanics

Course Code: MC2062

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To visualize the application of Mathematics in Physical Sciences
2. To develop the capacity to predict the effects of force and motion

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	calculate the reactions necessary to ensure static equilibrium	PSO - 2	U
CO - 2	apply the principles of static equilibrium to particles and rigid bodies	PSO - 4	Ap
CO - 3	understand the ways of distributing loads	PSO - 5	C
CO - 4	identify internal forces and moments of a rigid body	PSO - 3	Ap
CO - 5	apply the basic principles of projectiles into real world problems	PSO - 2	Ap
CO - 6	classify the laws of friction	PSO - 4	An

Unit I

Forces Acting at a Point: Resultant and Components - Sample cases of finding the resultant – Analytical expression for the resultant of two forces acting at a point – Triangle forces – Perperndicular Triangular forces – Converse of the Trigangle of Forces- The Polygon of Forces -Lami's Theorem - Parallel Forces, like and unlike parallel forces - Equilibrium of three coplanar forces - Centre of two parallel forces - Moments - Varignon's theorem of moments - Generalised theorem of moments.

Unit II

Couples – Equilibrium of two couples –Representation of a couple by a vector – Resultant of coplanar couples – Resultant of couple and a force - Coplanar Forces - Reduction of any number of coplanar forces - Conditions for a system of forces to reduce to a single force or a couple - Change of the base point - Equation to the line of action of the resultant - Solution of problems.

Unit III

Friction: Introduction – Experimental Results - Statical, Dynamical and Limiting friction - Laws of friction - Coefficient of friction - Angle of friction - Cone of friction – Numerical values - Equilibrium of a body on a rough inclined plane - Problems on friction.

Unit IV

Projectiles - Equation of path - Characteristics of the motion of the projectile - Maximum horizontal range - Two directions of projection for a given velocity - Velocity of the projectile.

Unit V

Motion under the action of central forces – Velocity and Acceleration in Polar Coordinates – Equation of Motion in Polar Coordinates – Note on the equiangular spiral – Motion under a central force – Differential Equation of central orbits – Perpendicular from the pole on the tangent – Pedal equation of the central orbit – Pedal equation of some of the well-known curves – Velocities in a central orbit – Two – fold problems in central orbits.

Text Books:

1. Venkataraman, M. K. (2012). Statics. (15th Edition). Agasthiar Publications.
   Chapter 2: Sections 2.1- 2.9; Chapter 3: Sections 3.1 to 3.13;
   Chapter 4: Sections: 4.1,4.2,4.5- 4.10; Chapter 6: Sections 6.1 to 6.3(Analytical proof only), 6.5, 6.7, 6.8 &
   Chapter 7: Sections 7.1 to 7.13 (up to example 15).
2. Venkataraman, M. K. (2012). Dynamics. (15th Edition). Agasthiar Publications.
   Chapter 6: Sections 6.1 to 6.10; Chapter 11: Sections 11.1 to 11.11

Reference Books:

1. Durai Pandian, P., Lexmi Durai Pandian., & Muthamizh Jayapragasam. (2011). Mechanics. Chand S. & Company Ltd.
2. Rajeshwari, I. (2016). Mechanics. (1st Edition). Saras Publication.
3. Chaudhry, K. R., & Aggarwal, A. C. (1983). Elements of Mechanics. Chand, S.& Company Ltd.
4. Mathur, D. S. (1985). Mechanics. S.Chand & Company Ltd.
5. John., Synge, L., Byron., & Griffith, A. (1970). Principles of Mechanics. (International Student Edition). McGraw - Hill Kogakusha Ltd.

Semester VI
Major Core XIII- Linear Programming
Course Code: MC2064

No. of hours per week	Credits	Total No. of hours	Marks
5	4	75	100

Objectives:

1. To formulate real life problems into mathematical problems
2. To solve life oriented and decision-making problems by optimizing the objective function

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	understand the methods of optimization and to solve the problems	PSO - 1	U
CO – 2	explain what is an LPP	PSO - 1	U
CO – 3	define how to formulate an LPP with linear constraints	PSO - 1	R
CO – 4	maximize the profit, minimize the cost, minimize the time in transportation problem, Travelling salesman problem, Assignment problem	PSO - 3	Ap
CO – 5	identify a problem in your locality, formulate it as an LPP and solve	PSO - 4	C

Unit I

Formulation of L.P.P - Mathematical Formulation of L.P.P - Solution of L.P.P - Graphical method - Simplex method - Big-M Method - Algorithm for Big-M Method -

Unit II

Two phase method - Phase I: Solving auxiliary LPP using Simplex method - Phase II: finding optimal basic feasible solution- Duality in L.P.P - Primal - Formation of dual L.P.P - Matrix form of primal and its dual - Fundamental theorem of duality - Dual simplex method - Dual Simplex Algorithm -Degeneracy and cycling in L.P.P.

Unit III

Transportation problems - Mathematical formulation of Transportation Problems - Dual of a Transportation Problem - Solution of a Transportation Problem - North-West corner rule - Row Minima method - Column Minima method - Least Cost method - Vogel Approximation Method – Degeneracy in Transportation Problems

Unit IV

Assignment Problems - Mathematical formulation - Solution to Assignment Problems - Hungarian Algorithm for solving Assignment Problems -Travelling Salesman Problem.

Unit V

Sequencing of Jobs- Introduction- Processing n jobs in two machines- Processing n jobs in m machines- Processing two jobs in m machines

Text book:

Arumugam, S., &Thangapandi Issac, A. (2015). Operations Research (Linear Programming). (1st Edition). New Gamma Publishing house.

Chapter 3: 3.1 - 3.7, 3.9, 3.10 & 3.11; Chapter 4: 4.1 & 4.2

Chapter 5: 5.1, 5.2; Chapter 8: 8.0 to 8.3

Reference Books:

1. Gupta, P.K., & Hira, D.S. (1997). Operations Research. S.Chand and Co. Ltd.
2. Sankara Narayanan, T., & Joseph A. Mangaladoss. (2004). Operations Research. (5th Edition). Persi - Persi Publications.
3. Handy, A. Taha. (1989). Operations Research - An Introduction. (3^{rd}Edition). Mac Millan Publishing Co. Inc.
4. Vittal, P. R., & Malini, V. (2013). Operations Research. Margham Publications.
5. Sharma, J. K. (2013). Operations Research – Theory and Applications. (5th Edition). Macmillan Publishers India Ltd.

Semester VI

Elective II: (a) Astronomy

Course Code: MC2065

No. of hours per week	Credits	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To introduce space science and to familiarize the important features of the planets, sun, moon and stellar universe
2. To predict lunar and solar eclipses and study the seasonal changes

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	define the spherical trigonometry of the celestial sphere	PSO - 1	U
CO – 2	discuss the Kepler's laws	PSO - 1	U
CO – 3	calculate the motion of two particles relative to the common mass centre	PSO - 2	Ap
CO – 4	interpret latitude and longitude and apply this to find the latitude and longitude of a particular place	PSO - 4	E
CO – 5	distinguish between Geometric Parallax and Horizontal Parallax	PSO - 4	An

Unit I

Spherical trigonometry (only the four formulae) - Celestial sphere - Four systems of coordinates - Diurnal motion - Sidereal Time - Hour angle and Azimuth at rising - Morning and Evening stars - Circumpolar stars.

Unit II

The Earth - Zones of the earth - Perpetual Day and Perpetual night - Terrestrial latitude and longitude - Dip of Horizon - Twilight, Duration of Twilight, Twilight throughout night, Shortest Twilight.

Unit III

Geocentric parallax - Parallax - Effects of Geocentric parallax – Changes in R.A and Declination of a body due to Geocentric Parallax - Angular diameter – Equatorial horizontal Parallax - Heliocentric Parallax – Effect of Heliocentric Parallax – To find the effect of Parallax on the Longitude and Latitude of a Star - Parsec

Unit IV

Kepler's laws - Eccentricity of Earth's orbit –Verification of Kepler's Laws (1) and (2) - Newton's deductions from Kepler's laws – To derive Kepler's Third Law from Newton's law of Gravitation –To find the mass of a planet – To fix the position of a planet in it's elliptic orbit – Geocentric and Heliocentric latitudes and longitudes – To prove that the Heliocentric longitude of the Earth and Geocentric longitude of the Sun differ by 180°

Unit V

Two Body Problem -Introduction – Newton's Fundamental equation of Motion – Motion of one particle relative to another- The motion of the common centre of mass- Motion of two particles relative to the common mass centre – Motion of a planet with respect to the Sun

Text Book:

Kumaravelu, S., & Susheela Kumaravelu. (2012). Astronomy. (10^{th}Edition).
Chapter 2: art 39 to Art 83; Chapter 3: Art 93 & Art 106 to 116;
Chapter 5: Art 135 to143 & 145; Chapter 6: Art 146 to 156, 164 &165;
Chapter 8: Art 190 to 194; Chapter 16: Art 321 to 326

Reference Books:

1. Subramanian, K., Subramanian, L. V., Venkataraman., & Brothers. (1965). A text book of Astronomy. (1st Edition). Educational Publishers.
2. Ramachandran, G. V. (1970). A text book of Astronomy. (7th Edition). Theni Printers.
3. Daniel Fleish., Julia Kregenow. (2013). Mathematics of Astronomy. (1st Edition). Cambridge University Press. NewYork.
4. Smart, W. M. (1949). Spherical Astronomy. (4th Edition). Cambridge university press.
5. Jean Meeus. (2002). More Mathematical Astronomy morsels. (1st Edition). Willmann Bell Publishing

Elective II: (c) Web Designing with HTML

Course Code: MC2067

No. of hours per week	Credits	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To understand the importance of the web as a medium of communication
2. To create an effective web page with graphic design principles

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	define modern protocols and systems used on the web (such as HTML, HTTP)	PSO - 1	U
CO - 2	employ fundamental knowledge on web designing with makeup language	PSO - 2	Ap
CO - 3	gain strong knowledge in HTML	PSO - 1	U
CO - 4	use critical thinking skills to design and implement an interactive websites with regard to issues of usability, accessibility and internationalism	PSO - 4	An
CO - 5	to pursue future courses in website development and design	PSO - 2	Ap

Unit I

Introduction to HTML - Designing a Home Page - History of HTML - HTML Generations - HTML Documents - Anchor Tag - Hyper Links - Sample HTML Documents.

Unit II

Head and Body Sections - Header Sections - Title - Prologue - Links - Colorful Web Page - Comment Lines - Some Sample HTML Documents.

Unit III

Designing the Body Section - Heading Printing - Aligning the Headings - Horizontal Rule - Paragraph - Tab Setting - Images and Pictures - Embedding PNG Format Images.

Unit IV

Ordered and Unordered Lists - Lists - Unordered Lists - Headings in a List - Ordered Lists - Nested Lists.

Unit V

Table Handling - Tables -Table Creation in HTML - Width of the Table and Cells - Cells Spanning Multiple Row/Columns Coloring Cells - Column Specification - Some Sample Tables.

Text Book:

Xavier, C. World Wide Web Design with HTML. Tata Mcgram Hill Publishing Company Limited.
Chapters 4: 4.1 – 4.7; 5: 5.1 – 5.7; 6: 6.1 - 6.7; 7: 7.1 – 7.5; 8: 8.1 – 8.7

Reference Books:

1. Castro., Elizabeth., & Hyslop. (2013). HTML5, And CSS: Visual Quickstart Guide. (Eight Edition). Peachpit Press.
2. Devlin., & Ian. (2011). HTML5 Multimedia: Develop and Design. Peachpit Press.
3. Felke., & Morris. (2013). Basics of Web Design: HTML5 & CSS3. (2nd Edition). Addition -Wesley.
4. Felke., & Morris. (2014). -Web Development & Design Foundations with HTML5. (7th Edition). Addition - Wesley.
5. John Duckett. (2011). HTML and CSS: Design and Build Website. (1st Edition). John wiley and sons.

Programme Outcomes (POs)

PO	Upon completion of M.Sc Degree Programme, the graduates will be able to
PO – 1	prepare successful professionals in industry, government, academia, research, entrepreneurial pursuits and consulting firms.
PO – 2	face and succeed in high level competitive examinations like NET, GATE and TOFEL
PO – 3	carry out internship programmes and research projects to develop scientific skills and innovative ideas.
PO – 4	utilize the obtained scientific knowledge to create eco-friendly environment.

Programme Specific Outcomes (PSOs)

PSO	Upon completion of M.Sc. Degree Programme, the graduates of Mathematics will be able to	PO Addressed
PSO – 1	utilize the knowledge gained for entrepreneurial pursuits.	PO – 1
PSO – 2	sharpen their analytical thinking, logical deductions and rigour in reasoning.	PO – 2
PSO – 3	use the techniques, skills and modern technology necessary to communicate effectively with professional and ethical responsibilities.	PO – 3
PSO - 4	understand the applications of mathematics in a global economic environment and social context	PO – 4

Major Core III- Probability and Statistics

Course code: PM2013

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To upgrade the knowledge in Probability theory
2. To solve NET / SET related Statistical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the basic probability axioms, conditional probability, random variables and related concepts	PSO -2	R
CO - 2	compute marginal and conditional distributions and check the stochastic independence	PSO -2	U, Ap
CO - 3	recall Binomial, Poisson and Normal distributions and learn new distributions such as multinomial, Chi square andBivariate normal distributions.	PSO - 4	R, U
CO - 4	learn the transformation technique for finding the p.d.f of functions of random variables and use these techniques to solve related problems	PSO – 3,1	U, Ap
CO - 5	employ the relevant concepts of analysis to determine limiting distributions of random variables	PSO - 2	Ap
CO - 6	learn estimation, Point estimation and Confidence Intervals for Means, difference of means and variances.	PSO-2	U, Ap
CO - 7	design probability models to deal with real world problems and solve problems involving probabilistic situations.	PSO – 1,3	C, Ap

Unit I Conditional Probability and Stochastic Independence

Conditional probability - Marginal and conditional distributions, Correlation coefficient - Stochastic independence - Necessary and sufficient conditions for stochastic independence.

Unit II Some Special Distributions

The Binomial, Trinomial and Multinomial distributions - Poisson distribution - Gamma, Chi-square, Normal and Bivariate Normal distributions.

Unit III Distributions of Functions of Random Variables

Sampling theory - Transformations of variables of discrete and continuous type - Beta distribution, the t and F distributions

Unit IV Limiting Distributions

Limiting distributions - Stochastic convergence - Limiting moment generating functions - Central limit theorem - Some theorems on limiting distributions.

Unit V Estimation

Estimation- Point Estimation- Measures of quality of Estimators- Confidence Intervals forMeans- Confidence intervals for difference of Means- Confidence intervals for Variances.

Text Book:

Robert V. Hogg., & Allen T. Craig. (2004). Introduction to Mathematical Statistics. (4th edition). New Delhi, Pearson Education.

Chapter 2: 2.1 to 2.4; Chapter 3: 3.1 to 3.5; Chapter 4: 4.1 to 4.4

Chapter 5: 5.1 to 5.5; Chapter 6: 6.1 to 6.5

Reference Books:

1. Kapur, J.N., & Saxena, H.C. (2010). Mathematical Statistics. (12th Edition). S. Chand & Co.
2. Kadarkarai Thangam, K., & Subas Chandra Bose, A. (1995). Probability andStatistics. (1st Edition). Jeyalakshmi Publishers.
3. Morris H. DeGroot. (1975). Probability and Statistics. Addison Wesley Publishing Company.
4. Suddhendu Biswass., & Sriwastav, G.L. (2011). Mathematical Statistics. Narosa Publishing House.
5. Murthy, T.S.R. (1995). Probability and Statistics (1st Edition). I.K. International Publishing House.

Elective I (a) - Numerical Analysis

Course Code: PM2015

No. of hours per week	Credits	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To study the various behaviour pattern of numbers
2. To study the various techniques of solving applied scientific problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the methods of finding the roots of the algebraic and transcendental equations.	PSO - 2	R
CO - 2	understand the significance of the finite, forward, backward and central differences and their properties.	PSO - 3	U
CO - 3	learn the procedures of fitting straight lines and curves.	PSO - 2	U
CO - 4	compute the solutions of a system of equations by using appropriate numerical methods.	PSO - 1	Ap
CO - 5	solve the problems in ODE by using Taylor's series method, Euler's method etc.	PSO - 4	Ap

Unit I

Solution of Algebraic and Transcendental Equations - Introduction - Bisection Method - Method of False Position - Ramanujan's Method - Secant Method - Muller's Method.

Unit II

Differences of a polynomial - Newton's formulae for Interpolation - Central Difference Interpolation formulae - Gauss's central difference formulae - Stirling's formula - Bessel's formula - Everett's formula - Relation between Bessel's and Everett's formulae - Practical Interpolation.

Unit III

Least squares and Fourier Transforms - Introduction - Least squares Curve Fitting Procedure - Fitting a straight line - Multiple Linear Least squares - Linearization of Nonlinear laws - Curve fitting by Polynomials.

Unit IV

Numerical Linear Algebra - Introduction - Triangular Matrices - LU Decomposition of a matrix - Solution of Linear systems - Direct Methods - Gauss elimination - Necessity for Pivoting - Gauss - Jordan method - Modification of the Gauss method to compute the inverse - LU Decomposition method - Solution of Linear systems - Iterative methods.

Unit V

Numerical Solution of Ordinary Differential Equations - Solution by Taylor's series - Picard's method of successive approximations - Euler's method - Runge - Kutta methods - II order and IV order.

Text Book:

Sastry, S. S. (2000). Introductory Methods of Numerical analysis. (5th Edition). New Delhi, Prentice Hall of India PVT. Ltd.
Chapter 2: 2.1 to 2.3, 2.6 to 2.8; Chapter 3: 3.5 to 3.8; Chapter 4: 4.1, 4.2 (4.2.1 to 4.2.4)
Chapter 7: 7.1 to 7.3, 7.5 (7.5.1 to 7.5.4, 7.5.6), 7.6; Chapter 8: 8.1 to 8.5.

Reference Books:

1. Balagurusamy, E. (2002). Numerical Methods. New Delhi: Tata McGraw Hill Publishing Company Ltd.
2. Rao, H. S. G. (2011). Numerical Methods. New Delhi: IK International publishing House PVT. Ltd.
3. Goel Mittal. (2011). Numerical Anaysis. (21st Edition). Pragati PrakashanEducational Publishers.
4. Vedamurthy, V. N., & N. ch. S. N. Iyengar. (2009). Numerical Methods. New Delhi,Vikas Publising House PVT. LTD.
5. Devi Prasad. (2010). An Introduction to Numerical Anaysis. Narosa PublishingHouse

Elective II(a)-Classical Dynamics

Course Code: PM2025

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To gain deep insight into concepts of Dynamics
2. To do significant contemporary research

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	recall the concepts of Newton's laws of motion, momentum, acceleration, motion of a particle.	PSO - 4	R
CO – 2	understanding the generalized co-ordinates of the Mechanical system.	PSO - 1	U
CO – 3	apply D'Alembert's Principle to solve the problems involving system of particles.	PSO - 2	Ap
CO - 4	solve the Newton's equations for simple configuration using various methods.	PSO - 1	C
CO - 5	transforming the Lagrangian equations to Hamiltonian equations.	PSO - 2	U
CO - 6	define the canonical transformations and Lagrange and Poisson brackets.	PSO - 4	R
CO -7	evaluate the system of particles by deriving the Jacobi equation and Jacobi's theorem.	PSO - 1	E
CO - 8	understand the foundation of Hamilton's Principle and differential forms.	PSO - 2	U

Unit I

The Mechanical System - Generalized coordinates - Constraints - Virtual work and D' Alembert's Principle - Energy and Momentum.

Unit II

Derivation of Lagrange's equations - Problems using Lagrange's equation - Integrals of the motion.

Unit III

Hamilton's Principle - Hamilton's Equations - Legendre transformation - Other Variational Principles - Modified Hamilton's Principle - Principle of least action – Examples

Unit IV

Hamilton's Principal function - The canonical integral - Pfaffian differential forms - The Hamilton - Jacobi equation - Jacobi's theorem - Conservative systems and ignorable coordinates - Examples.

Unit V

Canonical Transformations - Differential forms and generating functions - Special transformations - Lagrange and Poisson brackets.

Text Book:

Greenwood G. T. (1979). Classical Dynamics. Prentice Hall.

Chapter 1: 1.1 - 1.5; Chapter 2: 2.1 - 2.3; Chapter 4:4.1 - 4.3
Chapter 5: 5.1, 5.2; Chapter 6: 6.1 - 6.3

Reference Books:

1. Goldstein, H. (1994). Classical Mechanics. (2nd Edition). Narosa Publishing.
2. Synge, J. L., & Griffith, B. A. (1959). Principle of Mechanics. McGraw Hill.
3. Rutherford, D. E. (2000). Classical Mechanics. New York: Oliver Boyd.
4. Chorlton, F. (1969). Text book of Dynamics. Van Nostrand.
5. Javier E. Hasbun. (2009). Classical Mechanics. Jones and Bartlett Publishers.

Elective III (a)-Algebraic Number Theory and Cryptography

Course code   : PM2034

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To gain deep knowledge about Number theory

2. To study the relation between Number theory and Abstract

3. To know the concepts of Cryptography

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	Recall the basic results of field theory	PSO - 1	R
CO - 2	Understand quadratic and power series forms and Jacobi symbol	PSO - 2	U
CO - 3	Apply binary quadratic forms for the decomposition of a number into sum of sequences	PSO - 3	Ap
CO - 4	Determine solutions using Arithmetic Functions	PSO - 3	Ap
CO - 5	Calculate the possible partitions of a given number and draw Ferrer's graph	PSO - 2	An
CO - 6	Identify the public key using Cryptography	PSO - 4	An

Unit I

Quadratic Reciprocity and Quadratic Forms: Quadratic Residues - Quadratic Reciprocity - The Jacobi Symbol.

Unit II

Binary Quadratic Forms - Equivalence and Reduction of Binary Quadratic Forms - Sum of Two Squares.

Unit III

Some Functions of Number Thoery: Arithmetic functions- The Mobius Inversion Formula- Multiplicative functions. Some Diophantine Equations: Pythagorean Triangles.

Unit IV

The Partition Function - Ferrers Graphs - Formal Power Series - Eulers Identity - Eulers Formula.

Unit V

Public Key Cryptography – Concepts of public key Cryptography – RSA –Discrete logarithm - Basic facts - Elliptic curve cryptosystems.

Text Book:

1. Ivan Niven., Herbert S. Zuckerman., & Hugh L. Montgomery. (2006). An Introduction to the Theory of Numbers. (5th Edition). John - Wiley & Sons.
   Chapter 3: 3.1 - 3.6; Chapter 4: 4.2 and 4.3; Chapter 5: 5.3; Chapter 10: 10.1 - 10.4
2. Neal Koblitz, A Course in Number Theory and Cryptography Second Edition, Springer-Verlag, New York 1987.
   Chapter 4: 1-3; Chapter 6: 1 and 2

Reference Books:

1. Hardy, G. H., & Wright E. M. (1975). An Introduction to the Theory of Number. (4th Edition). Oxford at the Clarendon Press.
2. David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, lowa,1989.
3. Tom. M. Apostol. (1998). Introduction to Analytic Number Theory. Narosa Publishing House.
4. Kenneth Ireland., & Michael Rosen. (1990). A classical Introduction to Modern Number Theory. (2nd Edition). Springer International Edition.
5. Graham Everest., & Thomas Ward. (2008). An Introduction to Number Theory. Springer International Edition.
6. John Stillwell. (2008). Elements of Number Theory. Springer International Edition.
7. Cryptography and Network Security Principles and Practice by William Stallings, Prentice Hall, Fifth Edition, New Delhi, 2011.

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Semester III

Elective III (b)- Stochastic Processes

Sub. Code: PM2035

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No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To understand the stochastic models
2. To relate the models studied to real life probabilistic situations

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Course Outcome

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CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	analyze and apply various probability models to describe random phenomena in real-world scenarios.	PSO – 1	An
CO – 2	develop proficiency in modeling and analyzing Markov chains, including their steady-state behavior and applications in decision-making processes.	PSO – 3	Ap
CO – 3	gain the skills to simulate and analyze stochastic processes using computational tools, enabling them to make probabilistic predictions.	PSO – 2	U
CO - 4	learn the fundamentals of stochastic calculus, enabling them to work with stochastic differential equations and their applications in finance and science.	PSO - 2	U
CO - 5	assess and manage risk in different contexts, such as finance and engineering, by applying stochastic modeling and decision-making techniques.	PSO - 4	An

Unit I

Stochastic processes - Specification of Stochastic processes - Stationary processes - Markov chain - Transition probabilities - Random walk - Higher transition probabilities.

Unit II

Classification of states and chains - Transient and recurrent states - Stability of a Markov system.

Unit III

Markov process with discrete state space - Poisson process - Generalizations of Poisson process - Poisson Cluster process - Pure birth process - Yule-Furry process - Birth Immigration Process - Birth and death process.

Unit IV

Renewal processes - Renewal process in Discrete time - Renewal process in continuous time - Renewal equation - Renewal theorems - Residual and current life times.

Unit V

Stochastic processes in queuing - Queuing processes - Steady state behaviour of M/M/1 queuing model -Non-Markovian queuing models - Queues with Poisson input- M/G/1 and GI/M/1 queuing models.

Text Book:

Medhi, J. (1994). Stochastic Processes. (Second Edition). New Age International Publishers. New Delhi.

Chapter 2: Sections 2.1, 2.2, 2.3; Chapter 3: Sections 3.1, 3.2, 3.4, 3.6.

Chapter 4: Sections 4.1, 4.3 (except 4.3.5 - 4.3.7), 4.4.

Chapter 6: Sections 6.1.1- 6.1.3, 6.2 (except example 2(b)), 6.3, 6.5 (except 6.5.2), 6.7.

Chapter 10: Sections 10.1(except 10.1.4), 10.2 (except 10.2.3.1),10.7 (except examples 7(a),7(b) & sections 10.7.3,10.7.4), 10.8 (except example 8(a)).

Reference Books:

1. Narayan Bhat, U. (1972). Elements of Applied Stochastic Processes. (Second Edition). John Wiley & Sons. New York.
2. Prabhu, N.V. (1970). Stochastic Processes. Mac Millon. New York.
3. Bhat, B.R. (2010). Stochastic Models Analysis and Applications. New Age International (P) Limited Publishers.
4. Veerarajan, T. (2006). Probability, Statistics and Random Processes. Tata McGraw - Hill Publishing Company Limited.
5. Salil Kumar Chaudhri., & Ashis K. Chakraborthy. (2009). Statistical Methods. Asian Books Private Ltd.

Semester IV

Major Core XIV - Operations Research

Course code   : PM2043

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	90	100

Objectives:

1. To learn optimizing objective functions

2. To solve life oriented decision making problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	Explain the fundamental concept of DP model , Inventory model and Queuing model	PSO - 2	U
CO - 2	Relate the concepts of Arrow (Network)diagram representations, in critical path calculations and construction of the Time chart	PSO - 3	U
CO - 3	Distinguish deterministic model and single item	PSO - 3	E
CO - 4	Interpret Poisson and Exponential distributions and apply these concepts in Queuing models	PSO - 4	Ap
CO - 5	Solve life oriented decision making problems by optimizing the objective function	PSO - 1	C

Unit I

Elements of the DP Model - The Capital Budgeting Example - More on the definition of the state - Examples of DP Models and computations - Solution of Linear Programming by Dynamic programming - Game theory.

Unit II

Arrow (Network) Diagram Representations - Critical Path Calculations - Construction of the Time Chart and Resource Leveling - Probability and Cost Considerations in Project Scheduling.

Unit III

A Generalised Inventory model - Types of Inventory Models - Deterministic Models - Single Item Static Model - Single Item Static - Model with Price Breaks - Multiple - Item Static Model with Storage Limitations - Single - Item.

Unit IV

Basic Elements of the Queueing Model - Roles of Poisson and Exponential Distributions - Queue with Combined Arrivals and Departure - Queueing Models of Type : (M/M/1): (GD/∞/∞) , (M/M/1): (GD/N/∞) .

Unit V

Queueing Models of Types : (M/G/1): (GD/∞/∞) - The Pollaczek - Khintchine Formula, (M/M/C) : (GD/∞/∞) - (M/M/∞) : (GD/∞/∞) Self service Model, (M/M/R) : (GD/K/K) R < K - Machine Service -Tandem or series queues .

Text Book:

Handy A. Taha. (1989). Operations Research - An Introduction. (3rd Edition). MacMillan Publishing Co. Inc.

Chapter 9: Section 9.1 - 9.3, 9.5; Chapter 11: Section 11.4
Chapter 12: Section 12.1 - 12.4; Chapter 13 : Section 13.1 - 13.3 (except 13.3.5)
Chapter 15: Section 15.1, 15.2 (only 15.2.1, 15.2.2), 15.3 (15.3.1, 15.3.2, 15.3.3, 15.3.4, 15. 3.6, 15.3.7), 15.5 - (only15.5.1).

Reference Books:

1. Er. Prem Kumar Gupta., & Dr. Hira, D.S. (2014). Operations Research. (7th Edition). S. Chand and company private ltd.
2. Sharma, J.K. (2009). Operations Research: Theory and Applications. (4th Edition). Macmillian Publishers India ltd.
3. Panneerselvam, R. (2009). Operations Research. (2nd Edition). PHI Learning private ltd.
4. Prem Kumar Gupta., Dr. Hira, D. S., & AartiKamboj. (2012). Introduction to Operations Research. S. Chand and Company ltd.
5. Naidu, N. V. R., Rajendra, G., & Krishna Rao, T. (2011). Operations Research. (Kindle Edition). IK. International Publishing house private ltd.

	Content Addressing Professional Ethics
	Content Addressing Environmental Sustainability