

DEPARTMENT OF MATHEMATICS

VISION

The Department of Mathematics, SLIET, has always strived to be among the best Mathematics Departments in the country and has worked towards becoming a centre for advanced research in various areas of mathematics so that it can contribute to the development of the nation.

MISSION

- To work towards transformation of young people to competent and motivated professionals with sound theoretical and practical knowledge.
- To make students aware of technology to explore mathematical concepts through activities and experimentation.
- To produce post-graduate students with strong foundation to join research or to serve in industry.
- To create an atmosphere conducive to high class research and to produce researchers with clear thinking and determination who can, in future, become experts in relevant areas of mathematics.
- To inculcate in students the ability to apply mathematical and computational skills to model, formulate and solve real life applications.
- To make the students capable of discharging professional, social and economic responsibilities ethically.

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समयास

विधि

INTEGRATED BSc-MSc PROGRAMME

Syllabus & Scheme of Mathematics in BSc Programme

(From the Academic Year 2024-25 Onwards)

BOARD OF STUDY



DEPARTMENT OF MATHEMATICS
SANT LONGOWAL INSTITUTE OF ENGINEERING &
TECHNOLOGY


(Deemed to be University under Ministry of Education, Govt. of India)
Longowal – 148106 (Punjab) INDIA

MM
03/06/24
Head
Department of Mathematics
Sant Longowal Institute of Engg. & Tech.
Longowal, Distt. Sangrur (Pb.) - 148106

Chin *JR* *RRM* *I* *AA* *Mal*
Sudhir *ਸੁਧੀਰ* *ਕੌਰ* *Is* *YD*

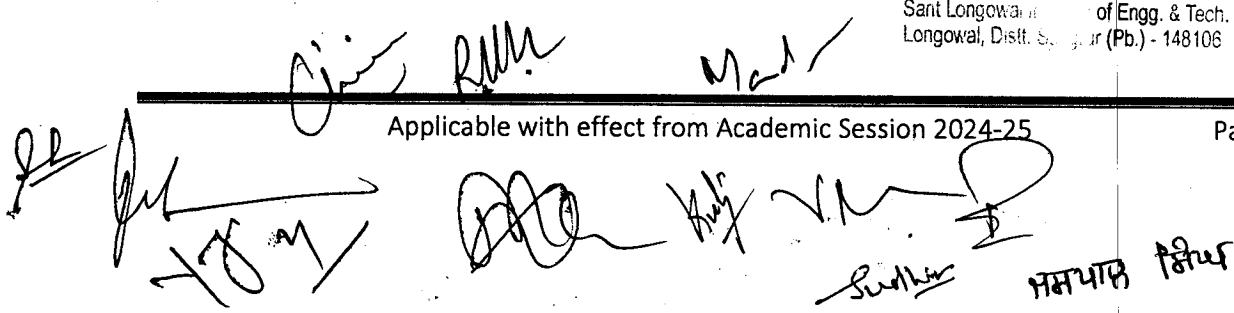
Study Scheme of Integrated B.Sc.-M.Sc. for Semester I to VI

Semester - I			
S.No.	Subject Code	Subject Title	L-T-P
1	PCMM-311	Mathematics -I (Calculus-I)	3-0-0
2	PCMM-312	Mathematics -II (Basic Algebra)	3-0-0
3	PCMP-311	Physics-I	4-0-0
4	PCMP-312	Physics Lab-I	0-0-2
5	PCMCS-311/PCMC-311	Computer Science-I (Object Oriented Programming in C++)/ Chemistry-I	4-0-0
6	PCMCS-312/PCMC-312	Computer Science Lab -I/ Chemistry Lab-I	0-0-2
7	PCMA-311	Language Skills- A or B	2-0-0
			20
Semester -II			
S.No.	Subject Code	Subject Title	L-T-P
1	PCMM-321	Mathematics -III (Calculus-II)	3-0-0
2	PCMM-322	Mathematics -IV (Coordinate Geometry)	3-0-0
3	PCMP-321	Physics-II	4-0-0
4	PCMP-322	Physics Lab-II	0-0-2
5	PCMCS-321/PCMC-321	Computer Science-II(Data Structure and File Processing)/ Chemistry-II	4-0-0
6	PCMCS-322/PCMC-322	Computer Science Lab -II/ Chemistry Lab-II	0-0-2
7	PCMS-321	Fundamentals of Computer	2-0-0
			20
Semester -III			
S.No.	Subject Code	Subject Title	L-T-P
1	PCMM-411	Mathematics -V (Advanced Calculus)	3-0-0
2	PCMM-412	Mathematics -VI (Ordinary Differential Equations)	3-0-0
3	PCMP-411	Physics-III	4-0-0
4	PCMP-412	Physics Lab-III	0-0-2
5	PCMCS-411/PCMC-411	Computer Science-III (Numerical Computing)/ Chemistry-III	4-0-0
6	PCMCS-412/PCMC-412	Computer Science Lab -III/ Chemistry Lab-III	0-0-2
7	PCMA-321	Environmental Sciences	2-0-0
			20
Semester -IV			
S.No.	Subject Code	Subject Title	L-T-P
1	PCMM-421	Mathematics -VII (Statistics & Probability)	3-0-0
2	PCMM-422	Mathematics -VIII (Partial Differential Equations)	3-0-0
3	PCMP-421	Physics-IV	4-0-0
4	PCMP-422	Physics Lab-IV	0-0-2
5	PCMCS-421/PCMC-421	Computer Science-IV (Design and Analysis of Algorithms)/ Chemistry-IV	3-0-0/ 4- 0-0
6	PCMCS-422/PCMC-422	Computer Science-IV (Discrete Mathematics)/ Chemistry Lab-IV	3-0-0/ 2- 0-0
7	PCMV-421	Indian Knowledge System	2-0-0
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The board of studies (BOS) for Mathematics courses in B.Sc. programme (Part of Integrated BSc-MSc programme) of Department of Mathematics included the following members:

Chairman

- Dr. J.R. Sharma, Professor & Head, Department of Mathematics, SLIET Longowal

External Members

- Dr. Vinay Kanwar, Professor, Department of Applied Sciences, UIET, Panjab University
- Dr. Mahesh Kumar Sharma, Professor, School of Mathematics, Thapar University, Patiala

Members

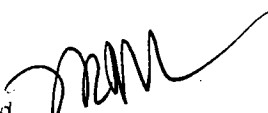
- Dr. S.S. Dhaliwal, Professor
- Dr. Mandeep Singh, Professor
- Dr. Vinod Mishra, Professor
- Dr. Sushma Gupta, Professor
- Dr. V.K. Kukreja, Professor
- Dr. R.K. Mishra, Professor
- Dr. R.K. Guha, Professor
- Dr. Yogesh Kapil, Assistant Professor
- Dr. Sudhir Kumar, Assistant Professor

Alumni Member

- Dr. Chinu Singla, Guest Faculty, Department of Mathematics, SLIET, Longowal

Parent Member

- Shri Jaspal Singh F/O Ms. Jatinder Kaur (M.Sc. Reg. No. 2262015)

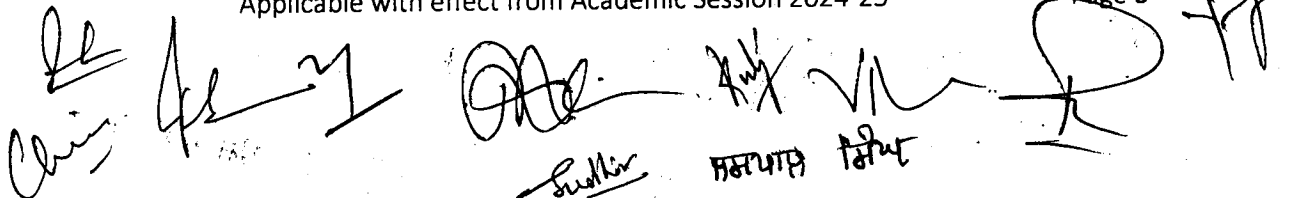

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Mathematics Syllabi in B.Sc.

Calculus-I

Subject Code : PCMM- 311


Weekly load : 3 hours

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Order property of real numbers, Bounds: l.u.b. and g.l.b. order completeness property of real numbers, Archimedean property of real numbers	5
	ϵ - δ definition of the limit of a function, Basic properties of limits, Infinite limits, Continuous functions, Types of discontinuities, Intermediate value theorem	6
	Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, their geometric interpretation and applications, Taylor's theorem, Maclaurin's theorem with various form of remainders and their applications, Indeterminate forms and L'Hospital rule	12
Unit-II	Differentiation of Hyperbolic and inverse hyperbolic functions, Successive differentiations, Leibnitz's theorem	7
	Concavity, convexity and points of inflexion, Multiple points, Asymptotes and curve tracing (cartesian and polar coordinates)	15

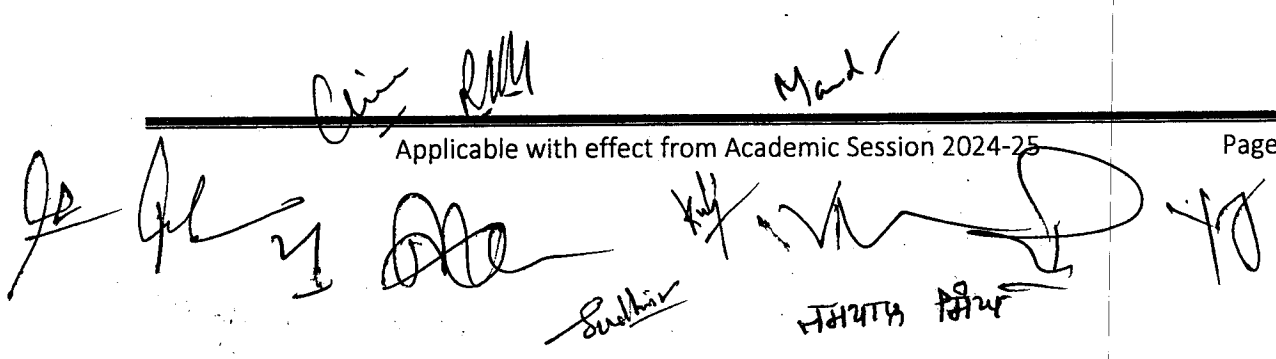
References:

1. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
2. Shanti Narayan and P. K. Mittal, Differential Calculus, Edition 2006, S. Chand & Co., New Delhi.
3. T. M. Apostol, Calculus (Vol. I, II), John Wiley and Sons (Asia) P. Ltd., 2002.



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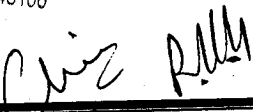
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Semester -V			
S.No.	Subject Code	Subject Title	L-T-P
1	PCMM-511	Real Analysis	3-1-0
2	PCMM-512	Abstract Algebra	3-1-0
3	PCMM-513	Mathematical Methods	3-1-0
4	PCMM-514	Number Theory	3-0-0
5	PCMOE-51*	Interdisciplinary (Open Elective)	03
6	PCMV-511	Life Management Skills	02
			20
Semester -VI			
S.No.	Subject Code	Subject Title	L-T-P
1	PCMM-521	Mechanics	3-1-0
2	PCMM-522	Linear Algebra	3-1-0
3	PCMM-523	Complex Variables	3-0-0
4	PCMME-521	Linear Programming Problems (Department Elective)	3-1-0
	PCMME-522	Numerical Analysis (Department Elective)	3-0-1
5	PCME-521	Interdisciplinary (Open Elective)	03
6	PCMS-522	Mathematica & Latex	0-0-2
			20

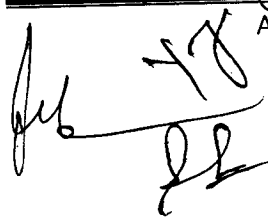





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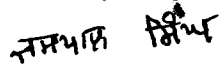

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Object Oriented Programming in C++

Subject Code : PCMCS-311


Weekly load : 4 hours Theory

Credits: 4 (Lectures 4-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Algorithm and its characteristics, pseudo code / flow chart, program, identifiers, variables, constants, primitive data types, expressions, structured data types, arrays, compilers and interpreters.	8
	Assignment statement, if then else statements, switch statement, looping statements- while, do while, for, break, continue, input/output statements, functions/procedures.	11
	Abstraction, encapsulation, objects, classes, methods, constructors, inheritance, polymorphism, static and dynamic binding, overloading. Program Development: Object oriented analysis, design, unit testing & debugging, system testing & integration, maintenance.	11
Unit-II	data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operator precedence, variables and constant declarations, expressions.	10
	Input using the extraction operator >> and cin, output using the insertion operator << and cout, preprocessor directives, increment (++) and decrement operations (--), creating a C++ program, input/output, relational operators, logical operators and logical expressions, if and if ... else statement, switch and break statements, "for", "while" and "do - while" loops, break and continue statement, nested control statement.	10
	Value returning functions, void functions, value versus reference parameters, local and global variables, static and automatic variables, enumeration type, one dimensional array, two dimensional array, character array, pointer data and pointer variables.	10

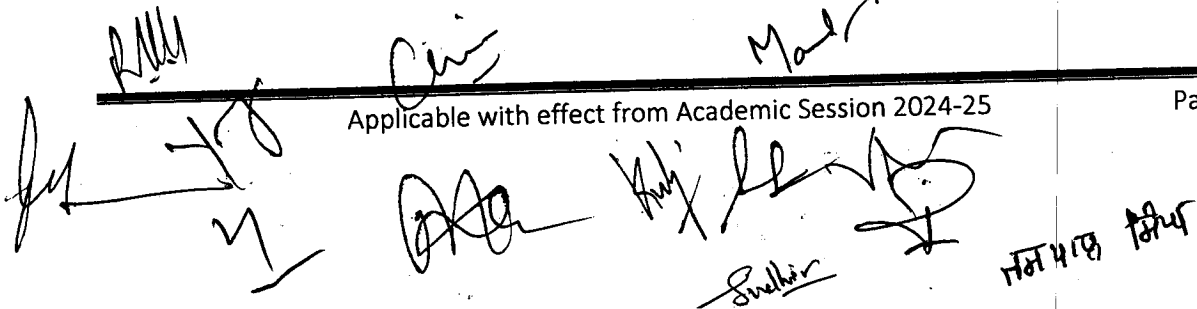
References

1. Richard Johnson, *An Introduction to Object-Oriented Application Development*, Thomson Learning (2006).
2. B. Stroustrup, *The C++ Programming Language*, Addison Wesley (2004).
3. Y. Kanetkar, *Let us C++*, BPB Publications (2020).
4. E. Balaguruswamy, *Programming in C++*, Tata McGraw-Hill (1992).


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Basic Algebra

Subject Code : PCMM-312


Weekly load : 3 hours


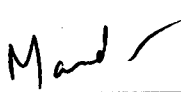
Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Euclid's algorithm, Synthetic division, Roots and their multiplicity, Relation between roots and co-efficients, Transformation of equations, Descartes' Rule of Signs	7
	Newton's method of divisors, Solution of cubic and bi-quadratic equations, Cardan's method for solving a cubic, Descarte's and Ferrari's method for a bi-quadratic	8
	D'Moivre's theorem, Application of D'Moivre's theorem including primitive n^{th} root of unity. Expansions of $\sin n\theta$, $\cos n\theta$, $\sin^n \theta$, $\cos^n \theta$, ($n \in \mathbb{N}$)	7
Unit-II	Exponential, logarithmic, direct and inverse circular and hyperbolic functions of a complex variable	5
	Hermitian and skew-Hermitian matrices, Linear dependence of row and column vectors, Row rank, Column rank and rank of a matrix and their equivalence. Theorems on consistency of a system of linear equations (both homogeneous and non-homogeneous)	9
	Eigenvalues, eigenvectors and characteristic equation of a matrix, Cayley-Hamilton theorem and its use in finding inverse of a matrix	9


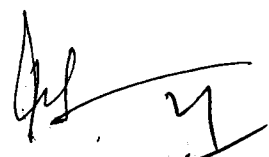
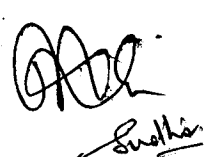
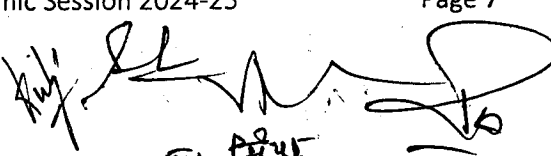
References:

1. Shanti Narayan and P.K. Mittal, A Text Book of Matrices, S. Chand & Co., New Delhi, Revised Edition, 2007.
2. S. R. Knight and H.S. Hall, Higher Algebra, H.M. Publications, 1994.
3. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning Publishers (2004).
4. R.S. Verma and K.S. Shukla, Text Book on Trigonometry, Pothishala Pvt. Ltd., Allahabad (1999).


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Sushila
तमपल मिश्र

Calculus-II

Subject Code : PCMM-321

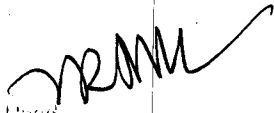
Weekly load : 3 hours


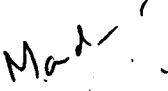

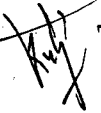


Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Integration of Hyperbolic and inverse hyperbolic functions, Reduction Formulae.	6
	Summation of Series, Quadrature, rectification, Volumes and surfaces of solids of revolution (Cartesian co-ordinates only)	7
	Limit and continuity of functions of two and three variables, Partial differentiation, Change of variables, Partial derivatives and differentiability of real-valued functions of two and three variables	10
Unit-II	Euler's theorem on homogeneous functions, Taylor's theorem for functions of two variables and applications, Jacobians	7
	Maxima, minima and saddle points of functions of two variables, Lagrange's multiplier method	6
	Gradient, Divergence and Curl with their properties and applications (equations of tangent and normal)	9

References :

1. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
2. Shanti Narayan and P.K. Mittal, Differential Calculus, Edition 2006, S. Chand & Co., New Delhi.
3. T. M. Apostol, Calculus (Vol. I, II), John Wiley and Sons (Asia) P. Ltd., 2002.


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Lab-I (C++ Programming)

Subject Code : PCMCS-312

Weekly load : 4 hours Lab

Credits: 2 (Lectures 0-Tutorials 0-Practical 2)

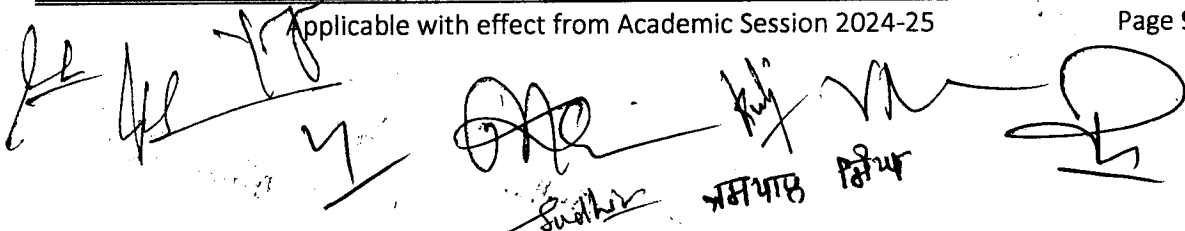
Programs based on the course PCMCS-311 (Object Oriented Programming in C++) will be performed using C++ Language.


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Santhia *Blaker* *Patru*

Data Structure and File Processing

Subject Code : PCMCS-321


Weekly load : 4 hours Theory

Credits: 4 (Lectures 4-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Basic Data Structures: Abstract data structures- stacks, queues, linked lists and binary trees. Sets: Dictionary implementation, use of priority queues, hashing, binary trees, balanced trees, sets with merge-find operations.	7
	Searching: Internal and external searching, use of hashing and balancing techniques. Memory Management: Garbage collection algorithms for equal sized blocks, storage allocation for objects with mixed size, buddy systems.	10
Unit-II	Physical Devices: Characteristics of storage devices such as disks and tapes, I/O buffering. Basic File System Operations: Create, open, close, extend, delete, read- block, write-block, protection mechanisms.	10
	File Organizations: Sequential, indexed sequential, direct, inverted, multi-list, directory systems, Indexing using B-tree, B+ tree and their variants, hashing – hash function, collision handling methods, extendible hashing.	13

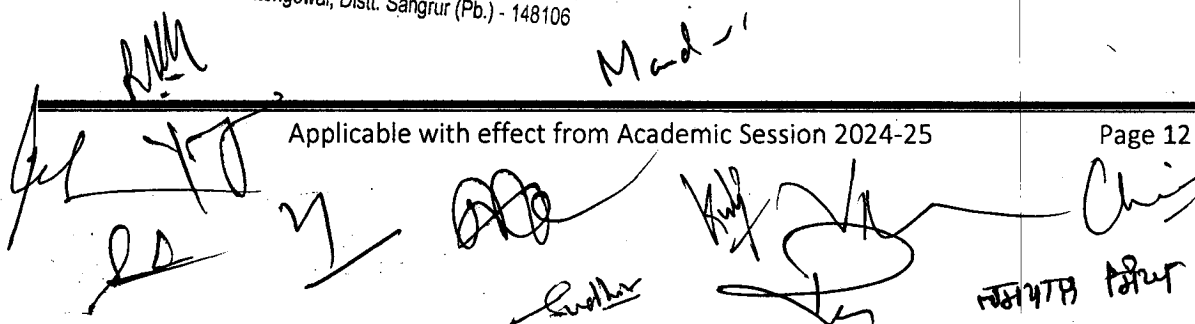
Referenes

1. Richard Johnson, *An Introduction to Object-Oriented Application Development*, Thomson Learning, 2006.
2. B. Stroustrup, *The C++ Programming Language*, Addison Wesley, 2004.
3. M.T. Goodrich, R. Tamassia and D. Mount, *Data Structures and Algorithms in C++*, John Wiley and Sons, Inc., 2004.
4. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms*, 2nd Ed., Prentice-Hall of India, 2006.


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Coordinate Geometry

Subject Code : PCMM-322


Weekly load : 3 hours

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Equation of pair of straight lines and angle between them, Conditions of parallelism and perpendicularity, Joint equation of the angle bisectors	5
	General equation of circle, Circle through intersection of two lines, Tangent, Normal, chord of contact, Pair of tangents from a point, Equation of chord in terms of mid-point, Angle of intersection and orthogonality	6
	General equation of a conic, Tangent, Normal, Chord of contact, Pair of tangents from a point, Equation of chord in terms of mid-point, Diameter, Conjugate diameters of ellipse and hyperbola, Special properties of parabola, ellipse and hyperbola	10
Unit-II	Section of a sphere and a plane, Spheres through a given circle, Intersection of a line and a sphere, Tangent line, Tangent plane, Angle of intersection of two spheres and condition of orthogonality, Co-axial family of spheres	8
	Cylinder as a surface generated by a line moving parallel to a fixed line and through a fixed curve, Different kinds of cylinders such as right circular, elliptic, parabolic and hyperbolic cylinders in standard forms	8
	Cone with vertex at the origin, Homogeneous equation of second degree in x, y, z , cone as a surface generated by a line passing through a fixed curve and a fixed point outside the plane of the curve, right circular and elliptic cones	8

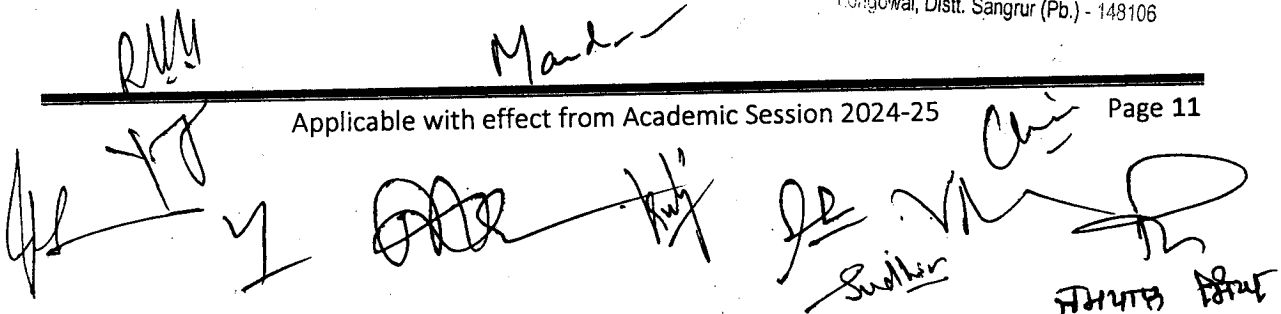
References :

1. S. L. Loney, The Elements of Coordinate Geometry, Macmillan and Company, London, 2nd Edition 2007.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 1999.
3. Shanti Narayan and P. K. Mittal: Analytical Solid Geometry, Seventeenth Revised Edition, S. Chand & Co., New Delhi, 2006.
4. P. K. Jain and Khalil Ahmad, Analytic Geometry of Two Dimensions, New Age International Publishers, 2022.
5. P. K. Jain and Khalil Ahmad, Analytic Geometry of Three Dimensions, New Age International Publishers, 2022.


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Advanced Calculus

Subject Code : PCMM-411


Weekly load : 3 hours

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Definition of a sequence, Bounds of a sequence, convergent, divergent and oscillatory sequences, algebra of limits, monotonic sequences, Cauchy's theorems on limits, sub-sequences, Bolzano-Weirstrass theorem, Cauchy's convergence criterion. sequential continuity and uniform continuity of functions of single variable	11
	Series of non-negative terms, p-test, comparison tests, Cauchy's integral test, Cauchy's root test, ratio tests, D'Alembert's test, Raabe's test, Gauss test, logarithmic test, alternating series, Leibnitz's theorem, absolute and conditional convergence	11
Unit-II	Double integral, area of bounded regions in plane, double integrals as volumes, change of variables in double integrals, change to polar coordinates, area in polar coordinates, triple integral, volume, change of variables in a triple integral to cylindrical and spherical coordinates	16
	Line, surface and volume integration. Gauss divergence theorem, Stokes' theorem, Green's theorem	7

References :

1. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
2. Shanti Narayan and P .K. Mittal, Differential Calculus, Edition 2006, S. Chand & Co., New Delhi.
3. P.K. Jain and S. K. Kaushik, An Introduction to Real Analysis, S. Chand & Co., New Delhi, 2000.
4. T. M. Apostol, Calculus (Vol. I, II), John Wiley and Sons (Asia) P. Ltd., 2002.
5. S. C, Malik and Savita Arora, Mathematical Analysis, New Age International Publishers, 2022.


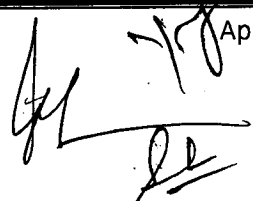



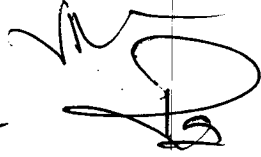



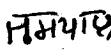

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Lab-II (Data Structure and File Processing)

Subject Code : PCMCS-322

Weekly load : 4 hours Lab

Credits: 2 (Lectures 0-Tutorials 0-Practical 2)

Programs based on the course PCMCS-321 (Data Structure and File Processing) will be performed using C++ Language.

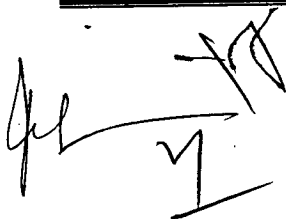

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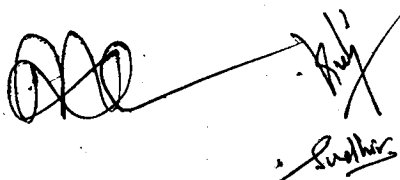


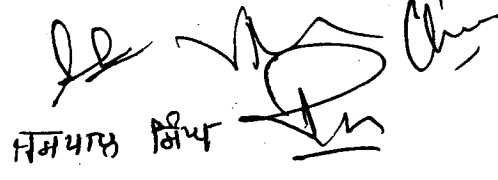


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Numerical Computing

Subject Code: PCMCS-411

Weekly load : 4 hours Theory

Credits: 4 (Lectures 4-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Solution to Transcendental and Polynomial Equations: bisection method, method of false position, secant method, Newton-Raphson method, fixed point iteration method; geometrical significance and rate of convergence of iterative methods.	9
	Matrices and Linear System of Equations: LU decomposition method for solving systems of equations, Jacobi and Gauss-Seidel methods. Eigenvalue problems: Rayleigh-Power method.	9
	Finite differences: various operators and relation between them, Fundamental theorem of finite difference calculus. Interpolation: Newton-Gregory forward and backward formulae, Gauss forward and backward central formulae, Lagrange's interpolation formula, Divided differences, Newton's divided differences interpolation formulae.	12
Unit-II	Curve fitting: Fitting linear and non-linear curves, method of least square for linear and quadratic curves; fitting of special curves.	7
	Numerical Differentiation using Newton's forward and backward difference formulae, Maxima and minima, Numerical Integration: Newton-Cotes formulae, trapezoidal rule, Simpson's 1/3 rd and 3/8 th rules, Error in numerical integration.	11
	Numerical Solutions of Ordinary Differential Equations: Initial value problem, Picard's and Taylor's series methods, Euler's, Modified Euler's, Runge's and Runge-Kutta (RK) methods. Numerical Solutions of Simultaneous Differential Equations: Runge-Kutta (RK) method.	12

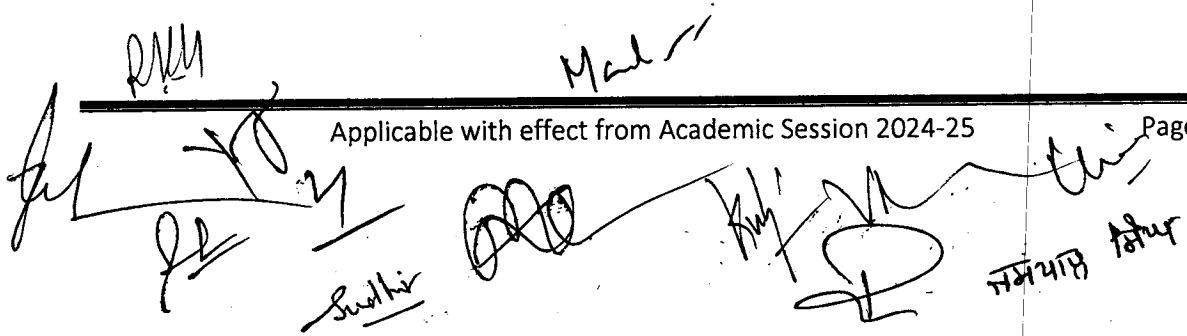
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2. K.E. Atkinson, W. Han, *Elementary Numerical Analysis*, 3rd Ed., Wiley (2003).
3. S.S. Sastry, *Introductory Method of Numerical Analysis*, PHI (2005).
4. B. S. Grewal, *Numerical Methods in Engineering & Science*, Khanna Publishers (2011).

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Ordinary Differential Equations

Subject Code : PCMM-412


Weekly load : 3 hours

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Differential equations: Introduction and review, First order first degree equations: Linear and Bernoulli equations, Exact differential equations and integrating factors, First order and higher degree equations solvable for x, y, p, Clairaut's form, Singular solution as an envelope of general solutions	8
	Geometrical meaning of a differential equations, Geometrical applications: Tangent, normal, subtangent and subnormal; Orthogonal trajectories of curves (rectangular and polar coordinates); Newton's law of cooling, Simple electric circuits	8
	Linear differential equations with constant coefficients: particular integral, complementary function and complete solution; Homogenous and non-homogenous equations	7
Unit-II	Linear differential equations with variable coefficients- Cauchy and Legendre Equations, Method of undetermined coefficients, Methods of variation of parameters and reduction of order, Simultaneous linear differential equations with constant coefficients	9
	Higher order linear differential equations with variable coefficients: Equations of the form $\frac{d^n y}{dx^n} = f(x)$; equations not containing dependent variable or independent variable; Solution by change of independent variable	5
	Applications of linear differential equations: Simple Harmonic Motion, Mass Spring Mechanical System, LCR Circuit and Simple pendulum	8

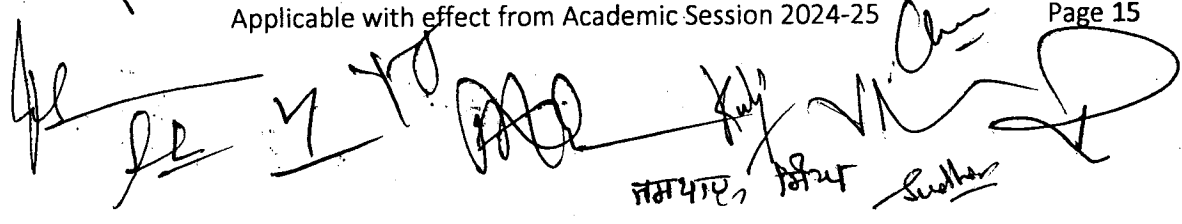
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1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. George F. Simmons, Differential equations with Applications and Historic Notes, Tata McGraw Hill.
3. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill.


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Statistics & Probability

Subject Code : PCMM-421


Weekly load : 3 hours Theory

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Origin and definition of statistics, Importance and scope of statistics, Limitations of statistics, Review of graphic presentation of data, Review of measure of central tendency, Review of measures of dispersion, Relation between standard deviation and root mean square deviation, Variance of the combined series, Coefficient of dispersion, Coefficient of variation	10
	Moments, moments about mean, moments about any arbitrary point and relation between them, Sheppard's corrections, Charlier's checks, Pearson's β and γ coefficients, Skewness, Kurtosis, Introduction of probability, different laws of probability, conditional probability, independent and dependent events, Bayes theorem.	12
Unit-II	Random variable, discrete random variables, probability mass function, continuous random variables; probability density function, distribution function and its properties, Mathematical expectation, expectation of a function of a random variable, addition and multiplication theorem of expectation. Correlation, Karl Pearson coefficient of correlation, rank correlation. regression, lines of regression, properties of regression coefficients, angle between two lines of regression.	11
	Probability distributions: Binomial, Poisson and Normal. Their chief characteristics, moments, mode, moment generating function, recurrence relations and fitting of these distributions.	12

References:

1. M.R. Spiegel, Schaum's Outline of Theory and Problems of Statistics, McGraw Hill (1992).
2. A.M. Goon, M.K. Gupta and B. Dasgupta, An Outline of Statistical Theory, Vol. I, World Press Pvt. Ltd. (2013).
3. T.W. Anderson, An Introduction to Multivariate Statistical Analysis, John Wiley (2003).
4. S.P. Gupta, Statistical Methods, S. Chand & Co., 43rd Edition, 2017.
5. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons (2014).

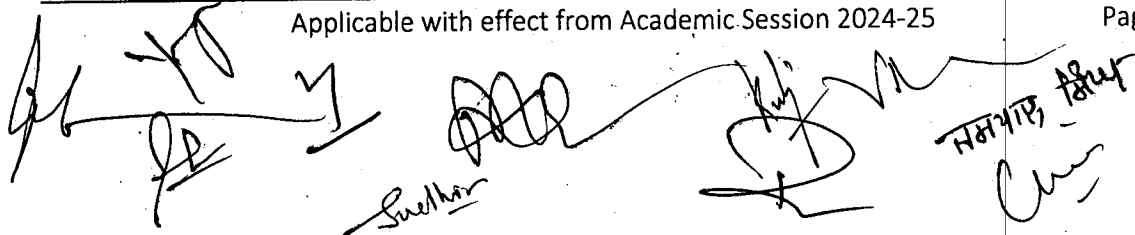

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Lab-III (Numerical Computing)

Subject Code : PCMCS-412

Weekly load : 4 hours Lab

Credits: 2 (Lectures 0-Tutorials 0-Practical 2)

Programs based on the course PCMCS-411 (Numerical Computing) will be performed using C++ Language.


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Design and Analysis of Algorithms

Subject Code : PCMCS-421


Weekly load : 3 hours Theory

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Introduction: RAM model, $O(\log n)$ bit model. Review of data structures: Balanced trees, Mergeable sets. Algorithm Design Techniques: Iterative techniques, Divide and conquer, dynamic programming, greedy algorithms.	11
	Searching and Sorting Techniques: Review of elementary sorting techniques-selection sort, bubble sort, insertion sort, more sorting techniques-quick sort, heap sort, merge sort, shell sort, external sorting.	11
Unit-II	Lower bounding techniques: Decision Trees, Adversaries. String Processing: KMP, Boyre-Moore, Robin Karp algorithms.	11
	Introduction to randomized algorithms: Random numbers, randomized Qsort, randomly Built BST Number Theoretic Algorithms: GCD, Addition and Multiplication of two large numbers, polynomial arithmetic, Fast-Fourier Transforms.	12

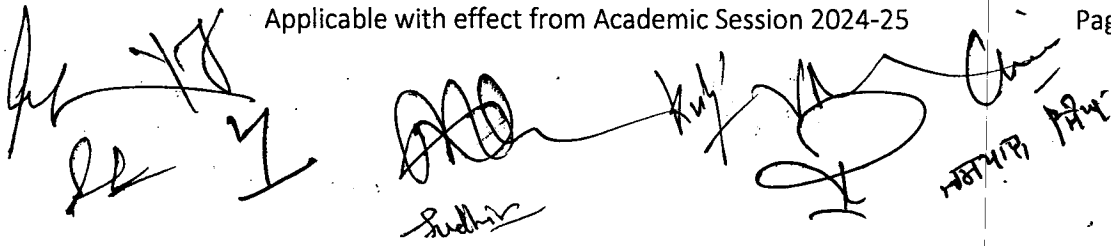
References:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms*, Prentice-Hall of India (2006).
2. J. Kleinberg and E. Tardos, *Algorithms Design*, Pearson Education (2006).
3. S. Baase, *Computer Algorithms: Introduction to Design and Analysis*, Addison Wesley (1999)
4. A.V. Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education (2006).


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Partial Differential Equations

Subject Code : PCMM-422


Weekly load : 3 hours

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Order and degree of partial differential equations, Linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order; Lagrange's Linear equation, general method, Non-linear partial differential equations of first order, Four specific cases, General method (Charpit's method)	11
	Higher order Linear partial differential equations with constant coefficients, Homogenous linear differential equations and their solution: complementary functions, particular integral, general method for particular integral, Non-homogenous linear differential equations and their solutions, Equations reducible to homogenous form	11
Unit-II	Second order partial differential equations, Canonical forms, Monge's methods, Classification into elliptic, parabolic and hyperbolic equations	10
	Method of separation of variables, One dimensional heat and wave equations, Two dimensional Heat and Laplace equations, Two dimensional heat conduction equation and Laplace equation in polar coordinates	13

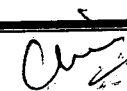
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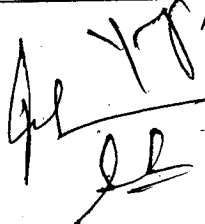
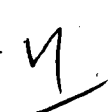
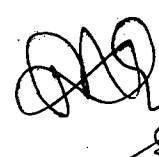
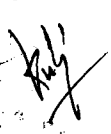
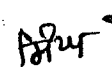
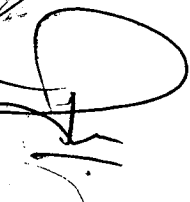
1. I. N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill.
3. M. D. Raisinghania, Advanced Differential Equations, S. Chand.


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Real Analysis

Subject Code : PCMM-511


Weekly load : 4 hours Theory



Credits: 4 (Lectures 3-Tutorials 1-Practical 0)

Unit	Contents	Lectures
Unit-I	Riemann integral, Integrability of continuous and monotonic functions, Properties of integrable functions, The fundamental theorem of integral calculus, Mean value theorems of integral calculus, Beta and Gamma functions.	12
	Improper integrals and their convergence, Comparison tests, Absolute and conditional convergence, Abel's and Dirichlet's tests, Frullani's integral. Integral as a function of a parameter. Continuity, derivability and integrability of an integral of a function of a parameter	11
Unit-II	Sequences and series of functions: Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann integration, uniform convergence and differentiation, Weierstrass approximation theorem (Statement only), Abel's and Taylor's theorems for power series	16
	Finite, countable and uncountable sets, cardinal numbers, continuum hypothesis	6



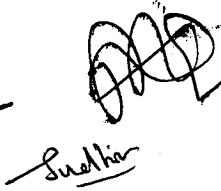

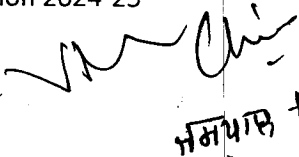
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1. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
2. Shanti Narayan and P.K. Mittal, Differential Calculus, Edition 2006, S. Chand & Co., New Delhi.
3. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S. Chand & Co., New Delhi, 2000.
4. T. M. Apostol, Calculus (Vol. I, II), John Wiley and Sons (Asia) P. Ltd., 2002.
5. Tom M. Apostol, Mathematical Analysis, Pearson (1974).


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संत लंगवाल इंस्टीट्यूट

Discrete Mathematics

Subject Code : PCMCS-422

Weekly load : 3 hours Theory

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Mathematical Logic: Statement and notations, proposition and logic operations, connectives (conjunction, disjunction, negation), Statement formulas and truth tables, propositions generated by set, Equivalence of formulas, Tautological implications law of logic, validity using truth table, Rules of inference, consistency of premises and Direct and indirect method of proof. Predicates, Statement function, Variables, Quantifiers, Universe of discourse, Inference of the predicate calculus.	11
	Pigeonhole Principle. Principle of mathematical induction, Numeric and Generating function. Recursive relation: definition, Introduction to primitive function. Polynomials and their recursion, iteration, degree and order of recurrence relations and their solutions.	11
Unit-II	Partial order relation and Partial Order set, Representation of relation: Matrix, Di-graph, Hasse diagram. Lattice Theory: Lattice, Basic properties of Algebraic systems, Distributive, Complemented and bounded Lattices and their properties. Boolean Lattices and Boolean Algebra, Uniqueness of finite Boolean Algebra, Boolean functions and Boolean expressions and simplifications of Boolean expressions.	11
	Basic terminology of graph theory, paths, circuits, degree, adjacency and their properties. Trees, Spanning trees, Properties of tree, binary trees, rooted trees, planer graphs, Euler's theorem for planer graph. Eulerian graphs, Hamiltonian graphs and their properties, Kruskal's and Prim's algorithm for finding minimum spanning tree.	12

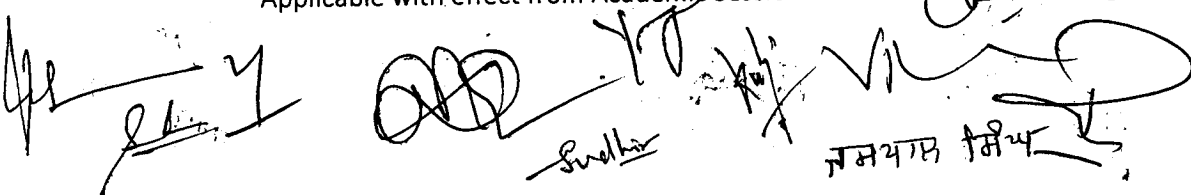
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1. J. P. Trembley and R. Manohar, A First Course in Discrete Structure with applications to Computer Science, Tata McGraw-Hill (1999).
2. M. K. Das, Discrete Mathematical Structures, Narosa Publishing House (2007).
3. Babu Ram, Discrete Mathematics, Vinayak Publications (2004).
4. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill (1978).

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Mathematical Methods

Subject Code : PCMM-513


Weekly load : 4 hours Theory

Credits: 4 (Lectures 3-Tutorials 1-Practical 0)

Unit	Contents	Lectures
Unit-I	Fourier expansion of piecewise monotonic functions, Fourier Series for odd and even Function, Half range series	8
	Linearity of the Laplace transformation, Existence theorem for Laplace transformations, Shifting theorems, Laplace transforms of derivatives and integrals, Multiplication of t, Division by t	7
	Linearity property, Shifting properties, Change of Scale Property. Inverse Laplace transforms of derivatives and integrals, Convolution theorem, Solution of differential equations with constant coefficients, Solution of differential equations with variable coefficients, Solution of simultaneous differential equations	8
Unit-II	Series solution of differential equations, its validity, Regular and singular points, Power Series method, Frobenius method, Bessel and Legendre equations	11
	Bessel functions of First and Second kind. Legendre polynomials, Generating functions, Recurrence relation and orthogonality of Bessel functions and Legendre polynomials	11

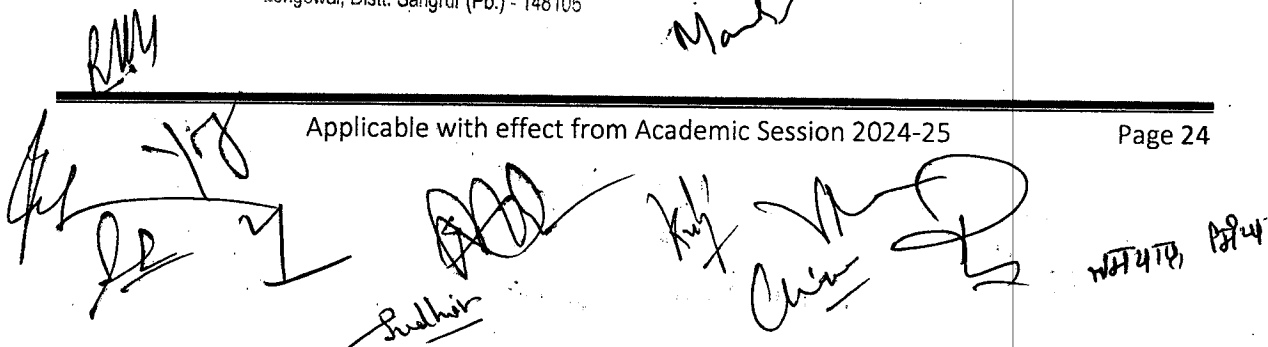
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1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 1999.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage Learning (2011).


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Abstract Algebra

Subject Code : PCMM-512

Weekly load : 4 hours Theory

Credits: 4 (Lectures 3-Tutorials 1-Practical 0)

Unit	Contents	Lectures
Unit-I	Groups, examples and properties, Equivalence relations, equivalence classes, Subgroups, subgroup criteria, cyclic groups, cosets, left and right cosets, index of a coset decomposition of a group, Lagrange's Theorem and its consequences, Normal subgroups and Quotient Groups.	11
	Homomorphisms, Isomorphism, Automorphisms and Inner automorphisms of a group, Automorphisms of a cyclic group, Permutation Groups, even and odd permutation, Alternating groups, Cayley theorem.	13
Unit-II	Introduction to rings, Subrings and Ideals, Integral domains, Division rings and Fields, Characteristic of a ring, Quotient Rings, Prime and Maximal Ideals.	15
	Euclidean rings/domains and divisibility and g.c.d criteria of elements.	6

References:

1. I. N. Herstein, Topics in Algebra, Wiley India Pvt. Ltd., New Delhi (2022).
2. J. A. Gallian, Contemporary Abstract Algebra, Cenage India Pvt. Ltd., New Delhi (2019).
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra, Cambridge University Press (1997).
4. Surjeet Singh and Qazi Zameeruddin, Modern Algebra, Vikas Publishing House (2006).
5. V. K. Khanna and S. K. Bhambri, A Course in Abstract Algebra, Vikas Publishing House (2017).

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Mechanics

Subject Code : PCMM-521


Weekly load : 4 hours Theory

Credits: 3 (Lectures 3-Tutorials 1-Practical 0)

Unit	Contents	Lectures
Unit-I	Basic notions, Composition and resolution of concurrent forces - Parallelogram law of forces, Components of a force in given directions, Resultant of any number of coplanar concurrent forces, Equilibrium conditions for coplanar concurrent forces, Equilibrium of a body resting on a smooth inclined plane, Equilibrium of three forces acting at a point-triangle law of forces, Lami's theorem, Parallel forces	12
	Moments and Couples -Moment of a force about a point and a line, Centre of parallel forces, General theorems on the moment of a couple, Varignon's theorem, Generalized theorem of moments, Resultant of a force and a couple, Resolution of a force into a force and a couple, Reduction of a system of coplanar forces to a force and a couple	11
Unit-II	Motion of a particle with constant acceleration, acceleration of falling bodies, motion under gravity, motion of a body projected vertically upwards: Newton's Laws of motion, Motion of two particles connected by a string, motion along a smooth inclined plane, Constrained motion along a smooth inclined plane, Problems of tautochrone and brachistochrone, Variable acceleration: Simple harmonic motion, elastic string	12
	Curvilinear motion of a particle in a plane: Velocity and acceleration, Projectile motion under gravity, Uniform circular motion, Work, power and energy, Conservative forces and potential energy, Work done against gravity, Potential energy of a gravitational field	10

Books:

1. S. L. Loney, The Elements of Statics and Dynamics, Part I and II, Cambridge University Press, Cambridge
2. W. D. MacMillan, Statics and Dynamics of a Particle, McGraw-Hill Book Company, New York
3. C. G. Geldard, Statics and Dynamics, Longmans, Green and Company, London.
4. F. Choriton, Text Book of Dynamics, CBS Publishers (1998).


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Number Theory

Subject Code : PCMM-514

Weekly load : 3 hours Theory

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Mathematical Induction, Binomial theorem. Divisibility theory in integers, division algorithm, Greatest common divisor and Least Common Multiple, Euclidean algorithm, Diophantine equation $ax+by=c$.	8
	Primes, The fundamental theorem of arithmetic, The Goldbach conjecture.	7
	Congruences and residues, Solutions of congruences, Linear congruences, Chinese remainder theorem.	8
Unit-II	Theorems of Euler, Fermat and Wilson and pseudo primes.	7
	Congruences of higher degree, Congruences of prime power moduli and prime modulus.	8
	Numbers of special form: perfect numbers, Fermat numbers.	7

References:

1. G. H. Hardy and E. M. Wright, Theory of Numbers, Oxford Science Publications (2003).
2. I. Niven and H. S. Zuckerman, Introduction to the Theory of Numbers, John Wiley & Sons (1960).
3. D. M. Burton, Elementary Number Theory, Tata McGraw-Hill (2006).
4. H. Davenport, Higher Arithmetic, Cambridge University Press (1999).

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Complex Variables

Subject Code : PCMM-523

Weekly load : 3 hours Theory

Credits: 3 (Lectures 3-Tutorials 0-Practical 0)

Unit	Contents	Lectures
Unit-I	Complex numbers, Geometric representation, Triangle inequality and its applications, Polar and exponential forms, Powers and roots	8
	Topology of the complex plane, Extended complex plane, Riemann sphere and stereographic projection	7
	Functions of a complex variable, One-to-one and onto functions, Limits, limit involving point at infinity, Continuity, Uniform continuity	8
Unit-II	Elementary functions, Polynomial and rational functions, Exponential function, Trigonometric functions, Zeros of $\sin z$ and $\cos z$, hyperbolic functions	8
	Multivalued function and its branches, Logarithmic functions, Complex exponents, Inverse trigonometric and inverse hyperbolic functions	7
	Sequences and series, Sequences and series of functions, Power series	7

References:

1. L. V. Ahlfors, Complex Analysis, Tata McGraw-Hill (1979).
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House (2007).
3. D. G. Zill & P. D. Shanahan, A first course in complex analysis with applications, Jones & Barlett (2010).

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Linear Algebra

Subject Code : PCMM-522


Weekly load : 4 hours Theory

Credits: 4 (Lectures 3-Tutorials 1-Practical 0)

Unit	Contents	Lectures
Unit-I	Vector Space : Definition and Examples of Vector Spaces, Subspaces, Algebra of subspaces, Linear span, Linear dependence and independence of vectors, Basis and dimension of a vector space, Direct sums and complements	13
	Linear transformations, Rank and Nullity of a linear transformation, Vector space of linear transformations	10
Unit-II	Linear transformations and matrices, Change of basis and applications	8
	Characteristic roots and characteristic vectors, Algebraic and Geometric multiplicity of a characteristic value, Cayley-Hamilton theorem, Diagonalizable matrices	14




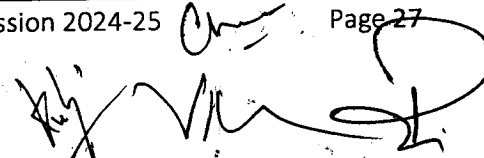
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2. J. Gilbert and L. Gilbert: *Linear Algebra and Matrix Theory*, Academic Press, (2013).
3. I. N Herstein, *Topics in Abstract Algebra*, Wiley India Pvt. Ltd. (2022).
4. Vivek Sahai and Vikas Bist, *Linear Algebra*, Narosa Publishing House (2008).


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नमो भगवते वासुदेवाय

Department Elective

Numerical Analysis

Subject Code : PCMME-522

Weekly load : 5 hours

Credits: 4 (Lectures 3-Tutorials 0-Practical 1)

Unit	Contents	Lectures
Unit-I	Accuracy of numbers: significant figures, round off. Errors in arithmetic operations and functions: Inherent, truncation, absolute, relative, percentage errors. Error in approximation of a function.	6
	Taylor series, Basic properties of equations, Initial approximation, Intermediate value property, Bisection method, Method of false position, Secant Method, Newton-Raphson method, Iteration method. Rate of convergence, Order of convergence.	9
	Solution of simultaneous linear equations: Gauss elimination method, Gauss-Jordan method, Factorization method, Jacobi's method, Gauss-Seidel method.	8
Unit-II	Finite differences: forward, backward and central differences. Shift and averaging operators. Relations between the operators. Interpolation: Newton's forward, Newton's backward, Newton's divided difference and Lagrange's formulae.	8
	Numerical differentiation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule, Simpson's one third and three-eighth rules. Error in integration.	6
	Initial and boundary value problems. Solution of ODE of first order: Taylor series method, Picard's method, Euler's method, Modified Euler's method and Runge-Kutta methods of various orders, Error analysis.	8

References:

1. Y. Kanetkar, Let us C++, BPB Publications (2020).
2. E. Balaguruswamy, Programming in C++, Tata McGraw-Hill (1992).
3. S.S. Sastry, Introductory Method of Numerical Analysis, PHI (2005).
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International (2007).
5. B. S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers, 2011.

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Department Elective

Linear Programming Problems

Subject Code : PCMME-521


Weekly load : 4 hours

Credits: 4 (Lectures 3-Tutorials 1-Practical 0)

Unit	Contents	Lectures
Unit-I	Introduction to Optimization Techniques, Basic concept and notations, Formulation of Linear Programming Problem (LPP), Graphical Solution, Convex set, Extreme points, adjacent point of a convex set, Basic solution (BS) and Basic Feasible Solutions (BFS) of system of linear equations, Gauss-Jordan Elimination process to find BS and BFS of an LPP	8
	Standard Form of an LPP, Fundamental theorem of LPP, Slack, Surplus & Artificial variables Simplex method, Degeneracy, Nature of the solution of LPP through simplex method. Big M method, Two phase method	7
	Primal and Dual problem, Duality theory, Complimentary slackness conditions, Solution of primal and Dual and vice versa.	7
Unit-II	Basic concepts, notations, Balanced & unbalanced TP, Initial BFS of TP by using different methods, Improving an initial BFS of a TP to optimal solution	7
	Introduction to Assignment Problem (AP), Basic concepts, notations, Hungarian method to solve an AP	6
	Introduction to game theory, The maximin & Minimax Criterion, Existence of saddle point, Game without saddle point, Mixed strategy, Solution of 2X2 game and rectangular game by mixed strategy (by Algebraic method), Dominance & its use to solve 2X2 game, 2XN & NX2 game, Graphical method, Solution of Game by LPP method and iterative method	10

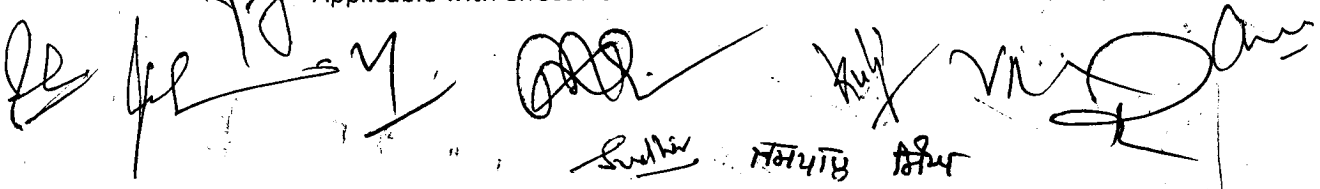
References:

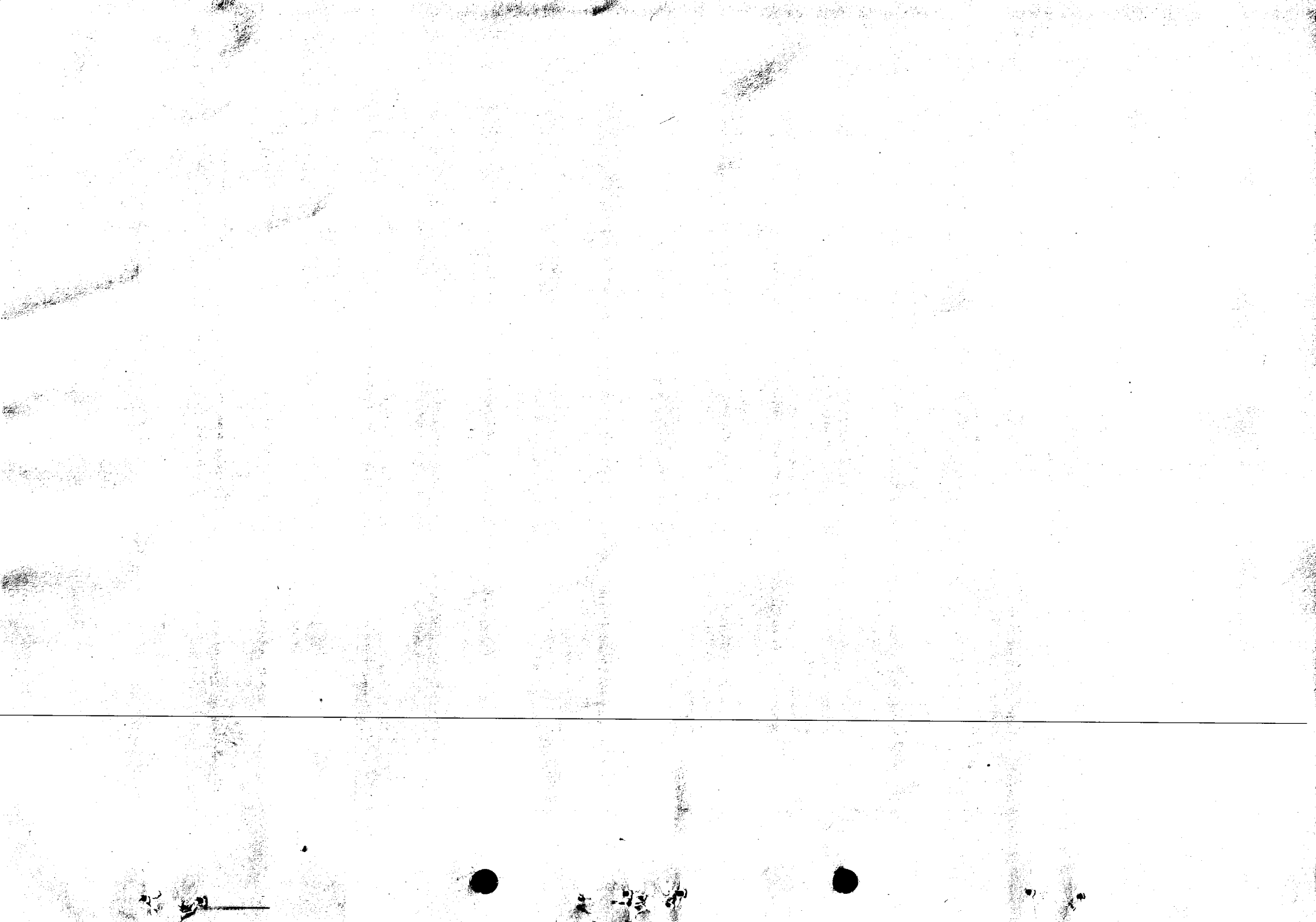
1. J.G. Chakravorty and P.R. Ghosh, Linear Programming and game Theory, Moulik Library (2009).
2. S.K. Gupta, Linear Programming & Network Models, Affiliated East-West Private Ltd. (1985).
3. Kanti Swarup, P.K. Gupta & Man Mohan, Operations Research, S. Chand & Sons (1994).
4. H.A. Taha, Operations Research, PHI (2007).


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Mathematica and LaTeX

Subject Code : PCMS-522


Weekly load : 4 hours Lab

Credits: 2 (Lectures 0-Tutorials 0-Practical 2)

Unit	Contents	Lectures
Unit-I	<p>Running Mathematica</p> <p>Numerical Calculation: Arithmetic, Exact & approximate result, Some Mathematical functions, Arbitrary-Precision Calculations, Complex Numbers</p> <p>Building up calculations: Using previous results, Defining variables, Making list of objects, The four kinds of bracketing in Mathematica, Sequence of operations.</p> <p>Using Mathematica system: The structure of Mathematica, Doing computation in Notebook, Notebooks as documents, Active elements in notebook, Getting Help in the Notebook Front end, Getting Help with a Text Based Interface, Mathematica Packages, Warning and Messages.</p> <p>Algebraic calculations: Symbolic computation, Values for symbols, Transforming algebraic Expressions, Simplifying Algebraic Expressions, Putting expression into different forms, Simplifying with assumptions, Picking out pieces of algebraic expression, Controlling the display of large expressions, The limits of mathematica.</p> <p>Symbolic Mathematics: Basic operations, Differentiation, Integration, Sums and products, Equations, Relations and logical operators, Solving equations, Inequalities, Differential equations, Power series, Limits, Integral Transforms, Recurrence equations, Packages for symbolic mathematics, Mathematical notation in Notebook.</p> <p>Numerical Mathematics: Basic operations, Numerical sums, product and integrals, Numerical equation solving, Numerical Differential equations, Numerical optimization, Manipulating numerical data, Statistics.</p> <p>Functions and Program: Defining function, Function as procedures, Repetitive operations</p> <p>Graphics: Basics plotting, Options, Redrawing and combining plots, Contour and Density plot, Two dimensional and three dimensional plots.</p> <p>Input and Output in Notebook: Entering Greek letters, Entering Two-dimensional input, Editing and Evaluating Two-dimensional expression, Entering formulas, Displaying and printing mathematica notebook.</p>	15 Labs
Unit-II	<p>Getting started with Latex : Preparing an input file, sentences and paragraphs. Simple text-Generating commands, footnotes, formulas. The document class, the title page, sectioning, displaying material, declarations. Changing the type style, symbols from other languages.</p> <p>Mathematical formulas and symbols, arrays, multiple formulas. Spacing and changing style in math mode, defining commands and Environment, figures and other floating bodies.</p> <p>The table of contents, cross references, Bibliography and citation. Making an index or glossary, keyboard input and screen input. Other document classes like books, slides and letters</p> <p>Document and page styles; line and page breaking, numbering. Length, space and boxes. Centering, line making environments. Fonts and colours, errors.</p>	8

References:

1. S. Wolfram, The Mathematica Book, Wolfram Media.
2. Leslie Lamport, A Document Preparation system: Latex, Pearson (1994).


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