Linear Algebra (19M21MA116)

Lecture-wise Breakup

Course Code	19M21MA116	**Semester** **Even**	**Semester** II **Session 2019-2020** **Month from** Jan 2020-June 2020
Course Name	Linear Algebra		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Himanshu Agarwal	
	Teacher(s) (Alphabetically)	Dr. Himanshu Agarwal	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C120.1	understand the vector spaces and their properties.	Understanding Level (C2)
C120.2	apply various concepts of the linear transformation.	Applying Level (C3)
C120.3	solve problems related to matrix diagonalization.	Applying Level (C3)
C120.4	analyse inner product spaces and its properties.	Analysing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Vector spaces	Vector space, subspace, elementary properties of vector spaces, sum of subspaces, linear combination, linear dependence and independence, basis and dimension, ordered bases and coordinates	**10**
2.	Linear transformation	Basic definitions, null space and range space, rank-nullity theorem, matrix of linear transformation, change of basis, linear functional, dual spaces, dual basis.	**10**
3.	Canonical forms	Eigenvalues and eigenvectors, eigenspace, minimal polynomial, The Cayley-Hamilton theorem, diagonalisation, invariant subspaces, Jordan canonical representation, norm of a matrix, computation of a matrix exponential.	**10**
4.	Inner product space	Inner product spaces, orthogonal and orthonormal vectors, normed space, Gram-Schmidt process for orthogonalisation, projection theorem, quadratic	**12**

		forms, positive definite forms, adjoint operator, unitary operators, normal operators.	
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**K. Hoffman and R. Kunze,** Linear Algebra 2nd Ed., Prentice Hall of India, 2015.
2.	**V. Krishnamurty, V. P. Mainra and J. L. Arora,** An introduction to Linear Algebra, Affilated East-West, 1976.
3.	**G. Strang,** Linear Algebra and its applications, 4rd Ed., Thomson, 2007.
4.	**H. Anton and C. Rorres,** Elementary linear algebra, 11th Ed., Wiley, 2016**.**
5.	**G. H. Golub and C. F. V Loan,** Matrix Computations, 3rd Ed., Hindustan Book Agency, 2007.

Complex Analysis (19M21MA117)

Lecture-wise Breakup

Course Code	19M21MA117	**Semester** Even	**Semester II** **Session 2019-2020** **Month from** Jan 2020-June2020
Course Name	Complex Analysis		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Prof. R. C. Mittal	
	Teacher(s) (Alphabetically)	Prof. R. C. Mittal	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C121.1	apply the concepts of differentiability and analyticity for functions of complex variables	Applying Level (C3)
C121.2	solve the problems of different types of contour integrations.	Applying Level (C3)
C121.3	explain Taylor's and Laurent's series expansion, singularities, residues and apply it to evaluate complex integrals.	Analyzing Level (C4)
C121.4	apply conformal and bilinear transformations to solve related problems.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Complex Differentiation	Limit, continuity and differentiability, analytic functions, Cauchy Riemann equation,. harmonic functions, harmonic conjugate, construction of analytic functions, exponential function, trigonometric and inverse trigonometric functions, logarithmic function, complex powers, branches of multi valued functions	**12**
2.	Complex Integration	complex line integral, Cauchy-Goursat theorem, independence and deformation of path; Cauchy's integral formulas and their consequences, Cauchy inequality, Liouville's theorem, fundamental theorem of algebra, Morera's theorem, maximum modulus principle, Schwarz lemma, analytic continuation.	**10**
3.	Power Series and Singularities	Taylor and Laurent series and their convergence. zeros and singularities of complex functions, classification of singularities: removable singularity, poles, essential singularities, residue at	**12**

		a pole and at infinity, Cauchy's residue theorem and its applications in evaluation of real integrals: integration around unit circle, integration over semi-circular contours (with and without real poles), integration around rectangular contours. Argument principle, Rouche's theorem.	
4.	Conformal Transformations	Conformal transformations, bilinear transformations, critical points, fixed points, problems on cross-ratio and bilinear transformation	**8**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Churchill, R. V. and Brown, J.W.,** Complex Variables and Applications, McGraw-Hill, 1996.
2.	**Spiegel, M. R.,** Complex Variables, McGraw-Hill, 2009.
3.	**Ahlfors , L.V.,** Complex Analysis, McGraw Hill, New York, 1990.
4.	**Lang , S.,** Complex Analysis, Springer-Verlag, 2003.
5.	**Gamelin ,T.W.,** Complex Analysis, Springer-Verlag, 2008.

Computer Programming (19M21MA118)

Lecture-wise Breakup

Course Code	19M21MA118	**Semester** **Even**	**Semester** II **Session** **2019-20** **Month from** Jan 2020 to June 2020
Course Name	Computer Programming		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Anuj bhardwaj	
	Teacher(s) (Alphabetically)	Dr. Anuj Bhardwaj	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C122.1	explain different types of computer representations of numbers.	Understanding Level (C2)
C122.2	explain basic concepts of programming.	Understanding Level (C2)
C122.3	apply the concepts of programming through functional decomposition.	Applying Level (C3)
C122.4	construct the pointers for dynamic memory allocation.	Applying Level (C3)
C122.5	apply the concept of object oriented programming for solving the problems.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basic Computer Fundamentals	Introduction to computer systems; number system, integer, signed integer, fixed and floating point representations; integer and floating point arithmetic, expression and operators.	**5**
2.	Basics of Programming	Input/output; Constants, variables, expressions and operators; Naming conventions and styles; Conditions and selection statements; Looping and control structures (while, for, do-while, break and continue); Arrays; File I/O, header files, string processing; Pre-processor directives.	**10**
3.	Programming through functional decomposition	Structures; design of functions, void and value returning functions, parameters, scope and lifetime of variables, passing by value, passing by reference, passing arguments by constant reference, recursive functions; Function overloading and default arguments; Library functions.	**10**

4.	Pointers	Pointers; Dynamic data and pointers, dynamic arrays.	**5**
5.	Object Oriented Programming Concepts	Data hiding, abstract data types, classes, access control; Class implementation-default constructor, constructors, copy constructor, destructor, operator overloading, friend functions; Object oriented design (an alternative to functional decomposition) inheritance and composition; Dynamic binding and virtual functions; Polymorphism; Dynamic data in classes.	**12**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Lafore R.,** Object-Oriented Programming in C++. Sams Publishing, 4th edition, 2001.
2.	**Stroustrup, B.,** The C++ Programming Language. Addison-Wesley, 3rd edition, 1997.
3.	**Deitel, H.M. and Deitel, P.J.,** C++ How to Program. Prentice Hall, 8th edition, 2011.
4.	**Schildt, H.,** C++: The Complete Reference. McGraw-Hill, 4th Ed., 2002.
5.	**Lippman, S. B. and Lajoie, J. and Moo, B.E.,** The C++ Primer. Addison-Wesley Professional, 5th Ed., 2012.

Functional Analysis (19M21MA119)

Lecture-wise Breakup

Course Code	19M21MA119	**Semester Even**	**Semester II Session 2019-2020** **Month from** Jan 2020 – June 2020
Course Name	Functional Analysis		
Credits	3	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Prof. B P Chamola	
	Teacher(s) (Alphabetically)	Prof. B P Chamola	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C123.1	explain the concept of normed spaces, Banach spaces and their properties	Understanding (C2)
C123.2	apply concepts of Banach space to prove Hahn-Banach theorem, open mapping theorem and closed graph theorem.	Applying (C3)
C123.3	explain inner product space, Hilbert spaces, orthonormal basis and Reisz-representation theorem	Understanding (C2)
C123.4	develop the concept of orthonormal systems and solve related problems.	Applying (C3)
C123.5	examine contraction mapping, Banach fixed point theorem and its simple applications.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Normed spaces and Banach space I	Review of Holder inequality, Minkowski inequality and vector spaces with examples to l_p and L_p spaces, normed space, Banach space, subspace of Banach space.	**5**
2.	Normed spaces and Banach space II	Finite dimensional normed space and subspaces. Linear operators, bounded and continuous linear operators, their properties and related results.	**7**
3.	Some fundamental theorems of normed spaces	Principle of uniform boundedness, boundedness and continuity of linear transformations, Hahn-Banach theorem, open mapping theorem, closed graph theorem.	**6**
4.	Inner Product Spaces and Hilbert	Inner product spaces, Schwarz and Minkowski inequalities, Hilbert spaces, relation between	**8**

	spaces 1	Banach and Hilbert spaces, projections, orthonormal basis, Reisz-representation theorem.	
5.	Inner Product Spaces and Hilbert spaces II	Convex sets, existence and uniqueness of a vector of minimum length, projection theorem, orthogonal and orthonormal systems in Hilbert spaces with examples.	**8**
6.	Inner product spaces and Hilbert spaces II	Bessel's inequality, Parseval's identity, characterization of complete orthonormal systems.	**4**
7.	Banach fixed point theorem	Contraction mapping, Banach fixed point theorem and its applications.	**4**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**E. Kreyszig**, Introductory Functional Analysis with Applications, John Wiley and Sons, Inc., 1978.
2.	**W. Rudin,** Functional Analysis, Mc-Graw Hill, 1973.
3.	**G. F. Simmons,** Introduction to Topology and Modern Analysis, Tata Mc-Graw Hill Education, New Delhi, 2004.
4.	**A. H. Siddiqi, K. Ahmad and P. Manchanda**, Introduction to Functional Analysis with Applications, Anamaya Publication, New Delhi, 2006.
5.	**L. Debnath and P. Mikusinski**, Introduction to Hilbert spaces with Applications, 3rd Edition, Elsevier, 2005.
6.	**G. Bachman and L. Narici,** Functional Analysis, Academic Press, 1972
7.	**M. T. Nair,** Functional Analysis: A First Course, PHI India, 2004.

Partial Differential Equations (19M21MA113)

Lecture-wise Breakup

Course Code	19M21MA113	**Semester Even**	**Semester** II **Session 2019-20** **Month from** Jan 2020- June 2020
Course Name	Partial Differential Equations		
Credits	4	**Contact Hours**	3 1 0
Faculty (Names)	**Coordinator(s)**	Prof. A. K. Aggarwal	
	Teacher(s) (Alphabetically)	Prof. A. K. Aggarwal	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C124.1	classify and solve first order linear and nonlinear partial differential equations (PDE).	Applying Level (C3)
C124.2	explain Fourier series and Fourier transforms.	Understanding Level (C2)
C124.3	classify second order PDE and solve Laplace equation in cylindrical and spherical polar coordinates.	Applying Level (C3)
C124.4	solve heat equation in cylindrical and spherical polar coordinates.	Applying Level (C3)
C124.5	solve wave equation using separation of variables.	Applying Level (C3)
C124.6	apply Fourier transforms to solve PDE.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1	**First-order Partial Differential Equations (PDEs)**	Formation and classification of first-order PDEs, linear semi-linear and quasi-linear equations, Cauchy problem, method of characteristics, nonlinear first order PDEs, complete integrals, envelopes and singular solutions, discontinuous solutions (shock waves), compatible systems, Lagrange method for first order PDEs, Charpit's method, Jacobi's method for nonlinear PDEs.	**10**
2	**Fourier Series**	Introduction to Fourier series, convergence of Fourier series for continuous and piecewise continuous functions, Fourier	**5**

		cosine and sine series, Fourier transform, Fourier sine and cosine transform.	
3	**Second-Order PDEs**	Classification of second-order linear partial differential equations into hyperbolic, parabolic and elliptic PDEs, reduction to canonical forms.	**3**
4	**Laplace's Equation**	Basic concepts, types of boundary value problems, the maximum and minimum principle, Green's identity and fundamental solution, Green's function, Poisson integral formula, the method of separation of variables, the Dirichlet problem for the rectangle, the Dirichlet problem for annuli and disk, the exterior Dirichlet problem, solution of Laplace equation in cylindrical and spherical polar coordinates.	**8**
5	**Heat Equation**	Derivation of the heat equation, maximum and minimum principles, uniqueness, continuous dependence, method of separation of variables, solution of heat equation in cylindrical and spherical polar coordinates.	**6**
6	**Wave Equation**	Derivation of the wave equation, infinite string problem, D'Alembert solution of the wave equation, semi-infinite string problem, finite vibrating string problem, method of separation of variables, inhomogeneous wave equation, Duhamel's principle.	**7**
7	**Fourier transform methods for PDEs**	Fourier transform methods for heat flow problem in an infinite and semi-infinite rod, Infinite string problem, Laplace equation in a half-plane.	**3**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35

TA **Total**	25 (Quiz, Assignments, Tutorials) **100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc.
(Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Sneddon, I. N.,** Elements of Partial Differential Equations, McGraw Hill, 1957.
2.	**John, F.,** Partial Differential Equations, Springer Verlag, 1982.
3.	**Strauss, W. A.,** Partial Differential Equations: An Introduction, John Wiley, 1992.
4.	**Willams, W. E.,** Partial Differential Equations, Oxford, 1980.
5.	**Evans, L. C.,** Partial Differential Equations, AMS, 1998.
6.	**McOwen, R.,** Partial Differential Equations, Pearson, 2002.
7.	**Powers, D. L.,** Boundary Value Problems and Partial Differential Equations, 5th Ed., Academic Press, 2006.

Computer Programming Lab

Lecture-wise Breakup

Course Code	19M25MA111	**Semester Even**	**Semester** II **Session 2019-20** **Month from** Jan 2020 to June 2020
Course Name	**Computer Programming Lab**		
Credits	01	**Contact Hours**	0-0-2
Faculty (Names)	**Coordinator(s)**	Dr. Lokendra Kumar	
	Teacher(s) (Alphabetically)	Dr. Lokendra Kumar	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C170.1	explain data types, variables, and arithmetic operators.	**C2**
C170.2	explain basic concepts of conditional statements, loops, structures and to understand the use of arrays.	**C2**
C170.3	apply the concepts of programming through functional decomposition.	**C3**
C170.4	describe the usage of the pointers for dynamic memory allocation.	**C3**
C170.5	demonstrate the use of various object oriented programming concepts with the help of programs	**C3**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Basic Computer Fundamentals**:	Basic data types, constants and variables, Arithmetic operators, built-in mathematical functions. Arithmetic expressions. Logical and relational operators, scanf() and printf() functions.	1
2.	**Basic Programming and Statements**	I/O using cin and cout, simple programs, control of flow using if, if … else, goto. Loops for, while and do … while, use of break, return and exit. Programs for n!, e^x, sin$x$, log(1+x). Arrays and strings, Sorting of arrays.	4
3.	**Functions and Structure**	User defined functions, call by value/reference, default parameters, returning values. Recursive functions. Structures, distance, complex, date.	3

4.	**Pointers**	Pointers and their applications in handling arrays and strings.	1
5.	**Object Oriented Programming Concepts**	Object and classes, Constructor/destructors, Private and public. More objects. Complex class, distance class, Matrix class. Operator overloading, Functions with objects, Friend functions, I/O handling in C++.	3
		Total number of lectures	**12**

Evaluation Criteria

Components	**Maximum Marks**
Lab Test 1	20
Lab Test 2	20
Day to day Evaluation	60 (Quiz, Assignments, Tests, Viva)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Lafore R.,** Object-Oriented Programming in C++. Sams Publishing, 4th edition, 2001.
2.	**Stroustrup, B.,** The C++ Programming Language. Addison-Wesley, 3rd edition, 1997.
3.	**Deitel, H.M. and Deitel, P.J.,** C++ How to Program. Prentice Hall, 8th edition, 2011.
4.	**Schildt, H.,** C++: The Complete Reference. McGraw-Hill, 4th Ed., 2002.
5.	**Lippman, S. B. and Lajoie, J. and Moo, B.E.,** The C++ Primer. Addison-Wesley Professional, 5th Ed., 2012.