EKLAVYA UNIVERSITY
ज्ञान प्राप्तये लक्ष्य संधानम्
Estd. by Madhya Pradesh Niji Vishwavidyalaya (Sthapna Avam Sanchalanal Adhyadesh, 2020

School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Final)
Semester/Year				II Year
Subject & Paper Code				Mathematics- MMATH20Y201
Paper				Functional Analysis-I
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	5	
3	2	0		

Course Objectives: The course provides an introduction to the methods of functional analysis.It builds on core material in analysis and linear algebra . The focus is on normed spaces and Banach spaces; a brief introduction to Hilbert spaces is included, but a systematic study of such spaces and their special features. The techniques and examples studied in this courses support, in a variety of ways, many advanced courses, in particular in analysis and partial differential equations, as well as having applications in mathematical physics and other areas.

Course Outcome:

1.Students will have a firm knowledge of real and complex normed vector spaces, with their geometric and topological properties.
2.They will be familiar with the notions of completeness, separability and density, will know the properties of a Banach space and important examples.
3.Will be able to prove results relating to the Hahn-Banach Theorem.
4.They will have developed an understanding of the theory of bounded linear operators on a Banach space.
5.WIll be able to solve Bessel's Inequality,Gram Schmidt orthonormalization process.

Student Learning Outcomes (SLO):

Upon completing the course, students will be able to:
1.To learn to recognize the fundamental properties of normed spaces and of the transformations between them.
2.Understand the notions of dot productand Hilbert space and to apply in analsis mathematics.

3.Knowledge and understanding and define Banach and Hilbert spaces and self-adjoint operators independently prove and thoroughly explain central theorems
4.Apply the Riesz' representation theorem and weak convergence, and critically reflect over chosen strategies and methods in problem solving independently decide if a linear space is a Banach spaceIidentify and Independently use contractions of Banach spaces via Brouwers and Schauders fixed point theorems.
5.Solve the problems basde on Adjoint of an operator on a Hilbert space,Reflexivity of Hilbert spaces ,Positive operators,Projection,Normal and Unitary operators.

Unit	Syllabus	Periods

Shama Nehwar Nidhi

UNIT - I	Convergence Completeness and Baire's theorem, Cantor's Intersection Theorem,Continuous mappings, Uniformly continuous mappings, spaces of continuous functions,Uniform Boundedness theorem and some of its Consequences,Open mapping and closed graph theorems.	11
UNIT - II	Euclidien and Unitary spaces, Cauchy Minkowski and Holders inequalities ,Normal linear spaces,Examples and Elementary properties,Equivalence and norms,Banach space and examples,Continuous linear transformations,Hahn-Banach theorem for real linear spaces,Hahn-Banach theorem for complex linear spaces and normed linear spaces	11
UNIT - III	Functionals and their extensions, related Lemma,Hahn Banach theorem for normed linear space,Conjugate of normed linear spaces,the natural embading of normed linear space in its second conjugate space,Reflexive banach spaces,Open mapping theorem ,Closed graph theorem,Reflexive spaces,Structure of Hilbert spaces,Orthonormal sets,Bessel's inequality,Complex orthonormal sets and Parseval's identity.	11
UNIT - IV	Conjugate of an operator,Uniform boundedness principle and its applications,Inner product space and their elementary properties,Parallelogram law,Schwartz inequality and polarization identity, Hilbert space and examples,Orhtogonal complements in Hilbert space,Projection Mapping,Projection theorem,Structure of Hilbert spaces,Riesz representation theorem.	11
UNIT - V	Orthonormal sets,Bessel's Inequality,Gram Schmidt orthonormalization process,Conjugate Space of Hilbert space,Riesz representation theorem,Adjoint of an operator,properties,Adjoint of an operator on a Hilbert space,Reflexivity of Hilbert spaces ,Positive operators,Projection,Normal and Unitary operators.	11

Text Books:

1 ,Topology and Modem Analysis,Mc Graw Hill International Eddition,1963 by G.F.Simmons

2 Introductory Functional Analysis with application, John Wiley & Sons New York by E. Kreyszig,

References Books:

1 E.Kreyszig introductory Analysis with Applications,John Wiley and Son's New York,1978.

2 R.E.Edwards,Functional Analysis,Dover Pub. New York 1995,P.K.Jain,O.P.Ahuja and Khalil Ahmad ,Functional Analysis,New Age International Pvt.Ltd.Pub.

3 Functional Analysis with application Wiley Eastern Ltd by B. Choudary and Sudarshan Nanda.

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School of Basic and Applied Sciences

Class				**M.Sc. Mathematics (Final)**
Semester/Year				**II Year**
Subject & Paper Code				**Mathematics- MMATH20Y202**
Paper				**Integral Transformation-II**
Max. Marks				**60(ETE) + 40(IA) = 100**
Credit			**Total Credits**	
L	T	P	5	
3	2	0		

Course Objectives: The course is aimed at exposing the students to learn the Laplace transforms and Fourier transforms. To equip with the methods of finding Laplace transform and Fourier Transforms of different functions. To make them familiar with the methods of solving differential equations, partial differential equations, IVP and BVP using Laplace transforms and Fourier transforms.

Course Outcome:

The Students will be able to:

1. Recognize the different methods of finding Laplace transforms .

2.Understand the Fourier transforms of different functions.

3.They apply the knowledge of L.T, F.T, and Finite Fourier transforms in finding the solutions of differential equations.

4.Understood Initial value problems and boundary value problems.

5.Understood Convolution & Parseval's identity.

Student Learning Outcomes (SLO):

Students will: enable to:

1.Know Laplace transforms , Fourier transforms and its properties.

2.Solve ordinary differential equations using Laplace transforms.

3. Familiarise with Fourier transforms of functions belonging to ଵଐ. ଏ class, relation between Laplace and Fourier transforms.

4.Explain Parseval's identity, Plancherel's theorem and applications of Fourier transforms to boundary value problems.

5.Learn Fourier series, Bessel's inequality, term by term differentiation and integration of Fourier series.

Unit	Syllabus	Periods
UNIT - I	Laplace Transforms,Application of Laplace Transforms: Laplace's equations, Laplace's wave equation.	11
UNIT - II	Laplace's equations,Application of Laplace Transforms in Heat conduction equation.	11

UNIT - III	Laplace's wave Equation,Application of Laplace Transforms to boundary value problems, Electric Circuits, Application to Beams.	11
UNIT - IV	Application of Laplace Transforms,The complex Fourier Transforms,Inversion Formula,Fourier cosine and sine transforms,properties of Fourier Transforms,Convolution & Parseval's identity.	11
UNIT - V	Heat Conduction equation,Fourier Transform of the derivatives, Finite Fourier sine & cosine transforms Inversion Operational and combined properties Fourier transform.	11

Text Books:

1. Integral Transform by Goyal & Gupta.
2. Integral Transform by Sneddon.
3. A.R.Vashista, Dr. R.K.Gupta, Integral transforms - Krishna Prakasham Mandir.

References Books:

1. D N Chorafas, Integral Transforms & their Applications.
2. Murray R.Spiegel, Theory and problems of Laplace transforms - Schaums Outline Series
3. 2. Murray R.Spiegel, Theory and problems of Laplace transforms - Schaums Outline Series,Tata Mac Grawhill.

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School of Basic and Applied Sciences

Class			M.Sc. Mathematics (Final)	
Semester/Year			II Year	
Subject & Paper Code			Mathematics- MMATH20Y203	
Paper			Integration Theory-III	
Max. Marks			60(ETE) + 40(IA) = 100	
Credit		Total Credits		
L	T	P	5	
3	2	0		

Course Objectives:

Describe integration for students to learn course.Integration program goals and objectives and the rest of the students' curriculum. Use action words that specify definite, observable behaviors of integration theory.

Course Outcome:

The Students will be able to:
1.Use the concepts of Radon Nikodym Theorem,;
2.State and explain the construction of the Lebesgue integral and use it;
3. Apply the theorems of Measurable functions,Baire Sets ,Baire measures.
4.Proof Caratneodary Extension theorem.
5.Understand Semifinite and σ Finite measure.

Student Learning Outcomes (SLO):

Students will:
1. Use the concepts of measurable set and measurable function.
2.Apply the theorems of monotone and dominated convergence and Fatou's lemma.
3. describe the construction of product measure and to apply Fubini's theorem.
4.State and explain properties of compact spaces.
5.Able to prove Hahn Decomposition Theorem,.

Unit	Syllabus	Periods
UNIT - I	General measure examples,Radon Nikodym Theorem,Lebsegue Decomposition Theorem.	11
UNIT - II	Semifinite and σ Finite measure,Caratneodary Extension theorem.	11
UNIT - III	Completion of a measure,Measurable functions,Baire Sets ,Baire measures,Regularity of measures on localy compact spaces.	11
UNIT - IV	Signed measure,Hahn Decomposition Theorem,Product measures,Fubini's theorem .	11
UNIT - V	Mutually Singular Measures Jorden Decomposition theorem.Integration of continuous with compact support on locally compact spaces Riesz-Makov theorem.	11

Shama Mehessar Nidhi

Text Books:

1. H.I.Royden Real Analysis,macmillian publishing co.Inc. Newyork,4th Edition,1993.
2. Measure Theory and Integration By M.M. Rao
3. Lebesgue measure and integration: An introduction, Wiley, 1997 by F. Burk.
4. Introduction to measure and integration, Addison Wesley, 1959 by M.E. Munroe.

References Books:

1. P.R.Halmos,Measure Theory,Van Nostrand
2. I.K.Rana,Introduction to measure and integration,Narosa Publishing House,New Delhi.
3. Lebesgue measure and integration, New Age, 1986, by P.K. Jain and V.P. Gupta.
4. Measure theory and integration, Second Edition, Marcel Dekker, 2004,by M.M. Rao.

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School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Final)
Semester/Year				II Year
Subject & Paper Code				Mathematics- MMATH20Y204
Paper				Operations Research- IV
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	5	
3	2	0		

Course Objectives:
To impart knowledge in concepts and tools of Operations Research.To understand mathematical models used in Operations Research.To apply these techniques constructively to make effective business decisions.This module aims to introduce students to use quantitive methods and techniques for effective decisions–making.

Course Outcome:
The Students will be able to:
1.Analyze any real life system with limited constraints and depict it in a model form operation research.
2.Convert the problem into a mathematical model.
3. Solve the mathematical model manually as well as using soft resources/software such as solver, TORA etc.
4. Understand variety of problems such as assignment, transportation, travelling salesman etc.
5.Understand Theory-Two persons, Zero sum Games, Maximia-Minima principle.
6.Understand Techniques and advances of network(PERT/CPM).

Student Learning Outcomes (SLO):
Students will: 1.take Knowledge and understanding real world problem.
2. Be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
3. Be able to build and solve Transportation Models and Assignment Models.
4 Be able to design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems.
5. Be able to implement practical cases, by using TORA, WinQSB.
6.Be able to solve Transportation problems.

Unit	Syllabus	Periods

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UNIT - I	Operations Research and its Scope,Origen and development of Operation Research,Characteristic of Operations Research.Transportation problems:North-West Corner Method ,Least-Cost Method,Vogel's Approximation Method,MODI Method,	11
UNIT - II	Model in Operation Research,Phases of Operation research,Uses and Limitations of Operations Research,Linear Programming Problems,Mathematical Formulation,Graphical Solution Method.Exceptional cases and problem of degeneracy,Assignment problems.	11
UNIT - III	Mathematical Formulation,Graphical Solution Method,Network analysis,constraints in Network,Construction of network,Critical Path Mehtod(CPM),PERT,PERT Calculation,Resource Leveling by Network Techniques and advances of network(PERT/CPM).	11
UNIT - IV	General Linear Programming Problem:Simplex Method,exceptional cases,Artificial variable techniques,Big-M method,Two phase method and cyclic Problems,Problem of degeneracy.Simulation of Networks,Advantage and Limitation of Simulation.	11
UNIT - V	Duality,Fundamental Properties of duality and theorem of duality.Game Theory-Two persons, Zero sum Games, Maximia-Minima principle, games without saddle points-Mixed strategies, Graphics solution of 2xm and mx2 games,Solution by Linear Programming,Techniqus-Kuhn-Tucker conditions Non negative Constraints.	11

Text Books:

1. Operation Research,Sultan Chand & Son's,New Delhi,by Kanti Swarup,P.K.Gupta and Manmohan,
2. Linear Programming & Dynemic Programming Addision Wesely Reading Mass,by G.Hadley.
3. Mathematical Programming Techniques, Affilated East-West Pvt. Ltd. New Delhi,Madras,by N.S. Kambo.

References Books:

1. S.D.Sharma,Operation Research
2. G.Hadley,Linear Programming,Narosa Publishing House,1995.
3. N.S.Kambo,Mathematical Programming Techniques,Affilated East-West Pvt. Ltd.New Delhi Madras.
4. Prem Kumar Gupta and D.S.Hira,Operation Research,an Introduction,S.Chand& Company Ltd. New Delhi.

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School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Final)
Semester/Year				II Year
Subject & Paper Code				Mathematics- MMATH20Y205
Paper				Partial Differential Equation-V (Optional-I)
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
2	2	0		

Course Objectives:

To equip students with the concepts of partial differential equations and how to solve linear Partial Differential with different methods. Students also will be Introduced to some physical problems in Engineering models that results in partial differential equation.

Course Outcome:

The Students will be able to:

1. Classify the fundamental principals of partial differential equations(PDEs) to solve hyperbolic, parabolic and elliptic equations.
2. Formulate appropriate numerical methods for solving various problems in partial differential equations.
3. Adapt mathematical software to solve various problems in partial differential equations.
4.Proof mean value theorem for harmonic function.
5.Solve of ordinary differential equation.

Student Learning Outcomes (SLO):

Students will:

1. Understanding of the qualitative difference between elliptic, parabolic and hyperbolic equations.
2.Understands which combinations of boundary values and initial values lead to well posed problems
3.it is able to derive partial differential equations from the underlying physical principles 4. we can apply fourier integral theorem of functions in various norms
5.Solve the problem of The Initial Value Problem : D' Alembert's solution.

Unit	Syllabus	Periods

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UNIT - I	Derivation of Laplace equation, derivation of passions equation, boundary value problems (BVPs), properties of harmonic function: the spherical mean, mean value theorem for harmonic function. Maximum-minimum principle and consequences.Uniqueness of the solution for the wave equation duhamel's principle, **Green's function :** introduction, green's function for laplace, the method of images, the eigen function, Green's function for the Wave equation-Helmholtz theorem.	11
UNIT - II	Separation of variables, solution of Laplace equation in cylindrical coordinates, solution of Laplace equation in spherical coordinates, parabolic differential equation occurrence of the diffusion equation, boundary conditions.Green's function for the diffusion equation, Transform of some elementary function, properties of Laplace transform, final value theorem, transform of a periodic function, transform of a error function.	11
UNIT - III	Elementary solution of diffusion equation, Dirac delta function, separation of variables method, Solution of diffusion equation in cylindrical coordinates, solution of diffusion equation in spherical coordinates.Transform of a Bessel's function, transform of dirac delta function, Inverse transform, Convolution Theorem, transform of unit step function, complex inversion formula (Mellin fourier integral), Solution of ordinary differential equation.	11
UNIT - IV	Maximum and minimum principle and consequence, Hyperbolic **Differential equation :** Occurrence of the Wave Equation, Derivation of One Dimensional Wave Equation, Solution of One dimensional Wave Equation by Canonical Reduction, The Initial Value Problem : D' Alembert's solution. **Solution of partial differential equation:** solution of diffusion equation, solution of a wave equation, Fourier transform methods: fourier integral representations: fourier integral theorem, sine and cosine integral representations, fourier transform pairs.	11
UNIT - V	Vibrating string-variables Separable solution, Forced Vibrations- solution of nonhomogeneous equation, boundary and initial value problems for two dimensional wave equation-method of Eigen function, periodic solution of one-dimensional wave equation in cylindrical coordinates, periodic solution of one-dimensional wave equation in spherical polar coordinates.Transform of elementary functionals, properties of fourier transform, parseval's relation, transform of dirac delta function, multiple fourier transform, finite fourier transform : finite sine transform, finite cosine transforms.	11

Text Books:

1 K. Sankara Rao, Introduction to partial differential equations (2003)

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2 Solution Techniques for Elementary Partial Differential Equations, New York: Chapman & Hall, 2010,by C. Constanda.

3 Differential equations with applications and historical notes, Tata McGraw Hill, 2003. (Unit I and II),by G. F. Simmons.

References Books:

1 L.C. Evans, partial differential equations (1998)

2 S.J. Farlow, An Introduction to Differential Equations and their Applications, Reprint, Dover Publications Inc., 2012.

3 An Introduction to Partial Differential Equations, 2nd ed., New York: Springer, 2004,by M. Renardy and R.C. Rogers.

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School of Basic and Applied Sciences

Class	**M.Sc. Mathematics (Final)**
Semester/Year	**II Year**
Subject & Paper Code	**Mathematics- MMATH20Y206**
Paper	**Advanced Special Function-V (Optional-II)**
Max. Marks	**60(ETE) + 40(IA) = 100**

Credit			**Total Credits**
L	T	P	4
2	2	0	

Course Objectives:
To equip students with the concepts of partial differential equations and how to solve linear Partial Differential with different methods. Students also will be Introduced to some physical problems in Engineering models that results in partial differential equation.

Course Outcome:
The Students will be able to:
1. Classify the fundamental principals of partial differential equations(PDEs) to solve hyperbolic, parabolic and elliptic equations.
2. Formulate appropriate numerical methods for solving various problems in partial differential equations.
3. Adapt mathematical software to solve various problems in partial differential equations.
4.Described Hypergeometric function and function 2f1 (a,b;c;z). A simple integral form valuation of 2F1 (a,b;c;z).
5.Described Generating functions.

Student Learning Outcomes (SLO):
Students will:
1.Understanding of the qualitative difference between elliptic, parabolic and hyperbolic equations.
2.Understands which combinations of boundary values and initial values lead to well posed problems
3.Be able to derive partial differential equations from the underlying physical principles
4. We can apply fourier integral theorem of functions in various norms.
5.Solve the Laguerre Polynomials Ln (X), Generating functions.

Unit	**Syllabus**	**Periods**
UNIT - I	Gamma and Beta Function: The Euler or Macheroni Constant γ, Gamma Function A series for Γ'(z)/Γ(z), Difference equation Γ(z+1)= Γz zΓ(z), value of Γ(1-z), Factorial function, Legendre's duplication formula, Gauss multiplication theorem.Bessel function, Bessel's differential equation, Generating function, Bessel's integral with index half and an odd integer.	11

UNIT - II	Hypergeometric function and function 2f1 (a,b;c;z). A simple integral form valuation of 2F1 (a,b;c;z). Contiguous function relations, Hyper geometric differential equation and its solutions, F (a,b;c;z) as function of its parameters.Generating function for legendre polynomials, Rodrigues formula, Bateman's generating function, Additional generating functions.	11
UNIT - III	Generalized Hypergeometric function.Definition of Hermite polynomials Hn(x), Pure recurrence relations, Differential recurrence relations, Rodrigue's formula. Other generating functions, Othogonality, Expansion of polynomials, more generating functions.	11
UNIT - IV	Elementary series manipulations, Simple transformation, Relations between functions of z and l-z.Laguerre Polynomials : The Laguerre Polynomials Ln (X), Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigue's formula.	11
UNIT - V	Confluent hyper geometric function and its properties.Jacobi polynomial. Generating functions, Differential Equation of Jacobi Polinomial, Orthogonal Properties.	11

Text Books:

1. Rainville, E.D., Special Functions, the Macmillan Co., New York 1971.
2. Srivastava, H.M., Gupta K.C. and Goyal, S.P.The H- Functions of one and two variables with applications, South Asian Publication, New Delhi.
3. Saran N., Sharma S.D. and Trivedi- Special Functions with application, Pragati Prakashan 1986.
4. The saxena V.P.- I-Function, anamaya- New Delhi, 2008.

References Books:

1. Lebdev, N.N., Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New Jersey, USA 1997.
2. Whittaker, E.T. and Watson, G.N., A course of Modern Analysis Cambridge University Press, London, 1963.

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School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Final)
Semester/Year				II Year
Subject & Paper Code				Mathematics- MMATH20Y207
Paper				Advanced Graph Theory-V (Optional-III)
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
2	2	0		

Course Objectives:
In this course the students will be trained to do problem solving in different areas of Graph Theory such as, Domination in Graphs, Labeling in Graphs, Colorings in Graphs, Matching Theory. Further the students will be motivated to take up research as their career.

Course Outcome:
The Students will be able to:
1.To understand and apply the fundamental concepts in graph theory
2. To apply graph theory based tools in solving practical problems
3.Umderstand trees and circuits.
4.Understand Euler digraphs, Directed paths and connectedness.
5.Solve Graphs, Fundamental Circuits in Digraphs.Matrix A, B and C of Digraphs.

Student Learning Outcomes (SLO):
Students will:
1.Be familiar with the history and development of graph theory
2.Write precise and accurate mathematical definitions of basics concepts in graph theory
3.Provide appropriate examples and counter examples to illustrate the basic concepts of trees.
4.Understand properties of graph and coloring problems of graph.
5.Acquire mastery in using graph drawing tools, apply various proof techniques in proving theorems in graph theory.

Unit	Syllabus	Periods
UNIT - I	Revision of graph theoretic preliminaries. Isomorphism of graphs, subgraphs.Matrix representation of graphs, Incidence matrix, Submatrices of A(G), Circuit Matrix, Fundamental circuit matrix and Rank of B, An application to a switching Network	11
UNIT - II	Walks, Paths and circuits, Connected graphs, Disconnected graphs and components, Euler Graphs, Operations on Graphs, Hamiltonian paths and circuits, The traveling salesman problem.Cut-set Matrix, Relationships among Af, Bf and Cf, path matrix, Adjacency matrix.	11
UNIT - III	Trees, Properties of trees, Distance and centers in a tree, Rooted and Binary trees, Spanning trees, Fundamental circuits, spanning trees in a weighted graph.Chromatic Number, chromatic Partitioning, chromatic Polynomial, Coverings, matching's.	11

Shama Mehnaz Nidhi

UNIT - IV	Cut-sets, Properties of a cut-set, Fundamental circuits and cut-sets, connectivity and separability.The four color problem, directed graph, some types of Digraphs, Digraphs and Binary relations, Euler digraphs, Directed paths and connectedness.	11
UNIT - V	Planar graphs, Kuratowski's two graphs, Different Representations of a planer graph, Detection of Planarity, Geometric Dual, Combinational Dual.Trees with directed graphs, Arboreocence, Fundamental Circuits in Digraphs.Matrix A, B and C of Digraphs, Adjacency matrix of a Digraph.	11

Text Books:

1. Graph theory with applications to Engineering and Computer Science by Narsingh Deo. Prentice Hall of India.
2. Bollobás, B. Modern Graph Theory (Graduate Texts in Mathematics). New York, by: SpringerVerlag,
3. Fundamentals of Domination in Graphs.New York: Marcel Dekker, Inc., 1998, by T.W. Haynes, S. T. Hedetniemi and P. J. Slater.
4. Introduction to Graph Theory, New Delhi: Prentice-Hall of India, 2011,by D.B. West.

References Books:

1. Graph theory by Harary.
2. 'Graph Theory with Applications'by Bondy,by J. A. and Murty,U.S.R., Springer, 2008.
3. Diestel, R. Graph Theory (Graduate Texts in Mathematics). New York, by: Springer-Verlag,
4. Chromatic Graph Theory. New York: CRC Press, 2009,by G. Chartrand and P. Zhang.