PROPOSED CURRICULUM PLAN FOR POST-GRADUATE MATHEMATICS FROM THE ACADEMIC YEAR 2018-19

FIRST YEAR PROGRAM **SEMESTER I**

Course No.	Course Title	Hours	Credits	Marks
PGM/PSM 4541	Algebra I	6	5	100
PGM/PSM 4543	Real Analysis I	6	5	100
PGM/PSM 4345	Fuzzy Mathematics	5	3	60
PGM/PSM 4347	Number Theory	5	3	60
PGM/PSM 4249	Ordinary Differential Equations	4	2	40
PGM/PSM 43xx	CBCS (NME)*	4	3	60
		30	21	420

SEMESTER II

Course No.	Course Title	Hours	Credits	Marks
PGM/PSM 4542	Algebra II	6	5	100
PGM/PSM 4544	Real Analysis II	6	5	100
PGM/PSM 4446	Graph Theory	6	4	80
PGM/PSM 4248	Combinatorics	4	2	40
PGM/PSM 4250	Partial Differential Equations	4	2	40
PGM/PSM 43xx	CBCS (NME)*	4	3	60
		30	21	420

SECOND YEAR PROGRAM **SEMESTER III**

Course No.	Course Title	Hours	Credits	Marks
PGM/PSM 5541	Topology	6	5	100
PGM/PSM 5543	Complex Analysis	6	5	100
PGM/PSM 5545	Statistics	6	5	100
PGM/PSM 5547	Measure Theory	6	5	100
PGM/PSM 5349	Programming in C++ with OOPS	4	3	60
PGM/PSM 5101	Programming in C++ with OOPS Lab.	2	1	20
		30	24	480

SEMESTER IV

Course No.	Course Title	Hours	Credits	Marks
PGM/PSM 5542	Functional Analysis	6	5	100
PGM/PSM 5544	Classical Mechanics	6	5	100
PGM/PSM 5546	Statistical Inference & Stochastic Processes	6	5	100
PGM/PSM 5548	Operations Research	6	5	100
PGM/PSM 5450	Project	6	4	80
		30	24	480

*CBCS courses: PGM/PSM 4301Programming in C(2T+2L); PGM/PSM4303Astronomy through ages;PGM/PSM4302Mathematics for Career Prospects; PGM/PSM 4304 Introduction to Statistical tools

Programme Specific Outcomes (PSOs) for MSC Mathematics

Oncompletion of the programme, the post graduates will be able to

1. *critically analyze*, *logicallydeduce* and arrive at *optimal solutions* to problems in every walk of life. Apply the *skills and the tools* they learnt to different fields of study.
2. learn independenlyand pursue research.
3. explain *the abstract mathematical concepts* with clear understanding of the basics coherently both in written and verbal form.
4. explore the new *frontiers of knowledge* in mathematics. Do programming and coding in the recent softwares and languages
5. experiment with *experiential learning* through projects.
6. *create* new abstract mathematical structures, propose and prove or disprove mathematical statements, become competent enough to defend the new mathematical statements proposed in the relevant academic bodies
7. be a successful learner/researcher in *inter disciplinary* fields of study.
8. assimilate *complex* and *intricate mathematical* concepts and use *logical deductions* for construction of irrefutable proof.
9. equip them self to suit any environment in the global context of multilingual, multicultural, multiethnic and multiracial communities without compromising the core values and ethos which in turn prepare them for a global citizen.
10. face competitive examinations either for placement or further studies in abroad

Mapping of Courses Outcomes (COs) with Programme Specific Outcomes (PSOs)

Courses	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10
PGM/PSM 4541	X	X	X		X	X		X		X
PGM/PSM 4543	X	X	X		X	X		X		X
PGM/PSM 4345	X	X	X		X	X	X			X
PGM/PSM 4347	X	X	X		X	X	X			X
PGM/PSM 4249	X	X	X		X	X	X			X
PGM/PSM 4301	X	X	X	X	X	X	X			
PGM/PSM 4542	X	X	X		X	X		X		X
PGM/PSM 4544	X	X	X		X	X		X		X
PGM/PSM 4446	X	X	X		X	X	X			X
PGM/PSM 4248	X	X	X		X	X	X			X
PGM/PSM 4250	X	X	X		X	X	X			X
PGM/PSM 4302	X	X	X		X	X	X			X
PGM/PSM 5541	X	X	X		X	X		X		X
PGM/PSM 5543	X	X	X		X	X		X		X
PGM/PSM 5545	X	X	X		X	X	X			X
PGM/PSM 5547	X	X	X		X	X		X		X
PGM/PSM 5349	X	X	X	X	X	X	X			
PGM/PSM 5101	X	X	X	X	X	X	X			
PGM/PSM 5542	X	X	X		X	X		X		X
PGM/PSM 5544	X	X	X		X	X	X			X
PGM/PSM 5546	X	X	X		X	X	X			X
PGM/PSM 5548	X	X	X		X	X	X			X
PGM/PSM 5450	X	X	X		X	X	X		X	
PGM/PSM 4303	X	X	X		X	X	X			
PGM/PSM 4304	X	X	X		X	X	X			X

Programme Outcomes (Pos) for Postgraduates

Postgraduate programmes are expected to have developed in postgraduates the following graduate attributes:

1. *Academic Excellence*: Being a member of the academic community with advanced discipline-specific knowledge and professional skills in the relevant field with the prowess to communicate complex ideas and to engage in current critical debates with all sensitivity and fairness.
2. *Higher Order Thinking Skills*: Ability to critically think, analyse, evaluate, and create new knowledge and skills both in the chosen discipline and across other fields.
3. *Subscription to Quality Research*: Ability to design and carry out independent research, to update oneself with current research trends and contemporary inputs in the discipline, and to evaluate research contributions.
4. *Lifelong Learning*: Ability to learn, unlearn, and relearn knowledge and skills in the emerging areas of the field of specialization.
5. *ICT Literacy*: Ability to be digital natives so that they can access a wide range of technologies for personal, academic and professional use and to be members of online communities enjoying the unlimited access blending transparency with accountability and fair practices.
6. *Good Communication*: Ability to participate in public discourse on varied themes and topics in one's mother tongue as well as in English as a global link language.
7. *Individuals as Assets*: To be academically honest, intellectually curious, ethically responsible, professionally competent, and spiritually inspiring citizens.
8. *Civic and Social Responsibility*: Ability to function as matured democratic citizens with participation in issues of equity, gender equality, social justice, sustainable development, and poverty alleviation.
9. *Continuous Professional Development*: Ability to continuously develop oneself professionally and to critically improve one's self with a view to taking appropriate decisions in diverse professional and real life environments.

10. *Global Citizenship*: Ability to work effectively and to live responsibly in a global context of cross-cultural life and capability, to value human diversity and lead life of timeless learning and endless opportunities.

Mapping of Programme Specific Outcomes (PSOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PSO1	X	X	X	X	X	X	X			
PSO2	X	X	X	X	X	X		X		
PSO3	X	X	X	X	X	X				
PSO4	X	X	X	X	X			X		
PSO5	X	X	X	X	X		X		X	
PSO6	X	X	X		X	X	X			X
PSO7	X	X	X	X	X		X	X		
PSO8	X	X	X		X		X		X	X
PSO9	X	X	X		X				X	X
PSO10	X	X		X		X			X	X

PGM 4541/PSM 4541 ALGEBRA I 6 Hrs / 5 Cr

The aim of the course is to introduce the fundamental areas of Algebra namely group theory and Ring theory to the students. This course will provide a strong foundation in the abstract approach for the budding Mathematician. The course deals with the group Theory, Ring Theory and various standard results in these areas.

One of the amazing features of twentieth century Mathematics has been its recognition of the power of abstract approach. Modern algebra has evolved with this abstract approach, and is one of the important current research areas of Mathematics, and also serves as the unifying thread which interfaces all of Mathematics – geometry, number theory, analysis, topology and even applied Mathematics. The basic ideas in algebra are used in Functional Analysis, Complex Analysis, Operations Research, Computer Science, Physics and Chemistry.

At the end of the course, students will be able to

i. explain the properties of homomorphism and automorphism in the context of Cayley and Cauchy theorem.
ii. characterize different groups in the context of Sylow's theorem.
iii. identify solvable groups and demonstrate Jordan Holder theorem.
iv. compare and contrast the algebraic structures such as rings, ideals,quotient rings and integral domain.
v. determine the characteristics of rings specifically polynomial rings and illustrate Hilbert basis theorem.

Unit 1: Group theory: Introduction to groups, homomorphism and Automorphism, Cayley theorem and Cauchy theorem.

Unit 2: Permutation groups, Class equation, Sylow theorem, Direct products, finite abelian groups.

Unit 3: Solvable groups, Schreier refinement theorem, Jordan Holder theorem.

Unit 4: Ring theory: Introduction to rings, ideals and quotient rings, Field of quotients of an integral domain.

Unit 5: Euclidean rings, Principal ideal and unique factorization domain, Gaussian integers, Polynomial rings, Polynomials over the rational field, Polynomials over a commutative ring, Noetherian ring, Hilbert basis theorem.

TEXT BOOKS:

1.I.N.Herstein, Topics in Algebra, Vikas Publishing house, 2002.

Unit 1: Chapter 2.1 to 2.9
Unit 2: Chapter 2.10 to 2.14

2.Surjeet Singh and Quazi Zameeruddin, Modern algebra, Vikas publishing house, 2006.
Unit 3: Chapter 6

3.D.M.Burton, A first course in rings and ideals, Addison Wesley Publishing house, 1970.
Unit 4: Chapter 2, 5
Unit 5: Chapter 6, 7.1- 7.7(upto example 7.7),
Chapter 11(upto Hilbert basis theorem)

REFERENCE BOOKS:

1. M.Artin, Algebra, Prentice Hall of India, 1994.
2. B.Balumsla and B.Chandler, Theory and problems of group theory, Schuam outline series, Mcgraw Hill, 1980.
3. J.B.Fraleigh, A first course in Modern algebra, Addison Wesley Publishing house, 1970.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				
K2: Understanding		2			
K3: Applying			3		
K4: Analyzing					
K5: Evaluating				5	5
K6: Creating					

Mean = 3.2

PGM 4543/PSM 4543 REAL ANALYSIS I 6Hrs/5 Cr

The aim of the course is to provide every Postgraduate student a comprehensive idea about the principles of Real Analysis. This course will provide such treatment. This course deals with a thorough understanding of convergence, continuity and differentiation. Algebra and Analysis are like the two eyes of a man in the realm of Mathematics. Analysis takes a man into the highlands of Mathematics itself, where these concepts are inseparable in all of pure Mathematics as it is today. This course is the seed, which is primitive in appearance but has the capacity for vast and intricate development for an able mathematician.

Real Analysis is the foundation of pure Mathematics and the ideas of Real Analysis are used in Topology, Functional Analysis, Complex Analysis and Measure Theory. The students can apply the concepts studied in this course in Topology, Functional Analysis, Complex Analysis and Measure Theory.

At the end of the course, students will be able to

i. discuss well-order property of the real line and its completeness.
ii. explain the generalization of the distance in real line to the metric in any set, and its ramifications in the realm of compactness, connectedness and completeness.

iii. outline the importance of sequences and series by predict the limit of sequences/series using various tests.
iv. categorize continuity with limit as a tool and the implications of continuity on compactness and connectedness.
v. demonstrate with examples and counter examples of differentiable functions and their properties.

Unit 1: Ordered field, real field, properties of real line, Extended Real number system.

Unit 2: Metric spaces, compact sets, connected sets, perfect sets, cantor set.

Unit 3: Numerical sequences and series. Convergent sequences, Cauchy sequences, complete metric spaces, series, tests of convergence, conditional and absolute convergence, power series, summation by parts, rearrangement of series.

Unit 4: Continuity, limit of a function, continuity and convergence, continuity and compactness, continuity and connectedness, discontinuity, monotonic functions.

Unit 5: Differentiation, derivative of a real function, mean value theorems, the continuity of derivatives, L'Hospital rule, Taylor's theorem, differentiation of vector-valued functions.

TEXT BOOK:

W.Rudin-Principles of Real Analysis, McGraw Hill, 2004.

Unit 1: Chapter 1
Unit 2: Chapter 2
Unit 3: Chapter 3
Unit 4: Chapter 4
Unit 5: Chapter 5

REFERENCE BOOKS:

1. M. Apostol-Mathematical Analysis, Addison Wesley Publishing house, 2010.
2. V.Ganapathy Iyer-Mathematical Analysis, Tata Mcgraw Hill, 1985.
3. R.R.Goldberg-Methods of Real Analysis, Oxford and IBH publishing house, 1975.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding	2	2			
K3: Applying			3		
K4: Analyzing				4	
K5: Evaluating					5
K6: Creating					

Mean = 3.2

PGM4345/PSM 4345 FUZZY MATHEMATICS5Hrs/3Cr

The objective of this course is to introduce to the students all the basic ideas of fuzzy mathematics. The course deals with types of fuzzy sets, operations on fuzzy sets, fuzzy number, fuzzy interval, fuzzy logic, fuzzy relations and various connectives in fuzzy sets.

The learner will be able to appreciate the insufficiency of the Aristotelian logic when we think of artificial intelligence and machine language. He would appreciate the complexity of the fuzzy logic. The content of the course will enable him to realize the inherent fuzziness in every human language and find a way out to express in best possible mathematical expression.

At the end of the course, students will be able to

i. recall the basic concept of crisp sets and develop analogous patterns in fuzzy sets using alpha cuts and decomposition theorems.
ii. characterize fuzzy complement, t-norm, t-conorm.
iii. identify and characterize fuzzy numbers and realize real number as a special case of fuzzy number, illustrate arithmetic operation on fuzzy numbers and solve fuzzy equations.
iv. compare and contrast fuzzy relations with crisp relations.
v. discuss methods for solving fuzzy relation equations and illustrate with examples.

Unit 1: Introduction – Crisp sets – Fuzzy sets – Basic concepts – Properties of α–cuts – Representations of fuzzy sets –Decomposition theorems – – Extension Principle for fuzzy sets.

Unit 2: Fuzzy complements – First Characterization Theorem of Fuzzy complements – Second Characterization Theorem of Fuzzy complements – Fuzzy intersections (t – Norms) –Fuzzy Union (t-conorms) – Characterization theorem of t-norms, t-conorms – Combinations of operations – Aggregation operations .

Unit 3: Fuzzy Numbers – Linguistic variables – Arithmetic Operations on intervals – Arithmetic Operations on Fuzzy numbers – Lattice of fuzzy numbers – Fuzzy Equations.

Unit 4: Crisp and fuzzy relations – Projections and Cylindrical extensions – Binary fuzzy relations – Binary relations on a single set – Fuzzy equivalence relations – sup-i compositions of fuzzy relations – inf$\omega_i$compositions of fuzzy relations.

Unit 5: Fuzzy relation equations – Partitioning – Solution method.

TEXT BOOK:

George J. Klir and Bo Yuan, Fuzzy sets and fuzzy logic, theory and applications, Prentice Hall of India, 2005.

Unit 1 : Chapter 1,2(Sec 1.1 – 1.5 & 2.1 – 2.3)
Unit 2 : Chapter 3(Sec 3.1 – 3.6)
Unit 3: Chapter 4(Sec 4.1 – 4.6)

Unit 4 : Chapter 5(Sec 5.1 – 5.5 & 5.9 – 5.10 theorem 5.3 only)
Unit 5 : Chapter 6,7(Sec 6.1 – 6.3)

REFERENCE BOOKS:

1. G.J. Klir and T.A. Folger, Fuzzy sets, uncertainty and information, Prentice Hall of India, 2001.
2. H.T. Nguyen and E.T. Walker, A first course in fuzzy logic, Chapman and Hall, 1999.
3. H.J. Zimmermann, Fuzzy set theory and its applications, Allied publishers, 1996.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				
K2: Understanding		2			
K3: Applying					
K4: Analyzing				4	
K5: Evaluating			5		
K6: Creating					6

Mean = 3.6

PGM 4347 / PSM 4347 NUMBER THEORY 5 Hrs/ 3 Cr

The study of number theory inevitably includes knowledge of the problems and techniques of elementary number theory; however the tools which have evolved to address such problems and their generalizations are both analytic and algebraic, and often intertwined in surprising ways. This course covers topics from classical number theory including discussions of mathematical induction, prime numbers, division algorithms, congruences, andquadratic reciprocity.

At the end of the course, students will be able to

i. recall the fundamental concepts of divisibility.
ii. discuss congruences with emphasis on congruences involving prime modulus.
iii. find the existence or non existence of solutions to congruences, and system ofcongruences.
iv. analyse the quadratic residues and quadratic non residues.
v. formulate integer functions. Find integral solutions to linear Diophantine equations.

Unit 1: Divisibility – properties – division algorithm – G.C.D- related theorems - Euclid's lemma – Euclidean algorithm – primes – fundamental theorem of arithmetic- infinitude of primes.

Unit 2: Congruences – properties – Euler's phi function – Fermat's theorem – Euler's theorem – Wilson's theorem- Albert Girard theorem – Fermat theorem on two squares.

Unit 3: Solution of congruences - polynomial congruence equation - Chinese remainder theorem – applications – public key cryptography.

Unit 4: Quadratic residues- Euler's criterion- Legendre symbol – properties - Gauss lemma – Gaussian reciprocity law- Jacobi symbol.

Unit 5: Greatest integer function – properties – de poligrac's formula – day of the week from the date- arithmetic functions: $d(n), \sigma(n), \sigma_k(n), \omega(n), \Omega(\mathrm{n})$ - properties- Mobius inversion formula- Linear Diophantine equation: ax+by=c.

TEXT BOOK:

Ivan Niven, H. S. Zuckerman, and H.L. Montgomery, An introduction to the theory of numbers, 5^{th} edition, John wiley and sons, 2013.

Unit 1: Chapter 1(sec 1.2- 1.3)
Unit 2: Chapter 2(sec 2.1-2.2)
Unit 3: Chapter 2(sec 2.3-2.5)
Unit 4: Chapter 3(sec 3.1-3.3)
Unit 5: Chapter 4(sec 4.1-4.3), Chapter 5(sec 5.1)

REFERENCE BOOKS:

1. David M. Burton, Elementary Number theory, 7^{th} edition Tata McGraw- Hill education private limited, New Delhi, 2012.
2. Tom. M. Apostol, Introduction to analytic number theory, springer international student Edition, 1998.
3. G.H. Hardy and E.M. Wright, An introduction to the theory of Numbers, 6^{th} edition, London oxford university press, 1975.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				
K2: Understanding					
K3: Applying			3	3	
K4: Analyzing		4			
K5: Evaluating					5
K6: Creating					

Mean = 3.2

PGM 4249/PSM 4249ORDINARY DIFFERENTIAL EQUATIONS 4Hrs/2Cr

This course deals with the basic concepts of Ordinary Differential Equations and applies them to various physical problems.

This course will motivate the students in higher studies and research in applications of ordinary differential equations.

At the end of the course, students will be able to

i. recall the basic concepts of ordinary differential equations, Solve the initial value problems for the homogeneous equations and hence evaluate its independency using wronskian.
ii. differentiate homogeneous, non-homogeneous and homogeneous with analytic coefficients equations. Solve homogeneous equations with analytic coefficients.
iii. identify the regular singular points for both linear and second order ordinary differential equations and hence solve them.
iv. compute the Bessel's function of zero order and order α.
v. illustrate the concept of variable separation, exact equation and successive approximation and derive the Lipchitz condition.

Unit 1: Linear equations with variable coefficients, initial value problems for the homogenous equation, Solutions of the homogenous equation, The Wronskian and linear independence, reduction of the order of a homogenous equation.

Unit 2: The Non-homogenous equations, Homogenous equations with analytic Coefficients, The Legendre equation, Chebychev's equation, Hermite equation and Justification of the power series method.

Unit 3: Linear equations with regular singular points, The Euler equation, Second order equations with regular singular points.

Unit 4: A convergence proof, the exceptional cases, The Bessel equation.

Unit 5: Existence and uniqueness of solutions to first order equations: Equations with variables separated, Exact equations, The methods of successive approximations, The Lipschitz condition, Convergence of the successive approximations.

TEXT BOOK:
E.A.Coddington, An introduction to ordinary differential equations, Prentice Hall of India, 2004.

Unit 1: Chapter III: Sections 1, 2,3,4,5 and related problems
Unit 2: Chapter III: Sections 6, 7, 8 and related problems
Unit 3: Chapter IV: Sections 1, 2, 3 and related problems
Unit 4: Chapter V: Sections 5, 6, 7, 8 and related problems
Unit 5: Chapter VI: Sections 1, 2, 3, 4, 5, 6 and related problems

REFERENCE BOOKS:
1. G.F.Simmons, Differential equations with applications and historical notes,Tata McGraw Hill, 1995.
2. S.G.Deo and V.Raghavendra, Ordinary differential equations and stability theory, 1996.
3. Chakravarty, Elements of ordinary differential equations and special function, Wiley Eastern, 2001.
4. S.G.Deo, V. Lakshmikantham and V.Raghavendra, Text Book of Ordinary differential equations, Tata McGraw Hill Publishing Company Limited,1997.

	Unit-I	**Unit-II**	**Unit-III**	**Unit IV**	**Unit V**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1:Remembering	1		1		

K2:Understanding					2
K3:Applying	3	3	3	3	3
K4:Analyzing		4			
K5:Evaluating	5				
K6:Creating					

Mean = 2.8

PGM 4542 /PSM 4542 ALGEBRA II 6 Hrs/5 Cr

The course will aim to provide a strong foundation in the abstract approach for the budding Mathematician. In this course the students will be introduced to the third algebraic model, a vector space, field theory, algebra of linear transformation and various types of operators.
One of the amazing features of twentieth century Mathematics has been its recognition of the power of abstract approach. Modern algebra has evolved with this abstract approach, and is one of the important current research areas of Mathematics, and also serves as the unifying thread which interfaces all of Mathematics – geometry, number theory, analysis, topology and even applied Mathematics. These are potent and effective tools in all branches of Mathematics. These ideas trace its origin to topics in geometry and physics. The basic ideas in algebra are used in Functional Analysis, Complex Analysis, Operations Research, Computer Science, Physics and Chemistry.

At the end of the course, students will be able to

i. construct extension fields given an irreducible polynomial over the field, characterize the basic structure of finite field and splitting field.
ii. illustrate the Fundamental Theory of Galois Theory for small extensions.
iii. represent linear transformations and quadratic forms with matrices, and describe properties of these linear transformations based on the matrix representation.
iv. determine the Eigenvalues and associated Eigenvectors of a linear transformation with relevance to Cayley Hamilton theorem and demonstrate primary decomposition theorem with examples.
v. use the Gram-Schmidt ortho-normalization process to construct an ortho-normal basis for a given inner product space and discuss the operator theory.

Unit 1: Field theory: extension fields, Roots of a polynomial, splitting field of a polynomial.

Unit 2: Elements of Galois Theory, solvability by radicals.

Unit 3: Introduction to vector spaces, linear transformation, the algebra of a linear transformation, Isomorphism, representation of transformation by matrices, linear functional, double dual spaces, and transpose of Linear transformation.

Unit 4: Introduction, Characteristic roots and Characteristic vectors, annihilating polynomials, invariant subspaces, simultaneous triangulation and diagnolization, direct-sum decompositions, invariant direct sums and primary decomposition theorem.

Unit 5: Inner product spaces, linear functional and adjoints, unitary operators and normal operators.

TEXT BOOKS:

1. I.N.Herstein, Topics in Algebra, Vikas Publishing house, 2002.
   Unit 1: Chapter 5.1 to 5.5
   Unit 2: Chapter 5.6 to 5.8

2. K.Hoffman and R.kunze-Linear algebra, Prentice Hall, 2000.
   Unit 3: Chapter 3.1 to 3.7
   Unit 4: Chapter 6.1 to 6.
   Unit 5: Chapter 8.2 to 8.5

REFERENCE BOOKS:

1. M.Artin-Algebra, Prentice Hall of India, 1994.
2. J.B.Fraleigh- A first course in Modern algebra, Addison Wesley Publishing house, 1990.
3. Surjeet Singh and Quazi Zameeruddin-Modern algebra, Vikas publishing house, 1991.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding		2		2	
K3: Applying	3				3
K4: Analyzing					
K5: Evaluating			5		
K6: Creating					

Mean = 3

PGM 4544/ PSM 4544 REAL ANALYSIS II 6Hrs/5 Cr

The aim of this course is to provide every Postgraduate student a comprehensive idea about the principles of real analysis. This course will provide such treatment. This course will give a comprehensive treatment of integration, uniform convergence and end up with the three important results of any fundamental course in analysis namely inverse function theorem, implicit function theorem and rank theorem. Algebra and Analysis are the two eyes of a main in the realm of Mathematics. Analysis takes a man into the highlands of mathematics itself, where these concepts are inseparable in all of pure mathematics as it is today. This course is a sea, which is primitive in appearance but has the capacity for vast and intricate development for an able mathematician. If analysis is one of the eyes of a man in the realm of mathematics, differentiation and integration are the two eyes of a man in the realm of analysis.

Real analysis is the foundation of pure mathematics and the ideas of real analysis are used in topology, functional analysis, complex analysis and measure theory. The students can apply the concepts studied in this course in Topology, Functional Analysis, Complex Analysis, Differentiation, Integration, Differential Equations and Measure Theory.

At the end of the course, students will be able to

i. understand the concept of Riemann-Stieltjes integral as a limit of summation and its relevance in the context of derivative.
ii. explain the idea of sequences and series of functions. Also the ramification of uniform convergence on integration, continuity and differentiation.
iii. discuss on the importance of Stone-Weierstrass theorem as a polynomial approximation of continuous function.
iv. categorize different special functions as a consequence of series of functions.
v. demonstrate higher level multivariable real valued functions and their properties.

Unit 1: The Riemann-Stieltjes integral, definition and properties of integral, integration and differentiation, rectifiable curves.

Unit 2: Sequences and series of functions, Uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation.

Unit 3: Equi continuous families of function, Arzelo Ascoli theorem, Stone-Weierstrass theorem.

Unit 4: Some special functions, power series, exponential and logarithmic functions, trigonometric functions, Algebraic completeness of the complex field, Fourier series, gamma function.

Unit 5: Functions of several variable, linear transformations, differentiation, contraction principle, inverse function theorem, implicit function theorem, rank theorem.

TEXT BOOK:

W.Rudin-Principles of Real Analysis, McGraw Hill, 2004.

Unit 1: Chapter 6
Unit 2: Chapter 7 (Sec 7.1 –Sec 7.5)
Unit 3: Chapter 7 (Sec 7.6- Sec 7.7)
Unit 4: Chapter 8
Unit 5: Chapter 9 (Sec 9.1 –Sec 9.6)

REFERENCE BOOKS:

1. M. Apostol-Mathematical Analysis, Addison Wesley Publishing house, 2010.
2. V.Ganapathy Iyer-Mathematical Analysis, Tata Mcgraw Hill, 1985.
3. R.R.Goldberg-Methods of Real Analysis, Oxford and IBH publishing house, 1975.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					

K2: Understanding		2		2	
K3: Applying	3				3
K4: Analyzing					
K5: Evaluating			5		
K6: Creating					

Mean = 3

PGM 4446/PSM 4446 GRAPH THEORY 6 Hrs/4 Cr

Graph Theory is an important branch of Mathematics which has plenty of applications in almost all other fields such as Physics, Chemistry, Operations Research, Management, Sociology, Linguistics, Computer Engineering, Electrical Engineering, etc. This course covers all the basic concepts in Graph Theory namely trees, Eulerian and Hamiltonian graphs, Matching, vertex and edge coloring, Planar graphs and Applications of Graph theory in various fields.
The objective of the course is to give a complete introduction to Graph Theory andto cover very recent areas of Graph Theory, so that interested students can continue their research in this area.

At the end of the course, students will be able to

i. understand and write precise mathematical definitions of objects in graph theory.
ii. understand the properties of trees and distance concept in graphs.
iii. identify Eulerian/Hamiltonian graphs, apply algorithms to construct Eulerian trails in graphs, and understand the matching concepts.
iv. enumerate properties of vertex connectivity and edge connectivity.
v. validate and critically assess the vertex coloring and edge coloring.

Unit 1: Fundamental Concepts – Introduction, Graphs, labeled Graphs, weighted Graphs, vertex degrees, isomorphism, paths, cycles, and trails, connectedness, bipartite graphs, Eulerian Circuits, graphic sequences, directed graphs, Eulerian digraphs, radius and diameter, subgraphs, operations on graphs, adjacency, incidence and path matrices.

Unit 2: Trees and distances - basic properties, distances in trees and graphs, disjoint spanning trees, enumeration of graphs, minimum spanning trees.

Unit 3: Eulerian graphs, Hamiltonian graphs, necessary and sufficient conditions, Hamiltonian sequences, Matching, maximum matching, Hall's theorem, independent sets and covers, Konig's theorem, maximum bipartite matching, Tutte's theorem.

Unit 4: Connectivity and paths – cuts and connectivity, k-connected graphs, applications of Menger's theorem, maximum network flow.

Unit 5: Coloring of graphs – vertex colorings and upper bounds, Brooks' theorem, structure of k-chromatic graphs, extremal problems and Turan's theorem, color-critical graphs. Edgecoloring. Planar graphs - Embeddings and Euler's formula – dual graphs, Kuratowski's theorem (without proof), four colour conjecture, five colour theorem for planar graphs, face colouring.

TEXT BOOK:

J.A.Bondy and U.S.R.Murty – Graph Theory with Applications, Macmillan Co, 1976

Unit 1: Chapter 1.1-1.8
Unit 2: Chapter 2.1-2.5
Unit 3: Chapter 4.1-4.4, 5.1-5.3
Unit 4: Chapter 3.1-3.3
Unit 5: Chapters 6.1, 6.2, 7.1-7.3, 8.1-8.2, 9.1-9.6

REFERENCE BOOKS:

1. F. Harary – Graph Theory, Addison Wesley publishing house, 1972
2. R.Balakrishnan and K.Ranganathan – A text book of Graph Theory, Springer Verlag, 2000
3. G. Chartrand – Introductory Graph Theory, Dover publications, 1985
4. G. Chartrand and O. R. Oellerman – Applied and Algorithmic Graph Theory, Mcgraw Hill, 1993
5. M.Murugan – Topics in Graph Theory and Algorithms, Mudali publishing house, 2003,
6. Narasingh Deo – Graph Theory with Applications to Engineering and Computer science, Prentice Hall of India, 1984
7. K.R.Parthasarathy – Basic Graph Theory, Tata Mcgraw Hill, 1994
8. D. B.West – Introduction to Graph Theory, Prentice Hall of India, 2001

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				
K2: Understanding		2			
K3: Applying			3		
K4: Analyzing				4	
K5: Evaluating					5
K6: Creating					

Mean = 3

PGM 4248/PSM 4248 COMBINATORICS 4 Hrs / 2 Cr

Combinatorics is the branch of Mathematics studying the enumeration, combination, and permutation of sets of elements and the mathematical relations that characterize their properties. The objective is to introduce large variety of applications and how algorithmic approach can be applied to solve a combinatorial problem. This course will also initiate interest in the students in higher studies and research in applicable mathematics.

At the end of the course, students will be able to

i. identify and apply the rules of sum and product in combinatorics.
ii. discuss the distributions of distinct objects, identical objects and its application in counting principle.
iii. use generating function as a tool for solving counting problems.
iv. formulate recurrence relation for counting problems and solve them using known techniques including the generating functions.
v. outline the principle of inclusion and exclusion and solve counting problems.

Unit 1: Two basic coutinng principles – Simple arrangement and selections – Arrangement and selection with repetitions.

Unit 2: Distributions – distribution of distinct objects – Distribution of identical objects – Binomial identities.

Unit 3: Generating functions – Calculating coefficients of generating functions – Partitions– Exponential generating functions.

Unit 4: Recurrence relation – Solution of linear recurrence relations – Solutions of inhomogeneous recurrence relations.

Unit 5: Inclusion and exclusion formula – Derangement – Introduction to rook polynomial.

TEXT BOOK:

A.W.Tucker, Applied Combinatorics, Wiley, 2011.

Unit 1: Section 5.1, 5.2, 5.3
Unit 2: Section 5.4, 5.5
Unit 3: Section 6.1, 6.2, 6.3, 6.4
Unit 4: Section 7.1, 7.3, 7.4, 7.5
Unit 5: Section 8.2, 8.3 (page 335 -341)

REFERENCE BOOKS:

1. D.Cohen, Combinatorics, Wiley, 1978.
2. M.Hall, Combinatorial Mathematics, McGraw Hill, 1968.
3. C.L.Liu, Introduction to Combinatorial Mathematics, 1994.
4. H.J.Ryser, Combinatorial Mathematics, Carus Mathematical monograph,1965.
5. Krishnamurthy, Combinatorics, PHI, 1998.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding					
K3: Applying	3		3		3
K4: Analyzing				4	
K5: Evaluating					
K6: Creating		6			6

Mean = 4.12

PGM 4250 /PSM 4250 PARTIAL DIFFERENTIAL EQUATIONS 4 Hrs /2Cr

To give an introduction to Mathematical techniques in analysis of Partial Differential Equations.

At the end of the course, students will be able to

i. Distinguish the first order linear and nonlinear partial differential equations and solve them using Charpit's method, examine the compatibility of the first order equations.

ii. Differentiate linear partial differential equations with constant coefficients and variable coefficients and classify the equations with variable coefficients to its canonical forms and hence solve them.

iii. Solve the Laplace equation using the method of separation of variables, examine the families of equipotential surfaces and interpret the concept of boundary value problems.

iv. Apply Kelvin's inversion theorem in the relevant fields, invokes Green's functions for Laplace equation in an appropriate situations.

v. Solve one dimensional wave equation using Riemann Volterra, apply the concept of the calculus of variation in vibrating Membranes.

Unit 1 : Linear Equations of the first order – Integral Surfaces Passing through a given curve – Surfaces Orthogonal to a given system of surfaces – Nonlinear Partial Differential Equations of the first order – Cauchy's Method of Characteristics – Compatible systems of first order equations – Charpit's Method.

Unit 2: Linear partial differential equations with constant coefficient- Equations with variable coefficients - Characteristic curve of second order equation - Characteristics of equations in three variables - The solution of linear Hyperbolic Equations.

Unit 3: Separation of variables - Elementary solutions of Laplace equation - Families of equi-potential surfaces - Boundary value problems.

Unit 4: Separation of variables - Problems with axial symmetry - Kelvin's inversion theorem - The theory of Green's functions for Laplace Equations - The relation of Dirichlet's to the Calculus of Variation.

Unit 5: Elementary Solutions of the One – dimensional Wave equation – The Riemann-Volterra solution of the One- dimensional Wave equation – Vibrating Membranes: Application of the Calculus of the variations.

TEXT BOOK :

Sneddon IAN., "Elements of Partial Differential Equations", Mc Graw Hill Book Company,New York 1957; Republished by Dover in 2006.

REFERENCE BOOKS :

1.Dennemeyer R.,"Introduction to Partial Differential Equations and Boundary Value Problems", McGraw Hill Book Company, 1968.

2.Pinsky M.A, "Partial Differential Equations and Boundary Value Problems", McGraw HillBook Company, 3rd Edition, 1998.

3.Coleman P. M.,"An Introduction to Partial Differential Equations with MAT LAB", Chapman & Hall / CRC, 2005.

	Unit-I	Unit-II	Unit-III	Unit IV	Unit V
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**

K1:Remembering					
K2:Understanding			2		
K3:Applying	3	3	3	3	3
K4:Analyzing	4	4	4		
K5:Evaluating					
K6:Creating					

Mean = 3.22

PGM 4301/ PSM 4301 PROGRAMMING IN C 4 Hrs (2T+2L) / 3 Cr

C has become the starting point for learning a course on programming language. This course is mainly designed to use C to learn the art of programming, and to appreciate and understand the C language to creatively write a wide range of programmes and peep into the study of Data Structures.

At the end of the course, students will be able to

i. explain the importance of C, Create and execute simple C programs.
ii. develop a C program using operators and manage I/O operations.
iii. construct C program with the help of branching statements
iv. recall the syntax and use loop statements in C program
v. illustrate the uses of arrays and create C programs using arrays to compute and print the specified output.

Unit 1: Overview of C- basic structure – executing a C program - character sets – C tokens – keywords – identifiers - constants – variables – data types- declaration of variables.

Unit 2: Operators and expressions- arithmetic, relational, logical, assignment, increment and decrement, conditional, bitwise, special operators- managing input and output operations- formatted input and output

Unit 3: Decision making and branching –simple if – if … Else- nested if – else if ladder – switch statement –Goto statement.

Unit 4: Decision making and looping- while loop – for loop –do while loop – break, continue statements.

Unit 5: Arrays - introduction – declaration initialization of one dimensional arrays – initializing two dimensional arrays - character arrays and strings – declaring and initializing string variables – string handling functions.

TEXT BOOK:

E. Balagurusamy, Programming in ANSI C 6th edition, Tata McGraw Hill, 2013.

Unit 1: Chapter 1: sec 1.1-1.10, Chapter 2 sec 2.1-2.10
Unit 2: Chapter 3: sec 3.1-3.12, Chapter 4
Unit 3: Chapter 5
Unit 4: Chapter 6: sec 6.1-6.5
Unit 5: Chapter 7: sec 7.1-7.6, Chapter 8: sec 8.1-8.8

REFERENCE BOOKS:

1. P. Pandiyaraja, Programming in C, S. Viswanathan Pvt Ltd, 2005.
2. Herbert Schildt, Advanced C programming, Osborne McGraw Hill, 1990.
3. M. Tim Grady, Turbo C Programming Principles and Practices, McGraw Hill, 1990.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering				1	
K2: Understanding	2				2
K3: Applying		3	3	3	
K4: Analyzing					
K5: Evaluating					
K6: Creating	6				6

Mean = 3.25

PGM 4302/PSM 4302 MATHEMATICS FOR CAREER PROSPECTS 4 Hrs/ 3 Cr

This course aims at providing necessary logical reasoning part which is required of post graduates, especially from arts disciplines, in order to get through in competitive exams like UGC-NET/SET. This course includes Mathematical reasoning, logical reasoning and Data interpretation ideas. The contents were put in order so that a student who had undergone this course will get enhanced with numerical and logical abilities.

At the end of the course, students will be able to

i. solve verbal reasoning problems like series completion, Alpha-Numeric puzzle and time sequence test.
ii. apply mathematical operations to find the solution to the given situation.
iii. analyze and establish the relation between the given series of figures, solve arithmetic reasoning problems.
iv. relate the given statements and draw conclusions from it.
v. solve quantitative aptitude problems under data interpretation.

Unit 1: Alphabetic series - Numerical series - odd man out - Inserting a number in a series- Completing a series- Ranking in a series - Time sequence test.

Unit 2: Verbal reasoning- Problem solving by substitution - Interchange of signs and numbers- Deriving appropriate conclusions from given set of statements - Logical sequences of words - Venn diagram based problems.

Unit 3: Non-verbal reasoning- inserting the missing character - Five figure series - Analogy - Arithmetical reasoning - Analytical reasoning.

Unit 4: Logical reasoning - Two premise arguments - Three premise arguments - Statements and arguments-Statements and assumptions – Statements and course of actions-Statements and conclusions -Deriving conclusions from passages-Theme deduction -Cause and effect reasoning.

Unit 5: Data interpretation- Tabulation - Bar graphs - Pie charts - Line graphs.

TEXT BOOKS:

1. Dr.R.S. Aggarwal, A Modern Approach To Verbal and Non – Verbal Reasoning, S.Chand and Company.Pvt.Ltd,2013.
   Unit 1: Part 1. Section 1. 531-538, 541-548, 554-558,562-565.
   Unit 2: Part 1. Section 1. 569-584, 596-599, 605-606.
   Unit3: Part 2. Section 1. 628-637, 1-224, 225-344, 601-605, 382-410.
   Unit 4: Part 2. Section 2. 1-14, 24-33, 43-55, 77-88, 131-155, 159-170, 186-194, 212-217, 218-222.
2. R.S. Aggarwal, Quantitative Aptitude,2008.
   Unit 5: Part 2. 661-666,676-686, 695-700, 709-715.

REFERENCES BOOKS:

1.Dr.R.S.Aggarwal, A Modern Approach to Verbal Reasoning,S.Chand and Company Pvt.Ltd 2006
2.Dr.R.S.Aggarwal, A Modern Approach to Non – Verbal Reasoning, S.Chand and CompanyPvt.Ltd 2006
3. Dr.R.S.Aggarwal, A Modern Approach to logical Reasoning, S.Chand and Company Pvt. Ltd 2013

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding					
K3: Applying		3			
K4: Analyzing			4	4	
K5: Evaluating	5				5
K6: Creating					

Mean=4.2

PGM 4303/ PSM 4303 ASTRONOMY THROUGH AGES 4 Hrs/3 Cr

The course will concentrate on the celestial objects, various techniques used to fix an object in the sky, and the various parameters that help one to measure the distance of a star. The course also contains the laws governing the celestial bodies discovered by Keplar and Newton. The various phenomenon like eclipses and the waxing and waning of the moon, and the properties of different planets in the solar system, the development of calendar, and the astronomical instruments one uses to measure the celestial bodies are covered in the syllabus.

At the end of the course, students will be able to

i. define the celestial sphere and discuss its motion.
ii. determine variations in the duration of day and night, change of latitude and longitudes, distance between two mountains and duration of twilight.
iii. illustrate equation of time, astronomical seasons and different calendars and solve problems based on conversion of time.
iv. explain sidereal and synodic month and classify the successive phases of moon.
v. demonstrate and evaluate the conditions and occurrence of lunar and solar eclipses.

Unit 1: Celestial spheres: Celestial coordinates Diurnal motion

Unit 2: The earth: Zones of earth: Terrestrial Latitudes and Longitudes- Dip of Horizon-Twilight

Unit 3: Time: Equation of time- Seasons- Calendar- Conversion of time

Unit 4: The Moon: Relation between sidereal and synodic months- Elongation-Phase of moon-Path of the moon with respect to the sun

Unit 5: Eclipses: Solar eclipse- Lunar eclipse-Ecliptic limits- Synodic period of the nodes of lunar orbit

TEXT BOOK:

S. Kumaravelu, Susheela Kumaravelu ,Astronomy,2007

Unit 1: Chapter 2-Page number 41-67
Unit 2: Chapter 3-Page number 98-106, 113-116, 135-137, 144-146
Unit 3: Chapter 7-Page number 220- 230, 237-242,244-255(simple problems)
Unit 4: Chapter 11-Page number 372-384
Unit 5: Chapter 11-Page number 397-412

REFERENCE BOOKS:

1.Michael Zeilik-Astronomy The Evolving Universe- John Wiley & sons-1988.
2.George O.Abell, David Morrison, Sidney C. Wolff- Exporation of the Universe- Saunders College Publishing,1987.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				1
K2: Understanding			2	2	
K3: Applying					
K4: Analyzing				4	
K5: Evaluating		5	5		5
K6: Creating	6				

Mean = 3.44

PGM 4304/ PSM 4304 INTRODUCTION TO STATISTICAL TOOLS 4 Hrs/3 Cr

The objective of this course is to enable the students to learn about the statistical concepts of data collection, analysis, interpretation, and presentation of data to answer questions about the social world. Also it includes the basic concept of correlation, regression analysis, hypothesis testingand analysis of variance. Students will be familiar with the computer-based statistical software SPSS.

At the end of the course, students will be able to

i. utilize different tools in SPSS package as a statistical tool.
ii. use the basic workings of SPSS, and perform data checking and create simple tables and charts.
iii. compute the correlation coefficient and do regression analysis for the given data using SPSS.
iv. utilize effectively the sampling distribution to perform t-test, F-test and χ^2 test using SPSS.
v. perform advanced analysis like ANOVA in SPSS.

Unit 1: Introduction to SPSS – versions of SPSS – data editor –SPSS viewer – SPSS smart viewer – saving files and retrieving a file.

Unit 2: Introduction to Statistics- data types – collection of data – classification and tabulation of statistical data – diagrammatic representation- exploring data with graphs using SPSS

Unit 3: Concept of correlation coefficient – data entry for correlation analysis using SPSS– Interpreting a simple regression on SPSS.

Unit 4: Introduction to Sampling — problems related to t-test and chi square test using SPSS.

Unit 5: Introduction to analysis of variance –Running one-way ANOVA on SPSS– Output from one-way ANOVA - two-way ANOVA using SPSS– Output from two-way ANOVA.

TEXT BOOK :

Andy Field, Discovering Statistics using SPSS , Third edition ,SAGE Publications Ltd, 2009.

Unit 1: Chapter 3:sec 3.1- 3.9
Unit 2: Chapters 1 &4:sec 1.5 -1.7; 4.3-4.9
Unit 3: Chapters 6 & 7:sec 6.3,6.4,6.9; 7.2-7.4
Unit 4: Chapters 9 & 18:sec 9.3-9.5; 18.5
Unit 5: Chapters 10 & 12:sec 10.2-10.4; 12.2-12.7.

REFERENCE BOOKS:

1. Marija.J.Norusis, SPSS for Windows Base system users guide release 6.0, SPSS Inc,'chicago,Illinois,2007.
2. S.Arumugam & A. Thangapandian Issac, Statistics, New Gamma Publishing House, 2004.
3. S.C.Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & sons, 2007.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**

K1: Remembering				1	
K2: Understanding		2			
K3: Applying					
K4: Analyzing			4		
K5: Evaluating	5	5		5	5
K6: Creating				6	

Mean = 4.12

PGM 5541/PSM 5541 TOPOLOGY 6 Hrs/5 Cr

Thecourse will enable the students to master the basic concepts of topology. The course deals with various topics in topological spaces like compactness, connectedness, separation axioms, countability axioms and metrizability of topological spaces. The learner will be able to understand and appreciate that the Topological spaces are the generalization of the concept of metric spaces. The inherent complexity of topological spaces as the most abstract human imagination can be appreciated by the learner. The intrinsic and novel methods of proof adopted can be a source of inspiration for solving problems in every walk of life.

At the end of the course, students will be able to

i. Define a topological space, correlate the relation between basis and sub basis, use the basis and sub basis for creation of new topologies, extend the concept called continuity to topological spaces.
ii. Create new topologies from the known topologies. Distinguish between connectedness and path connectedness and its ramifications. Demarcate a metric space from a topological space.
iii. Familiarize himself/herself with compactness and related concepts. Learn the technique of compactification of topological spaces.
iv. Conceptualize more intrinsic and inherent properties like countability axioms, separation axioms and separability.
v. Gain knowledge on metrization of topological spaces and compactness of product spaces.

Unit 1: Topological Spaces, bases and sub bases, order topology, subspace topology , product topology, metric topology , closed sets and limit points, closure and interior, continuous functions and homeomorphisms

Unit 2: Product topology, Metric topology, Connected spaces, path connected spaces, locally connected spaces, components and path components

Unit 3: Compact spaces, limit point compact spaces, sequentially compact spaces, count ably compact spaces, equivalence of various compactness in metric spaces, locally compact spaces, Alexandroff one point compactification

Unit 4: Countability axioms, first countable and second countable spaces, separable and Lindelof spaces

Unit 5: Separations axioms-Frechet, Hausdorff, regular, completely regular, normal and completely normal spaces, Uryzohn lemma, Uryzohn metrization theorem, Tietz extension theorem, Tychonoff theorem.

TEXT BOOK:

J.R.Munkres- Topology, a first course, Prentice Hall of India. 1978

Unit 1: Chapter 2 (sec 12,13, 14, 15, 16,17, 18)
Unit 2: Chapter 2 (sec 19, 20, 21), Chapter 3 (Sec 23,24 ,25)
Unit 3: Chapter 3 (Sec 26, 27, 28, 29)
Unit 4: Chapter 4 (Sec 30, 31, 32)
Unit 5: Chapter 4 (Sec 33, 34, 35, 37)

REFERENCE BOOKS:

1. G.F.Simmons-Introduction to topology and modern analysis, McGraw Hill,1963
2. S.T.Hu-Introduction to general topology, Tata McGraw Hill.1979
3. K.D.Joshi-Introduction to general topology, Wiley Eastern, 1983

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding	2				
K3: Applying		3	3		
K4: Analyzing				4	4
K5: Evaluating					
K6: Creating		6	6		

Mean = 4

PGM 5543/PSM 5543 COMPLEX ANALYSIS 6Hrs/5Cr

The aim of this course is to gain an in depth knowledge in Complex Analysis, to have an understanding of concepts and techniques used in dealing with functions of complex variables and to facilitate on study of complex integration and series. The students will be able to know that how to apply the complex concepts like index and residue in screening tests.

At the end of the course, students will be able to

i. recall the definition of an analytic function and realize the fact that every power series is infinitely differentiable.
ii. demonstrate the strong relation between complex integration of an analytic function and its power series representation, and demonstrate the effective use of Cauchy theorem and integral formula in realizing analytic functions as a power series.
iii. distinguish different versions of Cauchy's theorem. And demonstrate near converse version of the Cauchy's theorem in the form of Goursat's theorem.
iv. apply integral theorems to count zeros and poles, and utilize argument principal to prove fundamental theorem of algebra.
v. identify the maximum value of analytic function in a region and estimate integrals of special forms in certain regions.

Unit 1: Elementary Properties and Examples of Analytic Functions: Power Series, Analytic Functions, Analytic Functions as Mappings, Mobius Transformations

Unit 2: Complex Integration: Power Series Representation of Analytic Functions, Zero's of Analytic Functions, The Index of a Closed Curve,Cauchy's Theorem & Integral Formula

Unit 3: The homotopic version of Cauchy's Theorem and Simple Connectivity, Counting Zeros, The Open Mapping Theorem, Goursat's Theorem

Unit 4: Singularities: Classification of Singularities, Residues, The Argument Principle

Unit 5: The maximum Modulus Theorem: The maximum Principle, Schwarz's Lemma, Convex functions and Hadamard's Three Circles Theorem, Phragmen-Lindelof Theorem.

TEXT BOOK:

J.B.Conway, Functions of one complex variable, Narosa publishing house, 1973

Unit 1: Chapter3: sections $1, $2, $3
Unit 2: Chapter 4: sections $1, $2, $3,$4,$5
Unit 3: Chapter 4: sections $6, $7,$8
Unit 4: Chapter 5: sections $1, $2, $3 and related problems
Unit 5: Chapter 6: sections $1, $2, $3, $4

REFERENCE BOOKS:

1.L.V.Ahlfors, Comples analysis, Mcgraw Hill, 1979
2.V.Karunakaran, Complex analysis, Narosa publishing house, 2002
3.S.Ponnuswamy, Foundations of Complex analysis, Narosa publishing house, 1997.

	Unit-1	**Unit-2**	**Unit-3**	**Unit-4**	**Unit-5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1:Remembering	1				

K2:Understanding		2			
K3:Applying				3	
K4:Analyzing			4		
K5:Evaluating					5
K6:Creating					

Mean = 3

PGM 5545/PSM 5545 **STATISTICS** **6Hrs /5Cr**

The Objective of this course is to develop an ability in the students to apply Statistical methods to real life problem, to understand the limitation of these methods, to think probabilistically and to generalize the statistical theory to several variables. The course deals with random variable, stochastically independence, distribution functions, conditional probability, standard theoretical distributions, sampling distributions, distributions of functions of random variable and limiting distributions.Statistical tools are applied in all branches of science and humanities to verify and test various hypothesis, estimation of values of certain unknown parameters, to find the relation between two or more quantities, to find meaningful inferences from raw data. In this course statistics is not dealt as statistical methods, but as the mathematical foundation of interpretation of mathematical data with rigorous mathematical treatment.

At the end of the course, students will be able to

i. recognize the difference between the discrete and continuous random variables.
ii. derive the distributions of two random variables and extent it to several random variables.
iii. explore some special distributions and their relevance in every walk of life.
iv. analyze the unbiasedness, consistency for different types of discrete and continuous functions. Realise the fact that the limiting case of all distributions are identical which is the normal distributions.
v. compile the theoretical buildup for Sampling.

.

Unit 1: Probability Set functions – conditional probability, random variables(discrete& continuous), expectation of random variables – Chebyshev's inequality.

Unit 2: Distribution of two random variables, conditional distribution and expectations, Correlation coefficient, independent random variables – extension to several random variables.

Unit 3: Some special distributions- Binomial, Poisson,Gamma, Chi-square and Beta distributions, Normal and Multivariate normal distributions, t and F distributions.

Unit 4: Unbiasedness, consistency and limiting distributions. Expectation of function, convergence in probability, convergence in distribution – mgf technique, Central limit theorem.

Unit 5: Sampling and statistics – Order statistics, confidence intervals for difference in means, confidence intervals for difference in proportions. Introduction to hypothesis testing. Statistical tests – Chi-squre tests.

TEXT BOOK:

Robert V. Hogg, Allen Craig, Joseph W. Mckean, Introduction to Mathematical Statistics, 6th ed., Pearson Prentice Hall,2011.

Unit 1: Chapter 1: Sec.1.3-1.10
Unit 2: Chapter 2: Sec.2.1-2.7
Unit 3: Chapter 3: Sec.3.1-3.6
Unit 4: Chapter 4: Sec.4.1,4.2,4.3.3.,4.4
Unit 5: Chapter 5:Sec:5.1,5.2.1,5.4,5.5.5.7.

REFERENCE BOOKS:

1.J.E.Freund – Mathematical Statistics, Prentice Hall of India, 2000
2.SS.Wilks – Mathematical Statistics, John Wiley and sons,1962
3.S.C. Gupta and V.K. kapoor – Fundamentals of Mathematical Statistics, Sultan chand and co,2000
4. T. Veerarajan, Fundamentals of Mathematical Statistics, Yes Dee Publishing Pvt.Ltd.2017.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1:Remembering	1				
K2:Understanding					
K3:Applying			3		
K4:Analyzing				4	
K5:Evaluating		5			5
K6:Creating					

Mean = 3.6

PGM 5547/ PSM 5547 MEASURE THEORY 6 Hrs / 5 Cr

The aim of the course is to enable the student to understand the basic ideas of measure theory. The course deals with the concepts abstract measure spaces, abstract integration, Lebesgue measure, Lebesgue integration and the relation with Riemann integration and various types of convergence of sequence of measurable functions.Measure theory generalizes the concept of length, area, volume, summation and integration in a general setup. Modern treatment of probability theory and mathematical statistics heavily relies upon measure theory ideas. These ideas are also used in functional analysis. Both ideas from real analysis and topology are needed to understand measure theory.

At the end of the course, students will be able to

i. understand the fundamental concepts of Lebesgue outer measure and its properties also distinguish between Borel and Lebsegue measurability.
ii. distinguish between Riemann and Lebesgue integrations and the ramifications on convergent sequence of functions
iii. analyse the four derivatives and evolve the relation between the integration and differentiation.
iv. understand and analyse an abstract measure and a measure space and integration with respect to an abstract measure.
v. understand and analyse a signed measure and evolve various decomposition theorems

Unit 1: Introduction – Lebesgue outer measure – Measurable sets – Regularity – Measurable functions – Borel and Lebesgue measurability.

Unit 2: Integration of non-negative functions – Lebesgue integral – Fatou's lemma – Lebesgue monotone convergence theorem –The general integral– Lebesgue dominated convergence theorem –Integration of series – Riemann and Lebesgue integrals.

Unit 3: The four derivates –Continuous Non– differentiable functions– Functions of bounded variation– Lebesgue's differentiation theorem–Differentiation and integration.

Unit 4: Measures and outer measures – Extension of a measure – Uniqueness of the extension– Completion of a measure – Measure spaces – Integration with respect to a measure.

Unit 5: Signed measures and the Hahn decomposition – The Jordan decomposition–The Radon–Nikodym theorem (statement only)–Some applications of the Radon –Nikodym theorem.

TEXT BOOK:

G.Debarra, Measure theory and integration, New age international,1996.

Unit 1: Chapter 2 (except section 2.6)
Unit 2: Chapter 3
Unit 3: Chapter 4 (except section 4.6)
Unit 4: Chapter 5
Unit 5: Chapter 8 (except section8.5)

REFERENCE BOOKS:

1. P.R. Halmos, Measure theory, Springer international student edition, 1981
2. Royden, Real analysis, Macmillan, 1988.
3. W.Rudin, Real and complex analysis, Tata MC Graw Hill,1966.
4. Munroe, M.E.,Introduction to measure and integration –Addison Wesley, 1953.
5. I.K.Rana, An Introduction to measure and integration, Narosa Publishing House, 1997.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding					
K3: Applying	3	3			
K4: Analysing			4	4	
K5: Evaluating					5
K6: Creating					

Mean = 3.6

PGM 5349 / PSM 5349 PROGRAMMING IN C++ WITH OOPS 4Hrs/ 3Cr

The objective of this course is to enable the students to understand the fundamental concepts of Object - Oriented programming using C++ and to train them to apply these concepts in solving the real world problems. Students are encouraged to write programs in C++ related to the problems they encounter in day-to-day life and validate in the computer lab.

At the end of this course, students will be able to

i. describe the structure and concept of object oriented programming
ii. differentiate various 'function prototypes'. Analyze overloading concept and understand the idea of constructors and destructors, and demonstrate in programming
iii. write programs using overloading concepts in conjunction with friend function
iv. categorize between various inheritances and apply them to write programs
v. evaluate the idea of polymorphism and manage to handle files

Unit 1: Introduction- Need for object oriented programming-Advantages of OOP-Basic concepts of OOP- Objects- Classes-Inheritance- Reusability- Polymorphism – Overloading- C++ console I/O commands- Tokens –Expressions – Control structures.

Unit 2: Function Prototyping- Call by reference-Return by reference-Inline functions-Default arguments - Function overloading- Classes and objects- Static member functions –Arrays of objects- Friend function-Pointers to members- Constructors and Destructors functions.

Unit 3: Operator overloading- Overloading unary and binary operators- Overloading binary operators using friend function-Manipulation of strings using operators-rules for overloading operators-Type conversion.

Unit 4: Inheritance- Single Inheritance –Multiple Inheritance –Multilevel Inheritance Hierarchical and hybrid inheritance- Virtual base classes-Abstract classes-Constructors in derived classes- Nesting of classes.

Unit 5: Polymorphism- Pointers- This pointer- Virtual functions-Pure virtual functions-Exception handling-Opening and closing a file- File pointers and their manipulations - Updating a file – Error handling during file operations.

TEXTBOOK:

Balagurusamy E., Object Oriented Programming with C++, PHI, 2008

Unit 1: Sections 1.3-1.8, 3.2-3.7, 3.13-3.19, 3.22, 3.24.
Unit 2: Sections 4.2-4.11, 5.3-5.18, 6.2-6.11.
Unit 3: Sections 7.2-7.8.
Unit 4: Sections 8.2-8.12.
Unit 5: Sections 9.1-9.7, 11.1-11.9,13.2-13.7.

REFERENCE BOOKS:

1. A. Chandra Babu & T. Joshuva Devadoss, Programming with C++, Narosha Publishing House Ltd. 2008
2. Herbert Schildt, Teach yourself C++, Osborne McGraw Hill, 1994.

3. Herbert Schildt, C++ Complete Reference, Osborne McGraw Hill, 1995.

4. Rajaram R, Object Oriented Programming and C++, New Age International Publications, New Delhi, 1997

5. Robert Latfore, Object Oriented Programming in Microsoft C++,Galgotia Publication, 1993.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding	2				
K3: Applying			3	3	
K4: Analyzing		4			
K5: Evaluating					**5**
K6: Creating		6			

Mean = 3.83

PGM 5101 / PSM 5101 PROGRAMMING IN C++ WITH OOPS LAB 2Hrs/1Cr

The objective of the course is to learn the fundamental programming concepts and methodologies which are essential to build a C++ programs. It enables them to write programs using these concepts and to practice them in the C++ programming language via laboratory experiences.

At the end of this course, students will be able to

i. execute simple programs using input/ output, conditional statements and looping statements
ii. execute simple programs using functions and function overloading.
iii. write programs using overloading concepts along with friend function.
iv. categorize between various inheritances and apply them to write programs.
v. evaluate the idea of polymorphism and manage to handle files.

1. Programs using cin and cout statements.

2. Programs using conditional statements.

3. Programs using looping statements.

4. Programs using functions (inline function, default arguments etc..)

5. Programs using the concept of function overloading.

6. Programs related to classes and objects.

7. Programs using static member function and arrays of objects.

8. Programs using the concept of friend and virtual functions.

9. Programs on Constructors and Destructors.

10. Programs on Operator overloading.

11. Programs related to Inheritance.

12. Basic programs on files.

PGM 5542 /PSM 5542 FUNCTIONAL ANALYSIS 6 Hrs/5 Cr

The aim of the course is to enable the student to understand the basic ideas of functional analysis. The course deals with Normed linear spaces, Banach spaces, Hilbert spaces, bounded linear functionals, operators and projections. Functional analysis is an important area of pure mathematics which has wide range of applications in quantum mechanics, theoretical physics, control theory, approximation theory, and optimization techniques. The learner will be able to appreciate these advanced mathematical structures and its application various fields.

At the end of this course, the student will be able to

i. Explain the concept of Normed linear spaces and the relevance of Hahn Banach theorems.
ii. Demonstrate the relevance of Open mapping theorem and closed graph theorems in the context of Normed linear spaces.
iii. Discuss the structural specialty of Inner product space as a special case of Banach spaces and its ramifications on the properties of Banach spaces.
iv. Compile the additional properties peculiar to Inner product space apart from those of the Banach space.
v. Outline the finite dimensional spectral theory

Unit 1: Normed Spaces, Continuity of Linear Maps, Hahn Banach theorems. Banach spaces.

Unit 2: Uniform Boundedness Principle, Closed Graphs and Open Mapping Theorems, Duals and Transpose.

Unit 3: Inner Product Spaces, Hilbert spaces, ortho normal sets, Approximation and Optimization, Projections and Riesz Representation Theorems.

Unit 4: Projections, Bounded Operators, Adjoint, Self Adjoint, Normal and Unitary Operators, orthogonal projections.

Unit 5: Finite dimensional spectral theory.

TEXT BOOKS:

1. B.V. Limaye, Functional analysis, Wiley Eastern 2015
   Unit 1: Chapter 2 (sec 5,6,7,8)
   Unit 2: Chapter 3 (sec 9, 10), Chapter 4 (sec 13)
   Unit 3: Chapter 6 (sec 21, 22, 23, 24)
   Unit 4: Chapter 7 (sec 25, 26)
2. G.F. Simmons, Introduction to topology and modern analysis, McGraw Hill, 1963.
   Unit 5: Chapter 11(sec 60, 61)

REFERENCE BOOKS:

1. S. Ponnuswamy, Foundations of functional analysis, Narosa Publishing house, 2001

2. W. Rudin, Functional Analysis, TataMcGraw-Hill Publishing Company, New Delhi, 1973.
3. G. Bachman and L. Naric, Functional Analysis, Academic Press, New York, 1966.
4. E. Kreyszig, Introductory Functional Analysis with Applications, John wiley & Sons, New York, 1978.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5

Bloom's Taxonomy	CO1	CO2	CO3	CO4	CO5
K1: Remembering					
K2: Understanding	2				
K3: Applying		3			
K4: Analyzing				4	
K5: Evaluating					5
K6: Creating			6		

Mean = 4

PGM 5544 / PSM 5544 CLASSICAL MECHANICS 6 Hrs / 5 Cr

The aim of this course is to enable the students to know the basic principles of classical mechanics and its applications. Students have a deep understanding of the mechanics of a particle and the motion of a rigid body.This course demonstrate knowledge and understanding of the following fundamental concepts in the mechanics of system of particles, motion of rigid body and the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics. Students should acquire thorough knowledge both of the fundamentals and of significant contemporary research developments.

At the end of the course, students will be able to

i. recall the concept of mechanics of a particle and define D' Alembert's principle
ii. understand the concept of Hamilton's principle, the Euler angles and the Cayley –Klein parameters
iii. discuss on the concept of Angular momentum and kinetic energy, and apply it to derive moment of inertia.
iv. analyze equations of Canonical transformation and examine the angular momentum – Poisson bracket relation
v. apply Jacobi equation in Hamilton's principle and illustrate the Kepler problem in action.

Unit 1: Mechanics of a particle – Mechanics of a system of a particles – Constraints – D' Alembert's principle and Lagrange's equations .

Unit 2: Hamilton's principle– derivation of Lagrange's equations from Hamilton's principle. The Euler angles - The Cayley –Klein parameters and related quantities – Euler's theorem on the motion of a rigid body – Finite rotations.

Unit 3: The rigid body equations of motion – Angular momentum and kinetic energy of motion about a point – Tensors and Dyadics – The inertia tensor and the moment of inertia. The heavy symmetrical top with one point fixed .

Unit 4: The equations of Canonical transformation - Examples – the integral invariants of Poincare'Lagrange and Poisson brackets and Canonical invariants. Equation of motion in Poisson bracket -Infinitesimal contact transformation - the angular momentum Poisson brackets relations - Lioville's theorem.

Unit 5: The Hamilton - Jacobi equation for Hamilton's principle function. The Harmonic Oscillator problem as example of Hamilton – Jacobi method Hamilton's- characteristic function – Separation of variables in Hamilton –Jacobi equation-Action angle variables – The Kepler Problems in Action-angle variables.

TEXT BOOK:

Classical Mechanics – H. Goldstein,Addison Wesley , Third edition, 2007.

Unit 1: Chapter 1: 1.1 to 1.4
Unit 2: Chapter 2:2. 1, 2.3 and Chapter 4: 4.4 to 4.7
Unit 3: Chapter 5:5.1 to5.3 and 5.7
Unit 4: Chapter 9:9.1, 9.2 and 9.5, 9.6, 9.7 & 9.9
Unit 5: Chapter 10: 10.1 to 10.4, &10.8

REFERENCE BOOKS:

1. Principle of Mechanics – J.L.Synge and B.A.Griffith , McGraw Hill, 1949.
2. Classical Mechanics – D.E.Rutherford, Oliver Boyd Ltd, 1964.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				
K2: Understanding		2			
K3: Applying			3		3
K4: Analyzing				4	
K5: Evaluating				5	
K6: Creating					6

Mean = 3.43

PGM 5546/ PSM 5546 Statistical Inference & Stochastic Processes 6Hrs/5Cr

This course intends to develop statistical inference (estimation and testing)based on likelihood methods, to study measures of quality of estimators and its properties, optimal tests of hypotheses and develop the knowledge of stochastic processes, Poisson process and related distribution.

At the end of the course, students will be able to

i. compute maximum likelihood estimation.
ii. enlist different measures of quality estimators, parameters for sufficient statistic.
iii. illustrate with examples of different likelihood ratio test.
iv. explain the concept of stochastic process and classify states and chains
v. apply the generalization of Poisson process and can compare and contrast the difference between Markov and Erlang process

Unit 1: Maximum Likelihood Estimation, Rao-Cramer Lower Bound and efficiency, Multi parameter case-Estimation.

Unit 2: Measures of quality estimators, Sufficient statistic for a parameter, properties of sufficient statistic, Completeness and Uniqueness, the exponential class of distributions, Functions of a parameter, Sufficiency, completeness and independence.

Unit 3: Most powerful tests – UMP tests, likelihood ratio tests, the Sequential probability ratio test.

Unit4: Stochastic processes- Specification of stochastic processes, stationary processes. Markov chains- definition and examples. Classification of states and chains. Determination of higher transition probabilities.

Unit 5: Poisson process and related distribution – generalization of Poisson process. Birth and Death process , Markov process with discrete state span – Erlang process.

TEXT BOOKS:

1. Robert V. Hogg, Allen Craig, Joseph W. Mckean, Introduction to Mathematical Statistics, 6th ed., Pearson Prentice Hall,2011.
   Unit 1: Chapter 6: Sec.6.1- 6.5
   Unit 2:Chapter 7: Sec7.1-7.6, 7.9
   Unit 3: Chapter 8: Sec 8.1-8.4
2. J.Medhi, Stochastic Processes, Wiley Eastern Limited,1986.
   Unit 4: Chapter 2: Sec2.1-2.3; Chapter 3: Sec3.1-3.6
   Unit 5: Chapter 4: Sec.4.1-4.6

REFERENCE BOOKS:

1. J.E.Freund – Mathematical Statistics, Prentice Hall of India, 2000
2. SS.Wilks – Mathematical Statistics, John Wiley and sons,1962
3. S.K.Srinivasan , K.M. Mehata, Stochastic Processes, Tata McGraw Hill, 1988.
4. S.C. Gupta and V.K. Kapoor – Fundamentals of Mathematical Statistics, Sultan chand and co,2000.
5. T.Veerarajan, Fundamentals of Mathematical Statistics, Yes Dee Publishing Pvt.Ltd.2017

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	1				
K2: Understanding		2		2	
K3: Applying					
K4: Analyzing			4		
K5: Evaluating					6
K6: Creating					

Mean = 3.2

PGM 5548/ PSM 5548 OPERATIONS RESEARCH 6Hrs/ 5Cr

This course deals with network models, dynamic and integer programming, inventory and queuing theory, nonlinear programming, and provide the mathematical basis behind these techniques.
The aim of this course is to help the students to understand and apply some of the widely used techniques of Operations Research.

At the end of this course, students will be able to

i. understand the theoretical background for Linear Programming Problem which culminates as Simplex method.
ii. solve Integer Programming Problem using Simplex method. Demonstrate that Dynamic Programming Problem is a tool for solving problems in real life.
iii. exploit the network models for finding shortest route problem and maximal flow problem.
iv. develop different Queuing models using suitable parameters.
v. solve unconstrained problems using Lagrangian multiplier techniques and Kuhn Tucker optimality conditions. Outline Nonlinear programming techniques and solve Quadratic programming problem.

Unit 1: Theory of simplex method- Computational aspects of simplex method- Simplex method and transportation problem.

Unit 2: Integer programming problem (Pure & mixed)- formulation- branch and bound method & cutting plane method. Dynamic programming- Capital budgeting problem-Bellman principle- shortest route problem- knapsack problem.

Unit 3: Network models- minimum spanning tree problem- shortest route problem- maximal flow problem- minimum cost capacitated problem.

Unit 4: Queuing theory- Queuing models-Basic characteristic of queueing system-Steady state solution of Morkovian queuing models-M/M/1, M/M/C with limited waiting space, M/G/1 Queuing models.

Unit 5: Determining points of extrema for unconstrained and constrained functions (Optimality conditions)- Jacobian method- Lagrangian multiplier techniques- Kuhn Tucker optimality conditions- Nonlinear programming -Quadratic programming problem.

TEXT BOOKS:

1. Hadley – Linear Programming
   Unit 1: Chapter 3, 4, 9.3
2. H.A.Taha -Operations Research an introduction. Prentice Hall of India, 7th edition, 2003.
   Unit 2: Chapter 9.2, 9.2.1, 9.2.3, 10.1, 10.2, 10.3, 10.3.1.
   Unit 3: Chapter 6.1, 6.2, 6.3.1-6.3.3, 6.4(except 6.4.4), 6.5(except 6.5.4)
   Unit 4: Chapter 17.6.6, 17.7, 17.7.1
   Unit 5: Chapter 20.1.1, 20.2 (pg: 719-729), 21.1.1 to 21.2.2

REFERENCE BOOKS:

1. F.S.Hillier and G.J.Liebermann-Introduction to operations research, Mcgraw hill, 1995.
2. F.S.Hillier and G.J.Liebermann-Introduction to Mathematical programming, Mc Graw Hill, 1995
3. S.S.Rao-Optimazation, theory and applications. Wiley eastern,1977.

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**
Bloom's Taxonomy	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering					
K2: Understanding	2	2			
K3: Applying					
K4: Analyzing					
K5: Evaluating			5		5
K6: Creating				6	

Mean = 4

PGM 5450/PSM 5450 **PROJECT** **6Hrs/4Cr**

The aim of this course is to train the students in literature collection and to gain experience for research. Students are encouraged to take it as a challenge, so that the result of the project shall be approved for publication in leading scientific journals.

At the end of the course, students will be able to

i. understand need and scope of research.
ii. compile and write dissertation based on their experiences as a researcher.
iii. use the modern gadgets and exploit the digital data for an enhanced accuracy and reliability.
iv. develop critical analysis and understanding on issues handled in the project as a mathematical model imitating the real time problem.
v. use the mathematical techniques for solving real time issues.
vi. make them sensitive to social issues and mould them as socially upright citizen.
vii. enhance their communication skill through meticulous interactions.

Guidelines & Instructions:

- The project work for M.Sc. Mathematics Program is to be undertaken during IV semester.
- A candidate may, however, in certain cases, be permitted to work on projects in an Industrial/Research Organization, on the recommendations of the Head of the Department. In such cases, the Project work shall be jointly supervised by a supervisor of the department and an expert, as a jointsupervisor from the organization.
- The student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.
- The Project work for M.Sc Mathematics shall be pursued for a minimum of 12 weeks during the final semester.
- The deadline for submission of final Project Report is the last working day of the semester in which project / thesis / dissertation is done.
- In case of candidates of M.Sc. Programmes not completing of project work successfully, the candidates can undertake again in the subsequent semester.

Evaluation:

The PG-Head of the Department and the supervisor shall constitute the review committee for each branch of study. The evaluation of Project Work for M.Sc. Mathematics shall be done independently in the respective semesters and marks shall be allotted as per the weightages given in tabular column. There shall be two reviews (each 10 Marks) during the semester by the review committee. The student shall make presentation on the progress made by him / her before the committee. The total marks obtained in the two reviews will be 20 Marks. The internal (Guide) will assess for 30 marks (Including the regular discussion, attendance and participation in Seminars/Workshops/Conferences). The project report (thesis / dissertation) shall carry a maximum 10 marks. The viva-voce examination shall carry 40 marks. (Marks are awarded to each student of the project group based on the individual performance in the viva –voce Examination).

Internal Assessment (50Marks)			**End Semester Examination (50 Marks)**	
			Evaluation	**Viva – Voce**

<table>
<tr><th rowspan="2">Review -I</th><th rowspan="2">Review -II</th><th rowspan="2">Internal (Guide)</th><th>(10 Marks)</th><th colspan="3">(40 Marks)</th></tr>
<tr><th>Internal (Guide)</th><th>Examiner I</th><th>Examiner II</th><th>Examiner III</th></tr>
<tr><td>10</td><td>10</td><td>30</td><td>10</td><td colspan="3">40</td></tr>
</table>

Review Committee members:
1. PG - Head of the Department
2. Supervisor/Guide.