DEPARTMENT OF MATHEMATICS

UNIVERSITY OF PESHAWAR

Khyber Pakhtunkhwa, PAKISTAN

COURSE CONTENTS FOR THE DEGREE OF PH.D. IN MATHEMATICS APPROVED BY THE ACADEMIC COUNCIL ON 16.05.1996 & SYNDICATE ON 31.07.1996 AND SUBSEQUENTLY UPDATED ON DIFFERENT DATES.

RULES AND REGULATIONS ARE AS GIVEN IN THE UNIVERSITY OF PESHAWAR STATUTES FOR THE DEGREE OF PH.D.

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STATUTES RELATING TO THE SCHEME OF STUDIES FOR THE DEGREE OF PH.D. IN MATHEMATICS

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01	Math-801	C* Algebra	03
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36	Math-941	Mathematical Theory of Continuum Mechanics	03
37	Math-942	Perturbation Methods	03
38	Math-943	Hypersonic Flow Theory	03
39	Math-944	Numerical Methods	03
40	Math-945	Mathematical Theory of Computer Science	03
41	Math-946	Mathematical Theory of Probability	03
42	Math-947	Linear Models	03
43	Math-948	Markov Chains: Theory and Applications	03
44	Math-949	The Asymptotic Theory of Extreme Order Statistics	03
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Course No. Math-801
Course Title: C* Algebra
Credit Hours: 03

Involutive Algebras, Normed Involutive Algebras, C^*-Algebras, Gelfand- Naimark Theorem, Positive Functionals, A characterization of C*-Algebras, Positive Forms and Representation, Applications of C*-Algebras to Differential Operators.

Recommended Books:

1. J.Dixmier. C^*-Algebras, North Holland Pub. 1977.
2. S.Sakai, C^*-Algebras and W*-Algebras, Springer-Verlag. 1971.
3. K.R. Goodearl, Notes on Real and Complex C^*-Algebras, Shiva Pub. Ltd. 1982.
4. W.Arveson, An Invitation to C^*-Algebras, Springer-Verlag 1976.
5. R.V. Kadison and J.R. Ringrose, Fundamentals of the Theory of Operator Algebras, Vol I, Elementary Theory, Academic Press, 1983.

Course No. Math-802
Course Title: Numerical Ranges of Operators On Normed Spaces
Credit Hours: 03

Numerical Ranges in Normed Algebras, Numerical Radius, Vidav's Theorem and Applications to C^*-Algebras, The Spatial Numerical Range, Spectral Properties, Second Dual of Banach Algera, Spectral States.

Recommended Books:

1. F.F. Bonsall & Duncan, Numerical Ranges of Operators on Normed Spaces and of Elements of Normed Algebras, London Mathematical Society Lecture Note Series 2, Cambridge University Press, 1971.
2. F.F. Bonsall & Duncan, Numerical Ranges II, Cambridge University Press, 1973.

Course No. Math-803
Course Title: Von Neumann Algebras
Credit Hours: 03

The Weak and Strong Topologies, Elementary Properties of Von Neumann Algebras, Commutant and Bicommutant, The Desnity Theorems, Comparison of Gelfand-Naimark-Siegal Constructions (GNS-Constructions).

Recommended Books:

1. J.Dixmier, Von Noumann Algebras, North Holland, 1977.
2. J.Dixmier, C*-Algebras, North Holland, 1977.
3. J. Schwartz, W*-Algebras, Gordon & Breach N.Y. 1967.
4. S.Sakai, C^*-Algebras and W*-Algebras, Springer-Verlag. 1971.
5. R.V. Kadison & J.R.Ringrose, Fundamentals of the Theory of Opertor Algebra, Vol-I, Elementary Theory, Academic Press, 1983.

Course No. Math-901
Course Title: Advance Group Theory Part-I
Credit Hours: 03

Advance Group Theory, generalized direct product of groups cartision product of groups, wreath product of groups, linear groups representation of linear groups, group algebras and representation modules group characters.

Varieties of groups, free groups, law in a group nilpotent groups varieties, metabelian group varieties, product varieties, finitely based varieties of groups.

Recommended Books:

1. C.W. Curties and I.R. Reiner Representation Theory of groups and Associative algebras. N.Y. and London inter science Publishers 1962.
2. The Hanna Newman. Varieties of groups by Springer Verlag, Berlin, Heidelberg N.Y. 1962.
3. John. S.Rose “A course on group theory” Cambridge University Press, Cambridge London N.Y.
4. E.Schenkman group theory Robert. E.Krieger, Publishing Company Huntington. N.Y. 1975.

Course No. Math-902
Course Title: Advance Group Theory Part-II
Credit Hours: 03

Presentation of groups, free groups, free presentation of groups, tietze-transformation coset enumerations, presentation of subgroups, presentation of group extension, minimal presentation of direct products, minimal presentation wreath products, cyclically presented groups.

Recommended Books:

1. H.S.M. Coxeter. W.O.J. Mnoser “Generators and relations for discrete groups” Springer-Verlag. Berlin Heidelberg N.Y. 1972.

2. A. Barrass and S.Solitar Combinatorial group theory presentation groups interms of generators and relations N.Y. 1966.
3. D.L. Johnson Presentation groups London Mathematical Society lecture notes Cambridge University Press London. N.Y. Berlin.
4. R.H. Crowall and R.H. Fox "Introduction to Knot Theory" Gim Boston 1963.
5. J.Lerch. computational Problems in abstract algebra Pergamon Oxford 1970.
6. A.W. Mostowski Decision problem in group theory Technical report University of Iowa 1969.

Course No. Math-903
Course Title: Advance Modules Theory
Credit Hours: 03

Representation and modules, Indecomposible modules, completely reducible modules modules ower principal ideal domains. Modules over dedeking domains, Induced representation and module Imprimitive modules, the restriction of irreducibility and equivalence of induced modules. Principal indecomposibly modules, modules into blocks, projective modules and infective modules.

Recommended Books:

1. P.M. Cohn " Algebra Volume 2 John Wiley & Sons London New York, Sys 1977.
2. Representation Theory of finili groups and associative algebras. Charles W.Curties, grvinge Reinew my Intersccience publishers New York London 1962.

Course No. Math-904
Course Title: Advance Ring Theory
Credit Hours: 03

The endomorphism ring of a vector space, the radical and semi premature rings, algebras with out unit elements semi perfect rings, central simple algebras, cross products, notherian rings, rings of fractions, prime and semi prime rings, generic matrix rings.

Recommended Books:

1. P.M. Cohn' Universal algebra's by Harber and Row N.Y.1965.
2. C.Faith. Algebra, rings Modules and categories Springer Berlin 1973.
3. Kaplansky. Fields and rings University Press Chicago 1969.
4. Kaplansky Commutative rings by Allyn and Boston 1970.
5. G.Lambek Rings and Modules by Blaisdell Boston 1966.
6. C.Procesi Rings with a polynomial identity by Dekker N.Y. 1973.

Course No. Math-905
Course Title: Advance Knot Theory-I
Credit Hours: 03

Introduction, Reidemeister moves, Equivalence. Ambient isotopy, Universes of Knots (Links), linking number, Twisting and writhing, Conway Polynomial, Split link, II and 2 II- Twist move. On C (L), Creating a_2 (K), Standard sequences, Unknot discussing, $\propto$(K) as an invariant, Skein theory, and operations, skein decomposition into generators, connected sum, Inequivalence of whitehead link, Stable equivalence class, weaving, orientation preserving homeomorphism, tangle, numerator and denominator of a tangle, quotient/fraction of a tangle, rational tangle, integral tangle, cable, and untwisted double of knot.

Recommended Book

On knots, L.H. Kauffman, Princeton University Press. (1987).

Course No. Math-906
Course Title: Advance Knot Theory-II
Credit Hours: 03

Quaternions, quaternions and the belt trick, quarternion group, rope trick, topological script, Spencer-Brown calculus, T-equivalence, States, mark and unmark state, Off to infinity, humanknots, quandles, topology of DNA., Knots and Fibonacci trees, odd knots, Kirkoff's matrix tree. Theorem, Axioms for Jones polynomial, Axioms for B-polynomial, Whitney degree, mirror theorem, generalized polynomial and regular isotopy, Axioms for R_k, and G_k polynomial, L and F polynomial, Chromatric state, connection with the Bracket polynomial, Tailt conjecture, L.H. Kauffmon conjecture, dichromatric polynomial.

Recommended Book:

On Knots (1987) L.H. Kauffman, Princeton University Press.

Course No. Math-907
Course Title: Galois Theory
Credit Hours: 03

Introduction, factorization of polunomials, field extension, degree of extension, Ruler and Cmpasses, Construction by ruler and compass, algebraic and transcendental numbers, idea behing Galois Theory, Normality, Separability, field degree and group order, homomorphism, automorphism, isomorphism, Galois correspondence, solution of equations by radicals, finite fields, calculating Galois groups.

Recommended Books:

1. Galois Theory 1989, I. Stewwart, Chapman & Hall Ltd.
2. Classical Galois Theory (1979), L. Gaal, Chelsea Publishing company.

Course No. Math-908
Course Title: Graph theory-I
Credit Hours: 03

Graph, Graphs as Models, sub graph, path and cycle, operations on graph, Matrix representation, bridge, loop, cut- vertex and connectivity, Euler tour, Hamiltonian graphs, Euler formula, trees, properties of trees, distance and centre in a tree, counting trees, spanning trees, isomorphism, 1-isomorphism, 2-isomorphism, planar graph, detection of planarity, platonic bodies, dual graph, geometric and combinatorial dual, Chinese postman problem, travelling salesman problem, marriage problem, personnel assignment problem, shortest path problem.

Recommended Books:

1. A First Work at Graph Theory (1991), J. Clark & D.A. Holton World Scientific Pub. Co.
2. Graph Theory with Application to Engineering and Computer Science (1984). Narsingh Deo, Prentice-Hall.

Course No. Math-909
Course Title: Graph Theory-II
Credit Hours: 03

Chromatric number, chromatic polynomial, vertex colouring, vertex colouring algorithm, critical graphs, cliques, cliques, eage colouring, map colouring, incidence incidence matrix, circuit matrix, cut-set matrix, path matrix, directed graphs, digraph, matrices of digraphs, Euler digraph, indegree and out degree, transport networks, Max-flow and Mini-cut theorem, minimal cost flows, electrical network, Kirchoff's current and voltage node.

Recommended Books:

1. A First Work at Graph Theory (1991), J. Clark & D.A. Holton World Scientific Pub. Co.
2. Graph Theory with Application to Engineering and Computer Science (1984). Narsingh Deo, Prentice-Hall.

Course No. Math-910
Course Title: Topological Groups
Credit Hours: 03

Fundamentals of Topology and Group Theory; topological spaces, metric spaces, neighborhood systems, bases and sub bases, separation axioms, nets and fitter, connectedness, compactness, direct products, uniform spaces and Ascoli's theorem, groups and linear spaces. Semi topological Groups; Semi-topological groups, construction, embedding of any group in a product group, B-& C-type, locally compact semi topological group.

General Theory of topological Group; translation, separation eaxioms in topological group. Uniform structure, subgroup, quotient groups, product and inverse limits of groups. Locally Compact Groups; classical linear groups, locally Euclidean groups, lie groups.

Open Homomorphism and closed graphs; Continuous and open homomorphism, open homomorphism and closed graph theorems.

Recommended Book:

Introduction to Topological Groups (1966), T. Hussain W.B.Saunders Co.

Course No. Math-911
Course Title: Knots and Physics-I
Credit Hours: 03

Physical knots, diagrams and moves, knottedness, Achirality, weaving pattern, shadow, Zero move, Reidemeister moves, regular isotopy, imbient isotopy, alternating diagrams, splicing, product of labels, invariants, writhe, normalized bracket polynomial, alternating links and checherboard surfaces, Gordan curve theorem, roadway problem, highest/minimum degree in <K>/span<K> , knots and graphs, mirror conjecture, Jenes poloynomial, Laurant polynomial, bracket and jones polynomial, reversing property, Alexander-Conway polynomial, L & F polynomial, Two variables polynomial, Homfly polynomial, band-links, framed links.

Recommended Books:

KNOTS and PHYSICS Vol. (1) 1991, L.H. Kauffman, World Scientific Pub. Co.

Course No. Math-912
Course Title: Knot and Physics-II
Credit Hours: 03

Channel and cross channel unitarity, triangle invariance, oriented triangles, annihilation and crossing, theory of hiches, square knot, granny knot, rubber band and twisted tube, armel effect, slide equivalence, mirror category, special mirror category, linking number and absoluts linking numbers, states summation, crossing circuites, Penrose chromatic recursion, planar cast, formation, purple, chromatic expansion, chromatic polynomial, edge-band, bond-graph, universe and planner graph, chromatic state.

Recommended Books:

KNOTS and PHYSICS Vol. (1) 1991, L.H. Kauffman, World Scientific Pub. Co.

Course No. Math-913
Course Title: Differential Topology
Credit Hours: 03

Topological spaces:, Neighborhoods, open and closed sets, continuous maps, topological products, connectedness and compactness.

Differentiable Manifolds: Differentiable functions and maps, differentiable manifolds, rank of differentiable map, manifold with boundary.

Submanifolds: Manifolds in Euclidean space, embedding theorem, embedding a manifold with boundary.

Tangent spaces and critical points: Trangent lines, critical points, nondegenerate critical points, a strong embedding theorem.

Recommended Books:

Differential topology (1977) A.Wallace, W.A. Benjamin, Inc.

Course No. Math-914
Course Title: Topology and Chemistry-I
Credit Hours: 03

Introduction, cotopology, irreducible basis of a topology, co-closure, partially ordered set and lattices, distributive lattices, intarvals in distributive lattices, direct product, reducibility, topologies and directed graphs, sub bases and graphs, topological and graphical connectivity, lattices of connected and disconnected spaces, connectivity of subsets, separated sets, cardinality of topology and subspace, connected set, generating function, $T_{\frac{1}{2}}$-space, two point correlation in , $T_{\frac{1}{2}}$-space.

Recommended Book:

Topological Methods in Chemistry (1989), R.E. Merrifield & H.E. Simmons, John Willy & Sons Inc.

Course No. Math-915
Course Title: Topology and Chemistry-II
Credit Hours: 03

Approaches to molecular topology, analysis of molecular topologies, Bond topology, construction and combinatorial properties of bond topology, Bond topology of Alkanes, structure of graph topology combinatorial properties of graph topology, graph topology of extended structure, topology of saturated hydrocarbons duplex of graph, duplex space, cardinality of duplex topology, duplex spaces of alternants and non-alternants, paraspectrality, chemical reaction spaces, kinetics in chemical reaction space.

Recommended Book:

Topological Methods in Chemistry (1989), R.E. Merrifield & H.E. Simmons, John Willy & Sons Inc.

Course No. Math-916
Course Title: Advance Homotopy Theory-I
Credit Hours: 03

Some simple topological spaces and topological problems, homotopy theory, category theory; natural transformation, funtor, Hom, Fundamental group, path, homotopy, more on fundamental group. Homotopy equivalence, contractibility, simply connected and arcconnected spaces, calculating fundamental group, covering spaces, path lifting property, Monodromy theorem, fundamental theorem of algebra, amalgamated product and quotient group, Van-Kampen theorem, track groups and homotopy groups.

Recommended Book:

Homotopy Theory (1977), B.Gray, Academic Press, Inc.

Course No. Math-917
Course Title: Advance Homotopy Theory-II
Credit Hours: 03

Relative homotopy groups, convarient functor, locally trivial bundles, fibar, Serre fibering, Hurewicz fibering, coordinate neighborhoods, Exactness, n-dimensional simplex, barycentric coordinates, barycentric subdivision, geometric finite simplicial complex, triangulation, polyhedron, subcomplex, n-skeleton, linearity, dense, nowhere dense, convex, affine independent, affine subspace, simplicial approximation theorem, n-cell, Blakers-Massey theorem, Frendenthal suspension theorem, calculating homotopy groups.

Recommended Book:

Homotopy Theory (1977), B.Gray, Academic Press, Inc.

Course No. Math-918

Course Title: Commutative Rings-I
Credit Hours: 03

Linearly compact modules and almost Maximal Rings, h-local domains,

Valuation Rings and Bezout Rings,
Basic Facts about FGC Rings and the local Case,
Further facts about FGC Rings and Torch Rings,
The zariski and patch topologies of the Spectrum of the Ring,
The Stone-Cech compactification of N.
Relating topology to the decomposition of Modules,
The main theorem.

Recommended Book:

Commutative Rings Whose Finitely Generated Modules Decompose (1979), willy Brandal Springer-Verlag.

Course No. Math-919
Course Title: Commutative Rings-II
Credit Hours: 03

Constructing examples, Valuations,

Long power series rings, Maximally complete valuating domains, examples of maximal valuation rings, Examples of almost maximal Bezout domains, examples of torch rings, canonical valuating of a valuating domain, chain of a partially ordered set, divisibility group, ideal of a totally ordered set, immediate extension, Krull dimension, lexicorraphic ordering, long power series, maximally complete valuation, order homomorphism, order isomorphism, partially ordered group. Residue field, value ring.

Recommended Book:

Commutative Rings Whose Finitely Generated Modules Decomposes, (1979), Willy brandal, Springer-Verlag.

Course No. Math-920
Course Title: Advance Complex Analysis
Credit Hours: 03

Conformal Mapping.

Preservation of angles, Linear fractional transformations. Normal families, Riemann mapping theorem. Continuity at the boundary. Conformal mapping of an annulus.

Zros of Holomorphic Functions.

Infinite products. The Welerstraos factorization theorem. Jensen's formula Blascake products.

Analytic Continuation.

Regula r points and singular points. Continuation along curves; the monodromy theorem. Construction of a modular function. The Picard theorem.

Recommended Books:

1. Complex analysis by Lars V. Ahlfors, 1992 (Pergamon Press).
2. Real & Complex Analysis by Walter Rudin. 1993 (Interscience).

Course No. Math-921
Course Title: Special Functions-I
Credit Hours: 03

Generalized Hypergeomeatrio Function.

The function ${}_pF_q$, the exponential and bioomial functions, a differential equation, other salutions of the differential equation. The ${}_pF_q$, with unt argument. Saalschutz theorem. Whipple's theorem. The Barnes integrals and the function ${}_pF_q$.

Bessel Function.

Definition of $J_n(z)$,Bessel's differential equation differential recurrence relations. A pure recurrence relation. Bessel's integral Index half an odd integer. Modified Bessel Functions. Neumann polynomials.

Confluent Hypergeometric Function.

Basic properties of the ${}_1F_1$. Kummer's first formula. Kummer's second formula. Definition of the function $W_k,m(z)$.

Recommended Books:

1. Special Functions by Earl D. Rainville, 1992 McGraw-Hill.
2. A course of Modern Analysis by E.T. Whittaker G.N. Watson 1991 Cambridge University Press.

Course No. Math-922
Course Title: Special Functions-II
Credit Hours: 03

Orthogonal Polynomials.

Zero of orthogonal polynomials. The three term recurrence relation Christoffel Darbax formula.

Hermite Polynomials.

Decinition of $H_n(z)$ recurrence relations,Rodrigues formula; other generating functions.

Leguerre Polynamials.

The polynomials $L_n(\propto)(X)$ Recurrence relations. The Rodrigues formula. Special properties. The simple Laguerrep Polynomials.

Elliptic Functions.

Deubly Periodic functions. Elliptic functions, elementary properties. Order of an elliptic function. The weierstrass function P (z). A differential equation for P (z). Connection with elliptic integrals.

Recommended Books:

3. Special Functions by Earl D. Rainville, 1992 McGraw-Hill.
4. A course of Modern Analysis by E.T. Whittaker G.N. Watson 1991 Cambridge University Press.

Course No. Math-931
Course Title: Integral Equations
Credit Hours: 03

Integral equations.Type of integral equations. Valtern Solutions. Fredholm equations. Symmetric equations. Theory ofHibert-Schmidt. Symmetric Kernels and othognal systems of functions. Singular or Non-linear integral equations. Dirichlet's problem and its application. The biharmonic equation. Application of Green's Salution. The generalized method of schwerz. Certain applications of integrals analogous to potential. Application of the theory of symmetric integral equations. Certain applications of the theory of ingular integral equations. Hibert's problem.

Recommended Books:

1. Integral Equations, by F.G. Tricomi Inter Science 1992.
2. Integral Equations, by S.G. Mikhlin translaced from the Russian by A.H. Armstrong Pergamon Press 1994.
3. Integral Equations, by Guido Hoheisel translated by A.Mary Tropper Nelson 1991.
4. Integral Equation Methods, by C.D. Green Nelson 1990.
5. Methods of Mathematical Physics. By P.M.Morse and H.Feshbach McGraw-Hill Vol.I & II 1988.
6. Integral Transforms in Mathematical Physics, by C.J.Tranterr John Wiley 1989.
7. Fourier Transforms, by I.N. Sneddon McGraw-Hill 1991.
8. Integral Equations, by F.Smithies Cambridge University Press 1988.

Course No. Math-932
Course Title: Advance Topics in Theoretical Astro Physics
Credit Hours: 03

The Theory of the Radiative equilibrium of stellar photosphers and the continuous spectrum of stars. The equations of transfer and their solutions. The formation of absorbation lines in the spectra of stars. The application of elementary theory of contours. Curves of growth. The physics of the solar envelops. The electrodynamics of the sun's atmosphere. Sunspots and faculae. Planetary rebulae. Novae. The dynamics of envelops. Equations of the emission line contours. The internal structure of stars. Equations governing the theory of the white dwarfs. The scattering of light in planetary atmospheres. Equation of radiative transfer. Principle of invariance and its application. Interstellar matter. General equations of radio emission.

Recommended Books:

1. Theoretical Astrophysics, by V.A. Ambartsumyan Pergam press 1992.
2. Astrophysics, by L.H. aller Chapman & Hall Ltd 1990.
3. Gaseous Nebulae, by L.H. Aller Ronald Press Co. 1988.
4. Astrophysical Concepts, by Martin Harwit John Wiley & Sons 1989.
5. Diffuse Matter in space, by Lyman Spitzer Inter Science 1989.
6. Astrophysics of Gaseous Nebulae, by D.E. Osterbrock , Freeman & Co. 1993.
7. Principles of Stellar Dynamics, by S.Chandrasekhar University of Chicago Press 1982.

Course No. Math-933
Course Title: Magnetohydrodynamics
Credit Hours: 03

Fundamental ideas. MHD approximation. The kinematric aspect of MHD. MHD equations. The Magnetic force and its effects. Magnetic diffusion. Viscosity and pressure. Linear Magneto hydrodynamics. Boundaries and external conditions. MHD Waves. Magneto gas dynamics. Earth's core and extreme outer atmosphere. The sun's magnatic field. Interplanetary and intersteller matter. Magnetoacousti waves. MGD shock waves.

Recommended Books:

1. Magnetohydrodynamics. By J.A. Shercliff Pergamon Press 1985.
2. Magneto-Fluid-Mechanics, by V.C.A. Ferraro and C.Plumpton Oxford University Press 1991.
3. Magnetohydrodynamics, by T.G.Cowling Inter Science 1987.
4. Magnetohydrodynamics, by P.C. Kendall & Co. Plumpton Pergamon Press 1992.
5. Hydrodynamics & Hydromagnetic stability, by S.Chandrasekhar Oxford University Press 1991.
6. Magnetohydrodynamics, by S.I.Pai Springer verlag 1992.
7. Magnetohydrodynamics, by A.B. Cambel, T.P. Anderson and M.M. Slawsky eds. North Western University Press 1992.
8. Magnetohydrodynamics by R.K.K. Landshoff edn. Stanford University Press 1990.

Course No. Math-934
Course Title: Cosmic Gas Dynamics
Credit Hours: 03

Astro physical introduction. Structure of the outer layers of a star. Solar and stellar activity. Surface nuclear reactions and accelerating mechanism. The role of electromagnetic activity in stellar evaluation. Solar Corona. Interplanetary plasma. Hydrodynamics of the solar corona and the solar wind. Theory of the interplanetary magnetic fields and the transport of rotational momentum. Microscopic and small scale phenomena. The termination of the solar wind.

Recommended Books:

1. Cosmic Gas Dynamics, by E.Schatzman & L.Biermann ed. By M.S. Uberol John Wiley & Sons 1990.
2. Interstellar Gas Dynamics, by S.A. Kaplan, ed. By F.D.Kahn Pergamon Press 1988.
3. Gas Dynamics of Cosmic Clouds by J.M. Burgers and H.C. Van de hulist Amsterdam: North Holland Publication Company 1985.
4. Interstellar Gas Dynamics, by H.J. Habing Dordrecht; D. Reidel 1990.
5. Stars and Stellar System, byL.Woltjer University of Chicago Press 1985.
6. Interplanetary Dynamical Processes, By E.Partker Inter Science 1988.

Course No. Math-935
Course Title: Plasma Dynamics
Credit Hours: 03

Introduction. Single Particle motions, Plasmas as fluids. Waves in plasmas. Diffusion and resistivity. Equilibrium and stability theory. Kinetic theory of plasmas. Plasma oscillations and Landau damping. Resistive drift waves. Collision in fully ionized plasmas. Recombination. Non Linear effects. Ion acoustic shock waves. The ponderomotive force. Plasma echoes. Controlled fusion. Pinches. Laser-fusion. Plasma heating. Fusion technology.

Recommended Books:

1. Introduction to Plasma Physics, by Francis F.Chen Plenum Press 1990.
2. Physics of fully ionized Gases, by Lyman Spitzer (Inter Science) 192.
3. Introduction to plasma physics, by W.B. Thomson (Pergamon press) 1990.
4. Plasma Dynamics by S. Chandrasekhar (University of Chicago Press) 1991.
5. Plasma and controlled Fusion., by D.J> Rose and M.Clark (M.I.T.Press) 1991.
6. Plasma Dynamics, by S.I.Pai (Springer-Verlag) 1992.
7. Plasma Dynamics, by F.H.Clasuer edn. (Perfamon and Addison-Wesley) 1990.
8. Plasma Physics, by J.G.Linhar(North Holland Pub) 1990.

Course No. Math-936
Course Title: Mathematical Theory of Quantum Mechanics
Credit Hours: 03

Mathematics introduction, wave mechanical concepts. Energy eigenfunctions. General principles and quantum mechanics. Matrix mechanics. Spin. Scattering. System of many particles. Angular momentum. Perturbation theory. Collision processes. Introduction to group theoretical ideas. Relativistic theory of the electron. Quantum theory of scattering. Schrodinger and Heisenberg equations of motion.

Recommended Books:

1. Quantum Mechanics, by F.Mandl (Sutterwort, London) 1990.
2. Introduction to Quantum Mechanics, by P.T. Mathews (McGraw-Hill book co) 1989.
3. Quantum Mechanics, by L.I. Schiff McGraw Hill 1989.
4. Introduction to Quantum Mechanics, by L.Pauling and E.B. Wilson McGraw Hill 1985.
5. The Principles of Quantum Mechanics, by P.A.M. Dirac Oxford University Press 1987.
6. Physical Principles of the Quantum Theory, by W.Heisenberg University of Chicago Press 1987.
7. Quantum Mechanics, by L.D.Landau and E.M.Lifshitz Pergamon Press 1990.
8. Quantum Theory, by David Bohn Dover Pub. Inc. 1989.

Course No. Math-937
Course Title: Mathematical Theory of Relativity
Credit Hours: 03

Tensors and Vector Fields. Historical introduction. Newtonian Mechanics, Einstein and Lorentz transformations. Relativistic kinematics. Relativitic mechanics. Relativity and electricity. Relativistic transformation of Maxwell's equations. Transformation of the potentials. Special Theory of Relativity. Electromagnetism and relativity. Cosmological models. The gravitational field equations.

Recommended Books:

1. An Introduction to the Theory of Relativity, by W.G.V. Rosser Butterworth London 1991.
2. The Mathematical Theory of Relativity, by A.S. Eddington Cambridge University Press 1990.
3. Special Relativity, by A.P.French Nelson, 1988.
4. Theory of Relativity, by W.Pauli Pergamon Press 1990.
5. The Theory of Relativity, by C.Moller Oxford University Press 1992.
6. Introduction to the theory of Relativity, by P.G. Bergmann Prentice Hall 1992.
7. The Principles of Relativity, byH.A. Lorentz, A.Einstein, H.Minkowski and H.Weyl. With notes by sommer field, translated by W.Perrett & G.B. Jeffery Dover Pub. Inc 1994.
8. Special Relativity, by Albert Shadowitz Dover Pub. Inc 1994.
9. Special relativity, by G.Stephenson and C.W.Kilmistar Dover Pub Inc. 1994.

Course No. Math-938
Course Title: Electrodynamics
Credit Hours: 03

Electrostatics. Dielectries, Current density. Constant magnetic fields. Ferromagnetism. Super conductivity. Maxwell's equations and conservation laws. Electromagnetic waves and their propagation. The passage of fast particles through matter. Electromagnetic fluctuations. Scattering of electromagnetic waves. Diffraction of X-rays in crystals. Application in special theory relativity. Cosmical problems.

Recommended Books:

1. Electrodynamics of Continuous Media, by L.D. Landau and E.M. Lifshitz Pergamon Press 1984.
2. Classical Electrodynamics, by J.D. Jackson Wiley Eastern Ltd 1989.
3. Cosmical Electrodynamics, by H.alfven and C.G.Falthammer. Oxford Clarendon Press 1990.
4. Cosmic Electrodynamics, by J.W.Dungey Cambridge University Press, 1988.
5. Principles of Electrodynamics, by Melvin Schwartz Dover Pub. Inc. 1994.
6. Electromagnetism, by John C.Slater and N.H. Frank Dover Pub. Inc 1994.
7. Elecrodynamics and Classical Theory of Fields and Particles, by A.O. Barut Dover Pub. Inc 1994.

Course No. Math-939
Course Title: Advance Mechanics
Credit Hours: 03

Survey of elementary equations and conservation laws. Equations of motion. Central motion. Collision of particles. Small Oscillation. Motion of a rigid body. The Canonical transformations. Wave equation in one dimension. Hamilton's equations. Hamilton-Jacobi Theory. Integrals and Interpretations of dynamics. Lagrange's equations. Relativistic dynamics. General dimensional theory. Similarity, modeling and examples of the applications of dimensional analysis. Application to the theory of a viscous fluid and turbulence. Application of similarity solution to unsteady-motion of a gas.Similarity solutions of astrophysical problems.

Recommended Books:

1. Mechanics by L.D. Landau and E.M. Lifshitz Pergamon Press 1990.
2. Similarity and Dimensional Methods in Machanics, by L.I. Sedov edt. By Maurice Holt, translated by Morris Friedman Academic Press 1991.
3. Classical Mechanics by H.Goldstein Narosa Publishing Co. 1992.
4. A Treastise on Analytical Dynamics by L.A. Pars Heinemann 1985.
5. Classical Dynamics byd.T. Greenwood Prentice Hall 1991.
6. Classical Mechanics, by H.C. Corben John Wiley and Sons 1980.

Course No. Math-940
Course Title: Mathematical Theory of Non-Uniform Gases and Statistical Mechanics
Credit Hours: 03

Thermodynamics. The vander Waals equations. Laws of thermodynamics. Application of thermodynamics to special system. Kinetic theory of gases. The equations of Boltzmann and Maxwell. Transport phenomena. The Chapman-Enskog method. General Statistical Mechanics. Viscosity, Thermal Conduction and diffusion. Dense gases. Quantum statistical mechanics. Special topics. Multiple gas mixture. Electromagnetic phenomena in ionized gases. Fundamental equations of fluid dynamics. Integral of collision equations.

Recommended Books:

1. The Mathematical Theory of Non-Uniform Gases, by S.Chapman and T.G.Cowling Cambridge University Press 1990.
2. Statistical Physics, by L.D.Landau and E.M. Lifshitz Pergamon Press 1990.
3. Statistical Mechanics, by Kerson Haung. John Wiley and Sons 1993.
4. Thermodynamics and Statistical Mechanics, by Arnold Sommerfeld Academic Press 1989.
5. Introduction to Statistical Mechanics, by G.S. Rushbrooke Oxford Clarden Press 1987.

Course No. Math-941
Course Title: Mathematical Theory of Continuum Mechanics
Credit Hours: 03

Mathematical foundations. Analysis of stress and strain. Deformation and strain. Equalibrium of rods and plates. Motion and flow. Elastic waves. Fundamental laws of continuum mechanics. Torsion. Dislocation. Shells. Problems of dynamical resistance. Linear elasticity. Fluids. Plasticity theory. Viscoelasticity. Damage mechanics. Crack mechanics.

Recommended Books:

1. Theory of Elasticity, by L.D. Landau and E.M. Lifshitz Pergamon Press 1990.
2. Continuum Mechanics, by G.E.Mase McGraw Hill 1990.
3. Mechanics of Solid Materials, by J. Lemaitre and J.L. Chaboche Translated by B. Shrivastava Cambridge University Press 1994.
4. Mathematical Theory of Elasticity, by I. Sololnikoff McGraw Hill 1986.
5. The Mathematical theory of plasticity, by R.Hill The Clarendon Press Oxford 1991.
6. Elementary Fracture Mechanics, by D.Brook Noordhoff 1989.
7. Continuum Damage Mechanics-Theory and Applications, by D.Kranjcinovic and J.Lemaitre Springer-Verlag 1992.
8. The Elements of Continuum Mechanics, by C.Truesdell Springer-Verlag 1986.
9. Mathematical Theory of Creep and Creep Rupture, by F.K.G. Odqvist The Clarendon Oxford Press 1994.
10. Introduction to Continuum Damage Mechanics, by L.M. Kachanov Martinus Nijhoff 1986.

Course No. Math-942
Course Title: Perturbation Methods
Credit Hours: 03

The nature of Perturbation theory. Regular and singular perturbation problems. The techniques of perturbation theory. Some singular perturbation problems in aerofoil theory. The method of matched asymptotic expansions. The method of strained coordinates. Viscous flow at high Reynolds number. Viscous flow at low Reynolds number. Some inviscid singular perturbation problems. Other aspects of perburbation theory. Hypersonic and supersonic low problems.

Recommended Books:

1. Parturbation Methods in Fluid Mechanics, by I.Van Dyke The Parabolic Press 1994.
2. Perturbation Methods, by A.H.Nayfeh Wiley N 1993.
3. Perturbation Methods in Applied Mathematics, by J.D. Cole Blaisedell Waltham, Mass 1989.
4. Asympotic Expansions, by A.Erdelyi Dover NY 1986.
5. Introduction to Singular Perturbations, by R.E. Malley Academic Press NY 1994.
6. Matched Asymptotic Expansions and Singular Pertubations, by W.Eckhaus North Holland Assterdam and London. American Elsevier 1984.
7. Fluid Mechanics and Singular Perturbations, by S.Kaplan P.A. Longeritrom, L.N. Howerd and C.S. Liu edns; Academic Press NY & London 1987.

8. Perturbation Techniques in Mathematics, Physics and Engineering by R.Bellman Holt, Rine hart and Winston, Dover Pub. 1992.
9. Asympotic Solutions of Differential Equations and their Applications, by F.W.J. Olver C.A. Wilcox edn; wiley NY 1984.

Course No. Math-943
Course Title: Hypersonic Flow Theory
Credit Hours: 03

Introduction. General Considerations. Small disturbance theory. Blunt body. Boundary layer separation. Similarity rule. Howtonian theory. Hypersonic shock waves. Transonic small disturbance. Newton-Busemann approximation. Canstant-density solutions. The theory of thin shock layers. Numerical methods for blunt body flows. Other methods for locally supersonic flows.

Recommended Books:

1. Hypersonic Flow Theory, W.D. Hayes and R.F. Probstein Academic Press 1991.
2. Modern Developments in Fluid Dynamics-High speed Flow by L.Howarth edn. Oxford University Press 1988.
3. Introduction to Hypersonic Flow, by G.G. Chernyi Translated by R.F. Probstein Academic Press 1988.
4. Viscous Hypersonic Flow, by W.H. Dorrance McGraw Hill 1992.
5. Fundamentals of Gasdynamics, by H.W. Emmons edn. Princeton University Press 1988.
6. Hypersonic Flow, by A.R. Collar and J.Tinkler edn. Butter-Worth 1990.
7. Hypersonic Flow Research, by F.R.Riddell edn. Academic Press 1992.
8. Hypersonic Flow, Proc. Fifth International. Aeronantical Conf; Los Angeles, by L. Leed Inst. Aero. Sci, New York 1985.
9. General Theory of High Speed Aerodynamics, by W.R.Sears edn. Princeton University Press 1984.
10. The Temperature Aspects of Hypersonic Flow, by W.C. Nelson edn. Pergamon Press 1984.

Course No. Math-944
Course Title: Numerical Methods
Credit Hours: 03

Classification of Problems. Classification of equations. Stability and convergence. Numerical solution of partial differential equations. Solution of parabolic, elliptic and hyperbolic type partial differential equation. Difference equations. The method of iteration. The method of relaxation. The Rayleigh-Ritz method. The numerical Solution of integral equations. Practical problems. Special topics. Empirical formulas. Weighted residuals and finite elements. Difference methods for initial-value problems. Boundary value problems. Multi-level difference equations. Applications.

Recommended Books:]

1. Numerical Methods for Partial Differential Equations, by William F. Ames Nelson 1992.
2. Numerical Solution of Ordinary and Partial Differential Equations, by L.FOX Pergamon Press 1990.
3. Numerical Mathematical Analysis, by James B. Scarborough the Johns Hopkins Press, 1991.
4. Difference Methods for Initial value Problems, by R.D. Richtmyer and K.W. Morton Inter Science 1991.

Course No. Math-945
Course Title: Mathematical Theory of Computer Science
Credit Hours: 03

Introduction. Number representation. Boolean Algebra. Special purpose Boolean Machines. Problem solving. Algorithm. Operational research. Linear Programming. Interative techniques and numerical integration. Hardware. AND, NOT and OR circuits. Computer design. Analogue Computing. Digital Computing. Binary Boolean Operations. Product and division of numbers using binary language. Storing and clearing of storage register. Floating point binary language. Machine language. Development of programming languages. Stop, Add, Copy etc. instructions. Survey of Computer language.

Recommended Books:

1. Introduction to Computer Science, by Francis scheid McGraw Hill 1992.
2. Computing Science, by D.C. Palmer and B.D. Morrie Arnold Pub. 1990.
3. A Mathematical Introduction to Computer Science, by Art Lew Prentice Hall 1994.
4. Introduction to Computer Science, by Thomas Bartee McGraw Hill 1991.
5. Mathematical Foundations of Programming, by F.S. Beckman Addison Wesley 1990.
6. Principles of Programming Languages, by R.D. Tennent Prentice Hall 1991.
7. Theory of Computer Science: A Programming Approach, by J.M. Brady Chapman and Hall 1987.
8. Mathematical Programming in Practice, by D.M.L. Beale Pitman London 1988.
9. Computer Methods for Mathematical Computations, by G.E. Forsythe, M.A.Malcolm and C.Molar Prentice Hall 1989.

Course No. Math-946
Course Title: Mathematical Theory of Probability
Credit Hours: 03

Probability axioms. Conditional Probability. Bayes theorem. Moment Inequalities. Moment Generating function. Characteristic functions. Conditional expectations. The Principle of least squares.

Discrete and continuous distributions. Order statistics and their distributions. The Bivariate and Multivariate Normal distribution. The exponential family of distribution. Modes of convergence. The weak and strong laws of large numbers. Limiting moment generating functions. The central limit theorem.

Sample characteristics and their distributions. X^2, t and F-distributions. The distribution of $\bar{X}, S^2$ in sampling from a normal population.

Recommended Books:

1. Rohatgi, V.K. 1976. An Introduction to Probability Theory and Mathematical Statistics. John Wiley and Sons New York.
2. Feller, W. 1968 Vol, I 3rd edn; Vol. II, 1971, 2nd edn. An Introduction to Probability Theory and its application. John Wiley and Sons, New York.
3. Fisz, M. 1963. Probability Theory and Mathematical Statistics, 3rd edn. John Wiley and sons. New York.

Course No. Math-947
Course Title: Linear Models
Credit Hours: 03

Linear and General Linear models. Least squares Estimation. Best Linear Unbiased Estimation. Testing Hypothesis. Confidence intervals. Multiple Regression. Multicollinearity and its diagnostics. Ridge Regression. Principal Components Regression. Latent root Regression. Comparison and evaluation of biased Estimator.

Recommended Books:

1. Searle, S.R.1971. Linear Models. John Wiley & Sons New York.
2. Kshirsagar, A.M. 1983. A Course in Linear Models Marcel Dekker, New York.
3. Montgomery, C.D. and Peck, A.E.1983. Introduction to Linear Regression Analysis. John Wiley and Sons. New York.

Course No. Math-948
Course Title: Markov Chains: Theory and Applications
Credit Hours: 03

Stochastic Process. The Markov Property and Transition Matrices. Concepts of Markov Chains. Classification of States. The renewal Theorem and its consequences. Sub stochastic Matrices. Absorption Times and Absorption Probabilities. Ratio limit Theorems. Algebraic Review. Theorems for classification of Finite Markov Chains. Some Examples.

Recommended Books:

1. Isaacson, D.L. Madsen, R.W. 1976. Markov Chains Theory and Applications. John Wiley and Sons. New York.
2. Chung, K.L. 1967. Markov Chains with Stationary Transition Probabilities, 2nd edn. Springer-Verlag, Berlin.

Course No. Math949
Course Title: The Asymptotic Theory of Extreme order statistics
Credit Hours: 03

Problems leading to extreme values of readom variables. The Mathematical model. Bounds on the distribution of Extremes. Special properties of the exponential distribution on the light of extremes. Suffiecient conditions. The asymptotic distribution of the maximum and minimum for some special distributions. Necessary conditions for weak convergence.

The special role of exchangeable variables. A limit theorem for mixtures. A theoretical mode. Stationary sequences. Minimum and maximum of independent variables. The asymptotic distribution of the kth extremes. Some applied models. Degenerate limit laws. Borel ---- Cantelli lemmas. Limsup and lim inf of normalized extreme.

Recommended books:

1. Galambos, J. 1978. The Asymptotic Theory of Extreme order Statistics. John Wiley and Sons, New York
2. David, H. A. 1970. Order Statistics. John Wiley and Sons New York.
3. Gumber, E.J. 1958 Statistics of Extremes. Columbia University Press. New York

Course No. Math-950
Course Title: Multivariate Analysis-I
Credit Hours: 03

Multivariate problems and techniques. The data matrix summary statistics. Linear combinations. Geometrical ideas. Characterization and properties. Linear forms. Transformations of normal data matrices. The Wishart distribution. The Hotelling T^2 – distribution. Distributions related to the multinormal.

Maximum likelihood exstimation and other techniques. The behren--- Fisher Problem. Simultaneous confidence internvals. Multivariate Hypothesis testing. The general linear hypothesis. Design matrices of degenerate rank. Multiple correlation. Least squares Estimation. Discarding variables.

Recommeded Books:

1. Mardia, K.V. Kent, J.T. and Bibby, J.M. 1982. Multivariate Analysis. Academic Press, London.
2. Kshirsagar, A.M. 1972. Multivariate Analysis. Marcel Dekker, New York

Course No. Math-951
Course Title: Multivariate Analysis-II
Credit Hours: 03

Definition and properties Principal components. Testing hypothesis about principal compnenets. Correspondence analysis. Discarding of variables. Principal component analysis in regression. The factor model. Relationships between factor analysis and principal component analysis. Mathematical development. Qualitative data and dummy variables. Qualitative and quantative data.

Discrimination when the populations are known Discriminiation under estimation. Fisher's linear discriminant function. Formulation of multivariate one-way classification. Testing fixed contrasts. Canonical variables and test of dimensionality. Two-way classification.

Recommended Books:

1. Mardia, K.V. Kent, J.T. and Bibby, J.M. 1982. Multivariate Analysis. Academic Press, London.
2. Kshirsagar, A.M. 1972. Multivariate Analysis. Marcel Dekker, New York

Course No. **Math-960**
Course Title: **Directive Study**
Credit Hours: **03**

Course No. **Math-970**
Course Title: **Thesis**

Viva-Voce