MAHARSHI DAYANAND SARASWATI UNIVERSIT

AJMER

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पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. MATHEMATICS

M.Sc. Semester I & II
(w.e.f. 2015-16)
M.Sc. Semester III & IV
(w.e.f. 2016-17)

संस्करण 2017

मूल्य : 12/-

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

NOTICE

1. Change in Statutes/Ordinances/Rules/ Regulations Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

सूचना

1. समय-समय पर संशोधन या पुनः निर्माण कर परिनियमों/ अध्यादेशों/नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। **विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।**

M. Sc. (MATHEMATICS) SYLLABUS
SEMESTER SCHEME
SCHEME OF EXAMINATION

There shall be 20 papers in all. Out of these ten papers shall be offered in first and second Semesters (five in each semester). In third and fourth semester there will be two compulsory papers and three optional papers in each semester. The optional papers are to be chosen in such a way that if paper O3(x) is opted in third semester then one has to opt paper O4(x) in fourth semester.

Note: Syllabus of each question paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks) is compulsory and contains **10** questions **(50 words each).** At least three questions will be set from each unit. Each question carries **3 marks.**

Part-B (25 Marks) contains 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt **5** questions taking at least one question from each unit but not more than 2 from any unit. Each question carries **5 marks.**

Part-C (45 Marks) contains **6** questions **(400 words each)** taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries **15 marks.**

FIRST SEMESTER

Five Theory Papers **Total Max marks: 500**

Paper	Name of Paper	Teaching hrs. per week	Examination Duration	Max. Marks
C1(i)	Abstract Algebra	6	3	100
C1(ii)	Complex Analysis	6	3	100
C1(iii)	Tensors	6	3	100
C1(iv)	Metric Space	6	3	100
C1(v)	Special Functions	6	3	100

SECOND SEMESTER

Five Theory Papers **Total Max marks: 500**

Paper	Name of Paper	Teaching hrs. per week	Examination Duration	Max. Marks
C2(i)	Linear Algebra	6	3	100
C2(ii)	Measure Theory	6	3	100
C2(iii)	Differential Geometry	6	3	100
C2(iv)	Topology	6	3	100
C2(v)	Integral Transform	6	3	100

THIRD SEMESTER

Five Theory Papers (Two compulsory and three optional) Total Max marks: 500

Compulsory papers

Paper	Name of Paper	Teaching hrs. per week	Examination Duration	Max. Marks
C3(i)	Functional Analysis I	6	3	100
C3(ii)	Advanced Differential Equations and Calculus of Variations	6	3	100

Optional Papers

Paper	Name of Paper	Teaching hrs. per week	Examination Duration	Max. Marks
O3(i)	Numerical Analysis-I	6	3	100
O3(ii)	Mathematical Statistics-I	6	3	100
O3(iii)	Special and General Theory of Relativity	6	3	100
O3(iv)	Hydro Mechanics	6	3	100
O3(v)	Continuum Mechanics-I 6	3	100	
O3(vi)	Graph Theory	6	3	100
O3(vii)	Astronomy-I	6	3	100
O3(viii)	Generalized Hyper-geometric Functions-I	6	3	100
O3(ix)	Operations Research	6	3	100
O3(x)	Mathematical Modeling in Biology and Medicine	6	3	100
O3(xi)	Dynamics of a Particle	6	3	100

FOURTH SEMESTER

Five Theory Papers (Two compulsory and three optional) Total Max marks: 500

Compulsory papers

Paper	Name of Paper	Teaching hrs. per week	Examination Duration	Max. Marks
C4(i)	Functional Analysis-II	6	3	100
C4(ii)	Linear Integral Equations	6	3	100

Optional Papers

Paper	Name of Paper	Teachin hrs. per week	Examination Duration	Max. Marks
O4(i)	Numerical Analysis-II	6	3	100
O4(ii)	Mathematical Statistics-II	6	3	100
O4(iii)	Cosmology	6	3	100
O4(iv)	Fluid Dynamics	6	3	100
O4(v)	Continuum Mechanics-II	6	3	100
O4(vi)	Discrete Mathematics	6	3	100
O4(vii)	Astronomy - II	6	3	100
O4(viii)	Generalized Hyper-geometric Functions-II	6	3	100
O4(ix)	Non-linear Programming	6	3	100
O4(x)	Practical	2	3	100
O4(xi)	Dynamics of Rigid Bodies	6	3	100

M.A / M.Sc. (Semester-I)
PAPER –C1(i)
ABSTRACT ALGEBRA

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A **(30Marks)** is compulsory and contains **10** questions **(50** words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B **(25 Marks) 9** questions **(100** words each) will be set taking 3 from each unit and the Candidate is required to attempt **5** questions taking at least one question from each unit but not more than **2** from any unit. Each question carries **5 marks.**

Part-C **(45 Marks)** contains 6 questions (400 words each) taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries **15 marks.**

UNIT-I

Groups: Normal and subnormal series, composition series, theorems on isomorphism of groups, class equation for finite group, Burnside theorem. Cauchy's theorem for finite abelian groups, Cauchy's theorem for finite groups, P-groups, solvable groups, Jordan- Holder theorem, nilpotent groups.

UNIT-II

Euclidean rings: Polynomial rings, field theory-extension fields, algebraic and transcendental extensions, separable and inseparable extensions, normal extensions, perfect fields, finite fields, primitive elements, algebraically closed fields, automorphisms of extensions.

UNIT-III

Galois extensions, fundamental theorem of Galois theory, solution of polynomial equations by radicals, insolvability of the general equation of degree 5 by radicals. Euclidean and polynomial rings, polynomials over rational fields, the Einstin's criterion, polynomial rings over commutative ring, unique factorization domain, chain conditions on rings.

Modules, sub modules, quotient modules, cyclic modules, simple module, semi simple modules, schuler's lemma, free Modules.

Reference Books:

(1)Algebra	Maclane and Birkhoff	Macmillan Company.
(2)Topics in Algebra	I.N.Herstein	Wiley Eastern Ltd.
(3) Abstract Algebra	D.Chatterji	PHI
(4) Modern Algebra	A.R.Vasistha	KPM

PAPER –C1(ii) COMPLEX ANALYSIS

Duration: 3 Hrs. Max.Marks: 100

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A **(30Marks)** is compulsory and contains **10** questions **(50** words each).At least three questions will be set from each unit. Each question carries **3 marks.**

Part-B **(25 Marks) 9** questions **(100** words each) will be set taking **3** from each unit and the Candidate is required to attempt **5** questions taking at least one question from each unit but not more than **2** from any unit. Each question carries **5 marks.**

Part-C **(45 Marks)** contains **6** questions (400 words each) taking two from each unit. Candidate is required to attempt three question selecting one from

each unit. Each question carries **15 marks**.

UNIT-I

Complex integration, Cauchy's Goursat theorem, Cauchy's integral formula, higher order derivatives, Morera's theorem, Cauchy's inequality and Liouville's theorem, the fundamental theorem of algebra, Taylor's theorem, maximum modulus principle, Schwarz lemma, Laurent's series, Isolated singularities, meromorphic functions, the argument principle, Rouche's theorem, inverse function theorem.

UNIT-II

Residues, Cauchy's residue theorem, evaluation of integrals, branches of many valued functions with special reference to arg z, log z and z^n.

UNIT-III

Spaces of analytic functions, Hurwitz's theorem. Montel's theorem , Riemann mapping theorem, Weierstrass factorization theorem, Gamma function and its properties, Riemann- Zeta function. Riemann's functional equation, Runge's theorem, Mittag-Leffler's theorem, analytic continuation, uniqueness of direct analytic continuation.

Reference Books:

(1)Complex Analysis — R. V. Churchil
(2) The Elements of Compex Analysis — B. Choudhry
(3) Functions of One Complex Variable — John B. Conway

PAPER –C1(iii) TENSORS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C **(total 100 Marks).**

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Transformation of co-ordinates, covariant, contravariant and mixed tensors, invariants, addition, subtraction and multiplication of tensors, contraction of tensors, quotient law of tensors, fundamental tensors, length of curve , associated tensors.

UNIT-II

Christoffel symbols, covariant differentiation of tensors , law of covariant differentiation. geodesics, null geodesics, geodesics co-ordinates, parallelism.

UNIT-III

Covariant derivative, Riemann-Christoffel tensor, curvature tensor, Ricci tensor, Bianchi identities, Riemann curvature, flat space, space of constant curvature.

Reference Books:

(1) Tensor Calculus — B. Spain
(2) Advanced Tensor Analysis — Raj Bali
(3) Cartesin Tensor — A.M.Goodbody

PAPER –C1(iv) METRIC SPACE

Duration: 3 Hrs. Max.Marks: 100

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Metric Spaces: Definition, Euclidean spaces, inequalities, bounded and unbounded metric spaces. Basic concepts of spheres, open sets, equivalent metrics, closed sets, neighborhoods, accumulation points, adherent points, closure interior exterior, frontier and boundary of a set, bases, subspaces of a metric spaces, product spaces.

UNIT-II

Complete Metric Spaces: Sequence and subsequences in metric spaces Cauchy sequences, complete metric space, Baire's category theorem, completeness and contracting mappings, complete metric spaces, completion of a metric space. Connectedness: Separated sets, connected and disconnected sets, connectedness on the real line, components, totally disconnected spaces, locally connected spaces.

UNIT-III

Compactness: Hausdroff axiom, compact spaces, Lindelof spaces, locally compact spaces, product of two compact spaces.

Continuity and homeomorphism: Preliminary limits and continuity, homomorphism, continuity and connectedness, continuity and compactness projection mappings, connectedness of the product of two spaces uniform continuity, extension theorems.

Book Recommended:

1. Metric spaces : Q.H. Ansari
2.First course in Metric spaces: B.K. Tyagi Cambridge
3. Metric spaces: Micheal O'Searcoid Springer
4. Real Variables with Basic Metric space topology: R.B.Ash Dover
5. Metric Spaces: J.N. Sharma Krishna Prakashan Mandir

PAPER –C1(v) SPECIAL FUNCTIONS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 contains questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Hypergoemetric functions: Series solution of Gauss hypergeometric equation, Gauss hypergeometric function and its properties, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, linear relation between the solutions of Gauss hypergeometric equation, Kummer's confluent hypergeometric function and its properties, integral representation, Kummer's first transformation.

UNIT-II

Bessel function and Legendre polynomial: Generating function for $J_n(x)$, alternative forms of generating functions, trigonometric expansions involving Bessel functions, Bessel's differential equation and its solutions, recurrence relations, Bessel's integrals, modified Bessel function, orthogonality of Bessel functions, some integral involving Bessel functions,Legendre's polynomial, associated Legendre's functions, generating function, recurrence relation, successive values of Legender polynomaial, Beltrami's result, Christofel's expansion, Christofel's summation formula, various forms of $P_n(x)$ Rodrigues formula, hypergeometric form, Laplace first and second integral of $P_n(x)$ and related problems, Legender's differential equation and its general solution, orthogonality properties, expansion involving Legender polynomial, Legender function of second kind and its properties.

UNIT-III

Hermite polynomial : Definition of Hermite polynomials $H_n(x)$, pure recurrence relations, differential recurrence relations, Rodrigue's formula, other generating functions, orthogonality, expansion of polynomials, more generating functions, hypergeometric representations, integral representation of Hermite polynomial, differential equation and its solution.

Laguerre Polynomials: The Laguerre Polynomials $L_n(x)$, generalized Laguerre polynomial, generating functions, pure recurrence relations, differential recurrence relation, Rodrigue's formula, orthogonal, expansion of polynomials, special properties, other generating functions integral relations..

Reference Books:

1.Special Functions: Earl D. Rainville, Chelsea Pub Co.
2.Special Functions with application:Saran, Sharma and Trivedi, Pragati Prakashan
3.Special Functions: R. Askey and R. Roy, Cambridge
4.Special Functions & Their Applications: N. N. Lebdev, Prentice Hall, nglewood Cliffs, NJ.

M.A / M.Sc. (Semester-II)
PAPER –C2(i)
LINEAR ALGEBRA

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is

question carries 15 marks (400 words).

UNIT-I

Vector Spaces: Bases and co-ordinates, dimensions, Sylvester law of nullity, linear transformations and their representation as matrices, change of basis, dual space, dually paired vector spaces.

UNIT-II

Eigen values and Eigen vectors of a linear transformation, diagonalisation, bilinear,quardric and Hermitian forms.

UNIT-III

Inner product spaces: Cauchy-Schwarz inequality, orthogonal vectors, orthogonal complements, orthonormal sets and bases.
Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process, normal and self adjoint matrices and transformation, unitary matrices and transformations, Principal axis theorem.

Reference Books:

(1) Linear Algebra S.Lang Addision Wesley
(2) Linear Algebra Hofmann and Kunz Prentice Hall
(3) Linear Algebra Friedberg,Insel and Spence
(4) Linear Algebra A.G.Hamilton Cambridge

PAPER –C2(ii)
MEASURE THEORY

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Countable and non-countable sets, the Lebesgue measure of sets of real number,measurable functions, structure of measurable functions, Weirestrass theorem on the approximation of continuous functions by polynomials.

UNIT-II

Lebesgue integral of measurable functions, properties of Lebesgue integrals.

UNIT-III

Summable functions, the space of square summable functions, functions of finite variation, the Stieltjes integral, the indefinite Lebesgue integral.

Reference Books:

(1) Lebesgue Measure and Integration P.K.Jain&V.P.Gupta
(2)Theory of functions of Real Variable Vol. 1 I. P. Natanson
(3)Measure Theory K.P.Gupta KPM
(4)An Introduction to Measure and Integration I.K.Rana Narosa

PAPER –C2(iii)
DIFFERENTIAL GEOMETRY

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Curves in space : Space curves, path ,arc length, tangent line, contact of a curve and surface, inflexinal tangent, the osculating plane, tangent at any point of a surface f(x,y,z)=0, normal plane, principal normal and binormal, curvature, torsion and skew curvature, Serret-Frenet formulae, Helices, fundamental theorems for space curves, circle of curvature, osculating sphere.

UNIT-II

Concept of surface and fundamental forms: Definition of surface, regular point and singularities on a surface, tangent plane and normal, first fundamental form, relation between E,F,Q and H, second fundamental form, Weingarton equations, angle between parametric curves, direction coefficients.

UNIT-III

Curves on a surface: Curvature of normal section, Meusnier theorem, principal directions and principal curvatures, mean curvature, first curvature and total curvature, minimal surface, navel point, lines of curvature, envelope, edge of regression, ruled surfaces, developable surface, asymptotic lines.

Reference Books:

(1) Differential Geometry — C.E.Weatherbum
(2) Differential Geometry — H.C.Sinha
(3) Coordinate Geometry of the three dimensions — Robert, L., Bell J. T.

PAPER –C2(iv) TOPOLOGY

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Topological spaces: Topology, T-open sets, weaker and stronger topology, Indiscrete and discrete topology, co-finite topology, usual topology, open sets, closed sets, neighborhood, closure, interior, limit point, relative topology, upper limit topology, intersection of topological spaces, Kuratowski-Space, theorems on metric spaces, equivalent metrics.

Bases, sub-bases and countability: Base, sub-base, local base, first countable, second countable, theorems, hereditary property, theorems related to metric space, sequence in a topological space.

UNIT-II

Continuous functions: Continuity, sequentially continuous, homeomorphism, topological property, open and closed maps, uniform continuity, product invariant, theorems.

Separation axioms: T_0, T_1, T_2, spaces, normal spaces, Hausdorff space, regular spaces, T_3, T_4-spaces, completely regular spaces, Tychnoff space, completely normal, T_0-Space.

UNIT-III

Compactness: Cover, open cover, finite sub-cover reducible, compact sets, finite intersection property, Heine-Borel, Lindeloff space, locally compact, Bolzano Weierstrass property, sequentially compact, Lebesgue number, totally bounded set.

Connectedness: Separated sets, disconnectedness, totally disconnected , maximal connected set, component, path , arc wise connected, locally connected, theorems on connectedness.

Product spaces: Product topology, projection maps, problems related to product invariant, topology for the cartesian product of arbitrary collection, Tychonoff topology.

Nets and convergence: Binary relation, directed set, residual subset, cofinite subset, net, sequence convergence of a set, cluster point, subnet, isotones map. Filters and ultra filters: Filter, cofinite filter, Nbd filter, filter base, ultrafilters.

Books Recommended:

1. Point set Topology	Munkres	Pearson
2. Basic topology :	M.A. Armstrong	Sringer
3.Topology of Metric spaces (second edition) :	S.Kumaresan	Narosa
4. Introduction to topology :	C. Adamas & R.Franzosa-	Pearson
5. Introduction to Topology and Modem	Analysis : G.F.Simmons	
6. Topological spaces:	Kowalsky	
7. General Topology :	Kelly	
8. Topology:	K.P.Gupta	Pragati

PAPER –C2(v)
INTEGRAL TRANSFORM

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks) is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) contains 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Laplace Transform: Definition and its properties, rules of manipulation, Laplace transform of derivatives and integrals, inverse Laplace transform, complex inversion formula, theorems of Laplace transform, convolution theorem for Laplace transforms, application of Laplace transform to solution of differential equations, solving boundary value problem using Laplace transforms.

UNIT-II

Fourier transform: Definition and properties of Fourier sine, cosine and complex transforms, convolution theorem, inversion theorems, Fourier transform of derivatives, sine and cosine Fourier transforms, solving differential equations and integral equations using Fourier transform.

UNIT-III

Hankel Transform: Definition and elementary properties , inversion theorem, Hankel transform of derivatives, parseval theorem.

Mellin Transforms : Definition, properties and evaluation of transforms, convolution theorem for Mellin transforms.

Reference Books:

1.Use of Integral Transforms: I. N. Sneddon, McGraw-Hill Inc.
2.Integral Transforms and Their Applications: Davies, Brian, Springer-Verlag.
3. Integral Transforms Sharma & Vasistha
4. Theory and problems of Laplace Transformation:M.R.Spegal

M.A / M.Sc. (Semester-III)
PAPER –C3(i)
FUNCTIONAL ANALYSIS-I

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Normed linear spaces, quotient space of normed linear spaces and its completeness, Banach spaces and examples, bounded linear transformations, normed linear space of bounded linear transformations, equivalent norms, basic properties of finite dimensional normed linear spaces and compactness, Reisz lemma, multilinear mapping, open mapping theorem. closed graph theorem, uniform boundedness theorem.

UNIT – II

Continuous linear functional, Hahn-Banach theorem and its consequences, embedding and reflexivity of normed spaces, dual spaces with examples, inner product spaces, Hilbert space and its properties.

UNIT-III

Orthogonality and functionals in Hilbert Spaces, Pythagorean theorem, projection

theorem, orthonormal sets, Bessel's inequality, complete orthonormal sets, parseval's identity, structure of a Hilbert space, Riesz representation theorem, reflexivity of Hilbert spaces.

Reference Books:

(1) Introduction to Topology and Modern Analysis: GG Simmons: McGraw Hill
(2) Elements of Functional Analysis : L. A. Luesternik and L.J Sobolev, Hindustan Pub. Co.
(3) Introduction to Functional Analysis :A.E. Taylor, John Wiley and Sons.

PAPER –C3(ii)
ADVANCED DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Existence and uniqueness of solution dy/dx = f(x,y), Sturm- Liouville boundary value problem, Green's function , Cauchy problem and characteristics.

UNIT-II

Canonical form, reduction of second order partial differential equations to canonical form and their solution, classification of second order partial differential equations, separation of variables for heat equation, wave equation and Laplace equation.

UNIT-III

Some basic problems of calculus of variation, linear functional, minimal functional theorem, general variation of a function, Euler-Lagrange's equation, variational problems with moving boundaries, Rayliegh method, variational methods for boundary value problems in ordinary and partial differential equations, application of calculus of variation.

Reference Books:

1. Calculus of Variations: I. M. Gelfand, S. V. Fomin, Dover
2. Differential Equations and the Calculus of Variations:LevElsgolts; Univ.Press, Pacific.
3. Advanced Differential Equations: M.D. Raisinghania, S Chand & Co
4. Calculus of Variation with Application, A.S.Gupta, PHI.

PAPER –O3(i)
NUMERICAL ANALYSIS-I

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least

three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Errors: Errors in numerical calculations and remainder terms in various interpolation and quadrature formulae.

Iterative Methods: Simple iteration theory of iteration, acceleration of convergence, methods for multiple and complex roots, Newton-Raphson method for simultaneous equations, convergence of iteration process in the case of several unknown.

UNIT-II

Solution of Polynomial Equations: Polynomial equation, real and complex roots, synthetic division, the Birge-Vieta, Bairstow's and Graeffe's root squaring methods.

Simultaneous Linear Algebraic Equation: Direct methods-methods of determination, matrix inversion method, Gauss elimination method, Gauss-Jordan method, Crout's method, method of factorization, Jacobi iterative method, Gauss-Seidel iterative method and relaxation methods.

UNIT-III

Eigen value Problems: Basic properties of Eigen values and Eigen vector, iterative method for dominant Eigen value, power method for smallest Eigen values, evaluation of all the Eigen values, smallest Eigen value, Complex Eigen values, the Eigen values of real symmetric matrices, Jacobi's method, Eigen values of complex matrices.

Reference Books:

(1) Numerical Analysis: Jain,Iyenger and Jain
(2) Numerical Solution of Differential equations: M.K.Jain
(3) Numerical Analysis F.B.Hildebrand TMH
(4) An Introduction to Numerical Analysis Atkinson,K.E. John Wiley & Sons

PAPER –O3(ii)
MATHEMATICAL STATISTICS-I

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Sample spaces, combination of events, statistical independence, conditional probability, Bays theorem, repeated trials, random variable, distribution function. probability, probability function, density function, mathematical expectation, generating function (mfg and pgf), continuous probability distribution, characteristic function, Fourier's inversion, Cheby-Shev weak and strong law of large numbers.

UNIT-II

Normal, Hyper-geometric, Rectangular, Negative, Binominal, Beta, Gama and Cauchy's distribution.

UNIT-III

Association of attributes, index number, introduction, price-relatives, quantity relatives, value relatives, link and chain relatives aggregate methods, Fisher's ideal index.

Reference Books:

1.Mathematical Theory of Statistics: Kapur and Saxena
2.A first course in Mathematical Statistics: Weaitherbum
3.The Advanced Theory of Statistics: MG Kendall
4.Introduction of Mathematical Probability: Uspensky

PAPER –O3(iii)
SPECIAL AND GENERAL THEORY OF RELATIVITY

Duration: 3 Hrs. Max.Marks: 100

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) contains 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Special Theory of Relativity: Inertial and non inertial frames, special and general Galilean transformations, Newtonian relativity, electromagnetism and Newtonian relativity, Michelson and Marley experiment (reasons and consequences). Lorentz transformation equations, transformation equations for spatial and temporal intervals, Lorentz contraction and time dilation, transformation equation for velocity, particle acceleration, velocity of light is fundamental velocity, aberration (relativistic), Doppler effect (Relativistic Treatment), the principles of the conservation of mass and momentum, mass of a moving particle, transformation equations for mass, momentum force, relation between mass, energy and momentum.

UNIT-II

Minkowski space, time like, light like and space like intervals, relativity and causality, null cone, proper time, world line of a particle, energy momentum tensor of a continuous material system.

General Relativity: Need of general theory of relativity, principle of equivalence, principle of general covariance. Mach's principle of rotating disc, geodesic postulate.

UNIT-III

Newtonian approximation of equation of motion, search for field equations, Einstein's field equations reduce to Poisson's equations, gravitational field in

empty space, clock paradox in general relativity, Schwarzschild exterior line element, isotropic form of Schwarzschild exterior line element, planetary orbits, the trajectory of a light ray in a Schwarzschild field, three crucial test, energy momentum tensor for perfect fluid, Schwarzschild interior solution, Boundary conditions. Brikhoff theorem .

Books Recommended

1. Introduction to special Relativity: Robert Resnick, Wiley Eastern
2. Relativity Thermodynamics & Cosmology: R.C. Tolman ;Oxford at the clarendon press
3. Introduction to General Relativity : Adler, Bazin and Schiffer
4. Theory of Relativity: S.R.Roy , Raj Bali: Jaipur Publishing House.

PAPER –O3(iv)
HYDRO MECHANICS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Fluid and fluid pressure: States of matter, basic properties of fluid, specific gravity. **Fluid pressure under gravity:** Pressure in a horizontal plane, pressure at some depth in a fluid, difference of pressure between two points, effective surface of liquid. **Fluid pressure on plane surfaces:** Whole pressure.

UNIT-II

Centre of pressure: Some theorems related to C.P., centre of pressure in some standard cases, centre of pressure of a compound area and of a remainder, C.P. by integration,

Fluid thrust on curved surfaces: Resultant vertical thrust, resultant horizontal thrust, resultant thrust on curved surfaces, principle of Archimedes, resultant thrust on a vessel containing some liquid, resultant thrust on curved surfaces bounded by a plane curve.

Floating bodies: Conditions of equilibrium of a freely floating body in a liquid, Conditions of equilibrium of a body floating freely in two or more liquids, tension in the string supporting a body.

UNIT-III

Kinematics of the flow field: Lagrange's and Euler's methods, equation of continuity in Cartesian, Cylindrical and Spherical polar coordinates, Lagrangian method, equivalence of the two forms of the equation of continuity, boundary surface, velocity potential, irrotational flow.

Conservation of Momentum: Euler's equation of motion along a streamline, equation of motion of an inviscid flow, Cauchy's integral, Bernoulli's equation, conservative field of force .

Reference Books:

(1) Hydrostatics — Maliur Rahman Md.

(2) A Treatise on Hydromechanics — Basant,W.H.,Ramsey,A.S. — Ulan Press
(3) Hydrostatics — J.M.Kar — Globe Library
(4) Fluid Dynamics — Shanti Swarup — .KPM

PAPER –O3(v)
CONTINUUM MECHANICS-I

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Cartesian Tensors, index notations and transformation, laws of Cartesian tensors, additions, subtraction and multiplication of Cartesian tensor, gradient of a scalar function, divergence of a vector function and curl of a vector function using the index notation, the identity stokes Gauss and Green's theorems.

UNIT-II

The continuum approach classification of continuous media, body forces and surface forces. components of stress tensor, forces and moment equation of equilibrium, the stress quadric, principle stresses and principle axes, stress invariants and the stress deviator tensor, maximum shearing stress.

UNIT-III

The equation of continuity, the equations of motion, vorticity-stream surface for inviscocid flow, Bernoullis equations, irrotational flow and the velocity potential, similarity parameters and fluid flow.

Reference Books:

1.Continuum Mechanics : D Frederic and T.S.Chang
2. Continuum Mechanics (Schaum Series): Mase. G
3. Mechanics Deformable bodies : Sommer field A
4. An Introduction to Continuum Mechanics: MortoneE.gurtin
5.Mathematical Theory of ContinuumMechanics : Rabindra Nath

PAPER –O3(vi)
DISCRETE MATHEMATICS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Relations and functions: A relational model for data base, properties of binary relations, equivalence relations and partitions, partial ordering relations and lattices, chains and antichains, a job scheduling problem, functions and the pigeonhole principle.

Finite State Machines: Finite state machine, Finite state machine as model of physical system, equivalent machine, finite state machine as language recognizers, finite state language and type-3 language.

UNIT-II

Analysis of Algorithm: Time complexity of algorithm, a shortest-path algorithm, complexity of algorithm, complexity of problems, tractable and intractable problems.

Discrete Numeric Functions and Generating Functions: Manipulation of numeric functions, asymptotic behavior of numeric functions, generating functions, combinatorial problems.

Recurrence Relations and Recursive Algorithms: Recurrence relations, linear recurrence relations with constant coefficients, homogeneous solutions, particular solutions, total solutions solution by the method of generating functions, sorting algorithms.

UNIT-III

Boolean Algebra: Lattices and algebraic system, principle of duality, basic properties of algebraic systems defined by lattices, distributive and complemented lattices, Boolean lattices and Boolean algebra, uniqueness of finite Boolean algebras, propositional calculus, design and implementation of digital networks, switching circuits.

Reference Books:

(1) Discrete mathematical structures with applications to computer science : J.P. Tremblay and R. Manohar McGraw Hill Book Co.
(2) Finite Mathematics International edition : Seymour Lepschtz McGraw Hill Book Co.
(3) Elements of Discrete Mathematics : C.Liu, McGraw Hill Bock Co.
(4) Introduction to Discrete Mathematics : Hirschfelder & Hirschfelder

PAPER –O3(vii)
ASTRONOMY-I

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-1

Spherical Trigonometry: Spherical triangle, length of a small circular arc, terrestrial Latitude and Longitude, different formulae, right angled and quadrantal

triangles, polar formulae, trigonometrical ratios for small angles.

Co-ordinates: The Celestial Sphere, systems of co-ordinates, Hour angle, conversion of coordinates, geometrical celestial sphere.

UNIT – II

Diurnal motion: Units of time, sidereal time, mean solar time, Hour angle of a heavenly body, time of transit, time of rising and setting, rising of the Moon, rate of change of zenith distance and azimuth, motion of the Sun , Motion of the Moon, twilight.

Refraction: Laws of refraction, apparent and true positions, parallel plate formula, the true and the apparent positions on the celestial sphere, parallel layers, homogeneous cell, concentric layers of varying density, integration of the differential equation for refraction, refraction in right ascension and declination, refraction in the distance between neighboring stars.

UNIT-III

Planetary motion: Kepler's laws, Newton's law of gravitation, masses of the planets, perturbations of the elements, the equation of the orbit, velocity of a planet in its orbit, the true and eccentric anomalies and their relations Kepler's equation, solutions of Kepler's equation.

Time: Uniform sidereal time, Sun's apparent orbit, the mean Sun, the year, conversion of mean and sidereal units, conversion of time, equation of time.

The Indian Calendar: The tithi, The Vara, The Nakshatra, The Yoga ,The Karana, The Lagna , The month, The Year, Horoscopes, Indian National Calender.

Reference Books:

(1) Spherical Astronomy — Gorakh Prasad — Pothishala
(2) Spherical Astronomy — W.M.Smart — Cup Vikas
(3) Spherical Astronomy — Robin M.Green — Cambridge
(4) A Text Book of Spherical Trigonometry and Spherical Astronomy — Pandey and Dubey — Swastik Pub.

PAPER –O3(viii)
GENERALIZED HYPER-GEOMETRIC FUNCTIONS-I

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Generalized hypergeometric function ${}_pF_q(a,b;c;z)$, characterization, integral representation, contiguous function relations, hypergeometric differential equation and its solutions, ${}_pF_q(a,b;c;z)$ as function of its parameters, elementary series manipulations, simple transformation and summations, confluent hyper geometric functions and other properties.

UNIT-II

Convergence conditions for '${}_pF_q$' differential equation and its solution, Watson's,

Dixon's, Whipple's and Saalschütz theorems for the series ${}_3F_2$ with unit argument, fundamental theorem due to Thomae's, Ramanujan's theorem, some special generalized hypergeometric functions.

UNIT-III

Contour integral representation for ${}_pF_q$ Euler's type integrals involving ${}_pF_q$, special cases, product formulae due to Ramanujan, Preece and Bailey, Mac Roberts E-function, definition and convergence conditions, recurrence relations and integrals involving E- functions.

Reference Books:

1. Special Functions: Rainville, E.D: The Macmillan co.,
2. Generalized Hypergeometric function with Application in Statistics and physical Sciences: Mathai and Saxena, Springer Verlag,
3. Special Functions with application, Saran, Sharma and Trivedi: Pragati Prakashan,
4. The Special Function and their approximation; Yudell L Luke: Academic Press.

PAPER –O3(ix)
OPERATIONS RESEARCH

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Sequencing models: Solution of sequencing problem – processing n Jobs through 2 machines – processing n Jobs through 3 machines – Processing 2 Jobs through m machines – Processing n Jobs through m machines.

Replacement Models: Replacement of items that deteriorate whose maintenance costs increase with time without change in the money value, replacement of items that fail suddenly, individual replacement policy, group replacement policy.

UNIT-II

Game theory - Two person, zero-sum games, games with mixed strategies, graphical solution, solution by linear programming.

Deterministic Inventory control Models: Introduction, classification of inventories, advantage of carrying inventory, features of inventory system, deterministic inventory models including price breaks.

UNIT-III

Network Analysis: Shortest path problem, minimum spanning tree problem, maximum flow problem, minimum cost flow problem, network simplex method, project planning and control with PERT-CPM.

Introduction to dynamic programming problems, deterministic dynamic programming.

Reference Book :

1) Introduction to Operation Research F.S. Hiller and GJ. Lieberman McGraw Hill International edition
2) Operations Research KantiSwarup, P.K. Gupta and Man Mohan Sultan Chand & Sons, New Delhi.
3) Operations Research-An Introduction Prem Kumar Gupta and D. S. Hira S. Chand & Company Ltd., New Delhi.

PAPER –O3(x)
MATHEMATICAL MODELING IN BIOLOGY AND MEDICINE

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Modeling: Introduction, basic steps of mathematical modeling, its needs, types of models and properties, limitations, models and reality, properties of models, building a model. Graphical Methods: Using graphs in modeling, comparative statistics, biogeography, diversity of species on islands, stability questions.

Biosciences: Population dynamics, mathematical ecology and mathematical bioeconomics, mathematical epidemiology, mathematical genetics, mathematical biomechanics, optimization models in biology and medicine.

UNIT-II

Microbial Population Models: Importance of microbial kinetics, stability of steady state for Chemostate, growth of microbial populations, product formation due to microbial action.

Single Species Non-Age-Structured Population Models: Simple logistic models, logistic model with time delay effects. Stochastic models of population growth.

Age Structure Population Models: Discrete -Time Discrete-Age scale population models, Continuous-Time Discrete-Age scale population models, Continuous-Time Continuous- Age scale population models, reconciliation of the three types of age structure population models.

Two Species Population Models: A simple prey-predator model, some other prey-predator model, predator-prey models with time delay, models for competition.

UNIT-III

Epidemic Model: Deterministic model without removal, general deterministic model with removal, general deterministic model with removal and immigration, control of an epidemic, stochastic epidemic model without removal, other stochastic epidemic models.

Models for Blood Flow: Some basic concept of fluid dynamics, basic concept about blood, cardiovascular system, and blood flows, steady Non- Newtonian fluid flows in circular tubes, Newtonian pulsatile flows in rigid and elastic tubes,

blood flow through artery with mild stenosis.

Reference Books:

(1) An Introduction to Mathematical Modelling - Edward A. Bender Dover
(2) Mathematical Modelling – Reinhard Illner AMS
(3) Mathematical Modelling in Applied Sciences- A. C. Fowler Cambridge
(4) Mathematical Modelling- J.N. Kapoor Wiley Eastern

PAPER –O3(xi) DYNAMICS OF A PARTICLE

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Projectiles on plane and inclined plane, motion of a projectile in a resisting medium in which the resistance varies as the velocity, trajectories in a resisting medium where resistance varies as some integral power of the velocity. Motion of an artificial satellite.

UNIT-II

Oscillatory motion , oscillations in a resisting medium, oscillations when the forces are periodic, motion of a pendulum in a resisting medium. Varying mass problem, examples of falling raindrops and projected rockets, motion of a free chain.

UNIT-III

Motion on a revolving curve, the hodograph. Kinematics in three dimensions, equations of motion in three dimensions.

Reference Books:

(1) Dynamics of a particle S.L.Loney MacMillan
(2) Dynamics of a particle M.Ray Students Friends
(3) Analytical Dynamics S.R.Gupta
(4) Textbook of Dynamics F.Chorltan

PAPER –C4(i)
FUNCTIONAL ANALYSIS-II

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Adjoint of an operator on a Hilbert space, self-adjoint, positive, normal and unitary operators and their properties, projection on a Hilbert space, invariance, reducibility. orthogonal projections.

UNIT-II

Derivatives of a continuous map from an open subset of Banach space to a Banach space, rules of derivation, derivative of a composite, directional derivative, mean value theorem and its applications.

UNIT-III

Partial derivatives and Jacobian matrix, continuously differentiable maps, higher derivatives, Taylor's formula, inverse function theorem, implicit function theorem, step function, regulated function, primitives and integrals, differentiation under the integral sign, Riemann integral of function of real variable with values in normed linear space.

Reference Books:

(1) Introduction to Topology and Modern Analysis GG Simmons: McGrawHill
(2) Elements of Functional Analysis : L.A.Luesternik & L.J. Sobolev, Hindustan Pub.Co.
(3) Introduction to Functional Analysis :A.E. Taylor, John wiley and Sons.

PAPER –C4(ii)
LINEAR INTEGRAL EQUATIONS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Integral Equations: Definition and classification, conversion of initial and boundary value problems to an integral equation, Linear Integral equation of the first kind, Abel's problem, Linear Integral equation of the second kind, relation between linear differential equation and Volterra's integral equations, Non linear equations, singular equations, types of solutions, solution of Fredholm and Volterra integral equation of second kind by method of successive substitution and successive approximations, resolvent kernel, Volterra's solution of Fredholm's equation, discontinuous solutions.

UNIT-II

Fredholm Integral Equations: Eigen values and Eigen functions, Fredholm's first theorem, uniqueness of the solution, zeros of the function $D(\lambda)$, traces of the kernel, Hadamard theorem, convergence of the series $D(\lambda)$ and $D(x, \xi, \lambda)$, Fredholm second theorem, Fredholm's associated equation, orthogonality, Fredholm third theorem, solution of the homogeneous integral equation when

$D(\lambda) = 0$, $D'(\lambda) \neq 0$, continuous solution, fundamental solutions, integral equations with degenerate kernels.

UNIT-III

Hilbert Schmidt Theory: Symmetric kernel, orthogonal functions, orthogonality of fundamental function, real symmetric kernel, real characteristic constants, the inequalities of Schwarz and the Minkowsky, Schwarz inequality, Minkowsky inequality, symmetric kernel with a norm not equal to zero has at least one eigenvalue, properties of orthogonal system of characteristics functions, bilinear formula, normalized orthogonal system of fundamental functions, Bessel's inequality, Riesz- Fischer theorem, Schmidts solution of the non homogeneous integral equations,solution of the Fredholm integral equation of first kind, Hilbert-Schmidt theorem.

Applications of The Fredholm Theory: Deflection of string, differential equation of the motion of an elastic string, one dimensional boundary value problem, Green's function, determination of Green's function, particular cases, influence function.

Reference Books:

(1) Integral Equations: LovitteW.V, Dover
(2) Linear Integral Equations: Kanwal R.P, Academic Press.
(3) Linear Integral Equations: Shanti Swarup KPM

PAPER –O4(i)
NUMERICAL ANALYSIS-II

Duration: 3 Hrs **.Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Curve fitting and Function Approximation: Least square error criterion, linear regression, polynomial fitting and other curve fitting, approximation of functions by Taylor series and Chebyshev polynomials.

UNIT-II

Numerical solution of ordinary differential equations: Taylor Series method, Euler's and modified Euler's methods, Runge-Kutta method up-to fourth order. **Multistep method (Predictor -corrector strategies):** Stability analysis-single and multistep methods.

UNIT-III

Difference methods for BVPs; Ordinary differential equations boundary value problems, (BVP's) shooting methods, finite difference method, difference scheme for non-linear boundary value problems of type $y'' = f(x,y)$, $y'' = f(x,y,y')$ and $y^{iv} = f(x,y)$.

Reference Books:

(1) Numerical Analysis: Jain,Iyenger and Jain
(2) Numerical Solution of Differential equations: M.K.Jain
(3) Numerical Analysis F.B.Hildebrand TMH

(4) An Introduction to Numerical Analysis Atkinson,K.E. John Wiley & Sons

PAPER –O4(ii)
MATHEMATICAL STATISTICS-II

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Elementary sampling theory: Distribution of means of sampling from Binomial, Cauchy, rectangular and normal distribution, distribution of second order moments in sampling from normal population, test of significance of difference between two means and two standard deviations tot large samples with modification for small samples and taken from normal population.

UNIT-II

Exact distribution of X^2, t, z and F, statistics in samples from a normal population, their simple properties and applications.

UNIT-III

Analysis of variance: Simple cases (one criteria and two criteria of classification), elementary statistical theory of estimation, Fisher's criteria for the best estimator, consistent, efficient and sufficient estimator, method of maximum likelihood estimators and other methods of estimation, method of least square.

Reference Books:

1. Mathematical Theory of Statistics: Kapur and Saxena
2. A first course in Mathematical Statistics: Weaitherbum
3. The Advanced Theory of Statistics: MG Kendall
4. Introduction of Mathematical Probability: Uspensky

PAPER –O4(iii)
COSMOLOGY

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) contains 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Introduction: The hydro-dynamical approximation, the cosmological principal,

the Robertson-Walker metric, Newtonian gravitation and cosmology, a comparison between Newtonian and Relativistic cosmology.

General relativity and relativistic cosmology: Basic equations of isotopic relativistic cosmology, the cosmological term and the static universe models, energy-momentum tensor and bulk viscosity, the singularity of isotropic models, the time behavior of isotropic models, the age of the universe, paths of particles and light rays and horizons, the red shift, relation involving H, z and the deceleration parameter q.

UNIT-II

Static cosmological models: The three possibilities for a homogeneous static universe, Einstein line element, the geometry of the Einstein universe, density and pressure of material in the Einstein universe, behavior of test particles and light rays in the Einstein universe comparison of Einstein model with actual universe.

The de-Sitter line element, the geometry of the de-Sitter universe, absence of matter and radiation from the de-Sitter universe, behavior of test practical and light rays in the de- Sitter universe, (a) geodesic equations (b) orbit of particles (c) light rays (d) Doppler effect. Comparison of de-Sitter model with actual universe

UNIT-III

Non-Static Homogeneous Cosmological Models: Reasons for changing static to non- static models, assumptions employed in deriving non-static line element, derivation of line element from assumptions of spatial isotropy, general properties of the line element (a) different forms of expression for the line element (b) geometry (c) transfer of origin of co- ordinates (d) physical interpretation of line element. Density and pressure in non-static universe, change in energy and matter with time, behavior of particle's and light rays in the model. Doppler effect, change in Doppler effect with distance.

Books Recommended:

1. Relativity, Thermodynamics' & Cosmology, R.C. Tolman : Oxford
2. Introduction to Cosmology: J.V. Narlikar: Cambridge
3. Theoretical Cosmology: A.K. Raychaudhuri : Oxford.
4. Theory of Relativity: S.R.Roy and Raj Bali : J.P.H.

PAPER –O4(iv)
FLUID DYNAMICS

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Irrotational Motion: General motion of a fluid element, motion of a fluid element (Cartesian Coordinates method), vorticity , body forces, surface forces , stress analysis at a point, strain analysis,flow and circulation , Stake's theorem , Kelvin's

circulation theorem , connectivity , cyclic constants , irrotational motion in multiply connected space, acyclic and cyclic motion , Green's theorem , Kelvin's minimum energy theorem .

Motion in Two Dimensions: Motion in two-dimensions, stream function , physical interpretation of stream function , complex potential and complex velocity , uniform flows, two dimensional source and sink ,complex potential of a source , two dimensional doublet , complex potential of a doublet , images in two-dimensions ,image of a source with regard to a plane ,image of a doublet with regard to a plane ,Circle theorem , image of a source with regard to a circle , linage of a doublet with regard to a circle , Conformal representation, application to fluid dynamics.

UNIT-II

Vortex Motion: Vorticity vector, vortex line, vortex tube, properties of vortex, strength of the vortex, rectilinear vorticity, velocity components, centre of vorticity, vortex pair, vortex doublet, vortex inside an infinite circular cylinder, image of a vortex filament in a plane, four vortices, Ka'rma'n vortex street, Kirchhoff vortex theorem, vortex sheets.

Irrotation Motion in three dimensions: Buttler's sphere Theorem, solution of the Laplace equation in three dimension, Motion of a sphere in an infinite mass of liquid at rest at infinity, ideal fluid flow round a sphere, concentric spheres, equation on motion of a sphere, three dimensional sources and sink, three dimensional doublet, Stroke's stream function, solid of revolution moving along their axes in an infinite mass of liquid.

UNIT-III

Viscous Fluid Flow: State of stress at a point, symmetry of stress tensor, stress in a fluid at rest, stress in a fluid in motion, transformation of stress component, stress quadric, orthogonality of principal stresses, transformation of the rates of strain, relation between stress and rate of strain, Navier-Stoke's equation of motion, limitation of Navier-Stoke's equation, equation of energy, dissipation of energy, vorticity and circulation in viscous fluid, the equation of state.

Dimensional Analysis: Relation between a set of variables, the ? theorem, similitude.

Exact Solutions: Laminar flow between parallel plates, Hagen-Poiseuille flow through a circular pipe, laminar flow between concentric rotating cylinders, study motion of a viscous fluid due to a slowly rotating sphere, flow in convergent and divergent channels.

Reference Books:

(1) Fluid Dynamics : Shanti Swarup KPM
(2) A Treatise on Hydromechanics : Basant,W.H.,Ramsey,A.S. Ulan Press
(3) Fluid Dynamics : Batchelor Cambridge
(4) Fluid Dynamics : M.D.Raisinghania S.Chand & Co.

PAPER –O4(v)
CONTINUUM MECHANICS-II

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Lagrangian and Eulerian description of deformation of flow, the comoving derivative, velocity and acceleration, the continuity equation, strain tensors, the linear rotation tensor and rotation vector, analysis of rotation displacement, geometrical meaning of the components of the linear strain tensor, principal axis theory for the linear strain tensor, properties of linear strain tensors.

UNIT-II

The linear cubical dilatation, compatibility equations for the linear strain components, the rate of strain tensors and the velocity tensor, the rate of rotation vector and the vorticity. properties of the rate of strain tensor, rate of cubical dilatation, Law of conservation of mass and of motion, kinetic equation of state, the first and the second law of thermodynamics and the dissipation function.

UNIT-III

Applications: Linear elasticity assumption and basic equations, generalized Hooke's Law for an isotropic homogeneous solid, compatibility equations. classification of types of problems in linear elasticity, the principle of superposition, the strain energy function, the uniqueness theorem, P-? relationship and the work kinetic energy equation, irrotational flow and the velocity potential, kinetic equation of state and the first law of thermo- dynamics.

Reference Books:

(1). Continuum Mechanics : D Frederic and T.S.Chang
(2). Continumm Mechanics (Schaum Series) : Mase. GE
(3). Mechanics Deformable bodies : Sommer field A
(4). An Introduction to Continuum Mechanics : MortoneE.gurtin
(5). Mathematical Theory of Continuum Mechanics : RabindraNathChatteijee

PAPER –O4(vi)
GRAPH THEORY

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Graph theory: Definition of undirected graph, paths, circuits, cycles and sub graphs, induced sub graphs, degree of vertex, connectivity, planner graphs and their properties.

UNIT-II

Trees: Euler's formula for connected planner graphs, complete and complete bipartite graphs, Kuratowski's theorem (statement only) and its use, spanning trees, cut sets, fundamental cut sets and cycles, minimal spanning trees and Krushal's algorithm..

UNIT-III

Matrix representation of graphs: Eulers theorem on the existence of Eulerian path and circuits, directed graphs, in degree and out degree of vertex, weighted undirected graphs, Dijkstra'algorithm strong connectivity and Warshall's algorithm, directed trees, search trees, tree traversals.

Reference Books:

(1) Graph theory with application to N.Deo Prentice Hall of India.
Engineering and computer science:
(2) Introduction to Graph Theory : West Douglas B PHI; 2nd edition (2002)
(3) Graph Theory : Ronald Gould Dover
(4) Graduate Text in Mathematics : J.A.Bondey &Murty Springer
(5) Introductory Graph Theory : Gary Chartrand

PAPER –O4(vii)
ASTRONOMY-II

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Planetary Phenomena: Retrograde Motion, the geocentric motion of a planet, elongation, elongation of a planet when stationary, phases, the brightness of the planets.

Precession and Nutation: Discovery, physical cause of precession and nutation, precession in right ascension and declination, nutation in right ascension and declination, independent day numbers.

UNIT-II

Aberration: aberration varies as the sine of the earth's way, the apex of the earth motion, aberration in longitude and latitude, the aberrational ellipse, aberration in right ascension and declination, the determination of the constant of aberration, diurnal aberration, diurnal aberration in hour angle and declination, independent day numbers.

Parallax: The shape of the earth, the angle of the vertical, geocentric parallax in zenith distance, the distance of the moon, the moon's size, lunar parallax in right ascension and declination, lunar parallax in azimuth, the parallax of the Sun, stellar parallax, parallax in longitude and latitude, parallactic ellipse, stellar parallax in right ascension and declination, measurement of stellar distances.

UNIT-III

Eclipses: Eclipses of the moon, the size of the shadow at the moon, ecliptic limits, calculation of the circumstances of a lunar eclipse, point on the moon where the eclipse commences, eclipses of the sun, commencement of a solar eclipse, solar ecliptic limits, greatest and least number of eclipses in a year.

Proper Motions of Stars: Proper motions, proper in right ascension and declination, the motion of the sun, the parallactic motion in right ascension and

declination, radial velocity, sun's velocity from the radial velocities.
Binaries: Kowalsky's method of determining the true orbit.
Reference Books:

(1) Spherical Astronomy	Gorakh Prasad	Pothishala
(2) Spherical Astronomy	W.M.Smart	Cup Vikas
(3) Spherical Astronomy	Robin M.Green	Cambridge
(4) A Text Book of Spherical Trigonometry and Spherical Astronomy	Pandey and Dubey	Swastik Pub.

PAPER –O4(viii)
GENERALIZED HYPER-GEOMETRIC FUNCTIONS-II

Duration: 3 Hrs. Max.Marks: 100

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Meijer's G~Function: Definition, Nature and convergence conditions for the contours, special cases, Identities, Transformation formulas,

UNIT-II

Differentiation formulas, recurrence relations, Contigues functions, relations. Simple finite and infinite integrals involving G-function

UNIT-III

Differential equation for G function, series for G function, Asymptotic expantion of G function, Mellin and Laplace transforms of G-function.

Reference Books:

1. Special Functions: Rainville, E.D: The Macmillan co.
2. Generalized Hypergeometric function with Application in Statistics and physical Sciences: Mathai and Saxena, Springer Verlag,
3. Special Functions with application, Saran, Sharma and Trivedi: Pragati Prakashan,
4. The Special Function and their approximation: Yudell L Luke: Academic Press.
5. The H-functions of One and Two Variables with applications: Srivastava, H.M. Gupta, K.C. and Goyal S.P.; South Asian Publication, New Delhi

PAPER –O4(ix)
MATHEMATICAL PROGRAMMING

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts:

Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Linear programming: Simplex method, theory of the simplex method, duality, Transportation and Assignment Problems.

UNIT-II

Revised Simplex method, sensitivity analysis in linear programming, integer programming models, integer programming models with binary variables, the Branch-and-Bound method for solving integer programming problems.

UNIT-III

Nonlinear Programming: One and multi variable unconstrained optimization, Kuhn- Tucker conditions for constrained optimization, quadratic programming, separable
programming, convex programming, non-convex programming.

Reference Books:

(1) Mathematical Programming Techniques : N.S. Kambo, Affiliated East-West Press
(2) Nonlinear and Dynamic Programming : G Hadley, Addison-Wesley
(3) Operations Research : S.D.Sharma KNRN
(4) Non Linear Programming : O.L.Mangasrian McGraw Hill
(5) Non Linear and Dynamic Programming: Hedley

PAPER –O4(x) PRACTICAL

Duration: 3 Hrs. **Max.Marks: 100**

Note: The distribution of marks is as under-

(A) Computational Mathematics Laboratory A (Two practicals of 20 marks each)	Marks 40
(B) Computational Mathematics Laboratory B (Two practicals of 20 marks each)	Marks 40
(C) Practical Record	Marks 10
(D) Viva Voce	Marks 10

Computational Mathematics Laboratory A.

Introduction to popular software for numerical computation and optimization. Knowledge of numerical algorithms for linear and non-linear algebraic equations, finite difference methods, interpolation, differentiation, integration, ODEs. Based on the knowledge of above topics and using software like Mathematica, MATLAB, MathCAD, etc.

Following practicals are to be done in the computer laboratory.

- Plotting of functions.
- Solution of linear and non-linear equations.
- Data analysis and curve fitting.
- Numerical integration.
- ODEs.

Computational Mathematics Laboratory B

Numerical algorithms for Eigen value problems. Laplace and Fourier transforms. Linear, integer, and non-linear optimization problems. Necessary theoretical background of above subjects, and using the following software: Mathematica, MATLAB, MathCAD, LINDO, etc,

Following practicals are to be done in the computer laboratory.

- Matrix operations and Eigen value problems.
- Laplace and Fourier transforms.

- Two and three dimensional graphics.
- Linear, integer, and quadratic programming

Reference Books:

(1) Math*CAD* Premium, User's Manual
(2) *MATLAB*-High Performance Numeric Computation and Visualization Software: User's Guide
(3) Mathematics, Wolfram, SCambridge

PAPER –O4(xi)
DYNAMICS OF RIGID BODIES

Duration: 3 Hrs. **Max.Marks: 100**

Note: The paper is divided into three units. The question paper is divided into three parts: Part-A, Part-B and Part-C (total 100 Marks).

Part-A (30Marks)is compulsory and contains 10 questions (50 words each).At least three questions will be set from each unit. Each question carries 3 marks.

Part-B (25 Marks) 9 questions (100 words each) will be set taking 3 from each unit and the Candidate is required to attempt 5 questions taking at least one question from each unit but not more than 2 from any unit. Each question carries 5 marks.

Part-C (45 Marks) contains 6 questions, taking two from each unit. Candidate is required to attempt three question selecting one from each unit. Each question carries 15 marks (400 words).

UNIT-I

Moment and products of inertia: Moment of inertia of a body with respect to a given line, product of inertia in simple cases, theorem of parallel axes, theorem of six constants of a body, momental ellipsoid, momental ellipse, principal axes.

D'Alembert's principle: The general equations of motion of a rigid body. Motion of centre of inertia and motion relative to centre of inertia.

UNIT–II

Motion about a fixed axis: Moment of momentum of a body about the fixed axis, kinetic energy, motion of the effective forces about the axis, equation of motion, motion under torque, the compound pendulum, Centre of suspension, centre of oscillation, centre of percussion.

Motion of a rigid body in two dimensions under finite forces: Dynamical equation of motions, moment of momentum or angular momentum, Dynamical equation, conservation of momentum (linear and angular), kinetic energy, equation of Vis Viva.

UNIT-III

Conservation of momentum and energy: Principle of conservation of linear momentum, Principle of conservation of angular momentum, when impulsive forces act, sudden fixtures, principle of conservation of energy, conservative forces.

Lagrange's equations of motion: Generalized co-ordinates, degree of freedom, Lagrange's function, principle of energy, small oscillation.

Hamilton's equations: Hamilton's equations of motion, Hamilton's principle and principle of least action.

Reference Books:

(1) Dynamics of a Rigid Body : M.Ray Students Friends & Co.
(2) Dynamics of a Particle & of Rigid Body : S.L.Loney The Macmillan & Co.
(3) Dynamics of a Particle & of Rigid Body : Anil Rao Cambridge
(4) Dynamics of Rigid Bodies : William Duncan Mac Millan
(5) Classical Dynamics : Jorge V. Jose Cambridge

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