M. D. S. UNIVERSITY, AJMER
M. Sc. (MATHEMATICS)
SYLLABUS

SEMESTER SCHEME 2015-16 AND 2016-17

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 (**30**Marks)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).

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	Teaching 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**	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 (**30**Marks)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

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

M.A / M.Sc.(Semester-I)
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 (**30**Marks)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

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

M.A / M.Sc. (Semester-I)
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 (**30**Marks)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

M.A / M.Sc. (Semester-I)
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 (**30**Marks)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

M.A / M.Sc. (Semester-I)
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 (**30**Marks)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

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 rakashan

3.Special Functions: R. Askey and R. Roy, Cambridge

4.Special Functions & Their Applications: N. N. Lebdev,Prentice Hall, Englewood 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 (**30**Marks)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

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

M.A / M.Sc. (Semester-II)
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 (**30**Marks)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.KJain&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

M.A / M.Sc. (Semester-II)
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 (**30**Marks)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 (ft^1): 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.

M.A / M.Sc. (Semester-II)
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 (**30**Marks)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 Weirerstrass 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

M.A / M.Sc. (Semester-II)
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 (**30**Marks)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

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 interal 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	