PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

SEMESTER - I

Real Analysis

L	T	P
4	1	0

MODULE CODE	MATH5101
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To achieve knowledge and understanding of sets, their various properties and capabilities to solve wide range of problems in science and engineering.
2. To get familiar with concepts of cardinal numbers and develop ability to solve simple and complex problems.
3. To understand Rings and their applications in mathematical sciences.
4. To learn basic concepts of Differentiations and Integrations.
5. To acquire knowledge of Convergence series.

LEARNING OUTCOMES:

1. Able to work comfortably with sets.
2. Exposure to cardinal numbers and their compatibilities.
3. Enhance the knowledge regarding Ring theory and its application.
4. Able to understand Differentiations and Integrations and their applications.
5. Ability to acquire knowledge of Convergence series.

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

MODULE CONTENT:

UNIT-I: Sets

Peano axioms, natural numbers, properties of natural numbers, natural numbers as a well-ordered set. finite sets and their properties, infinite sets, set of integers, rational numbers from the set of integers, set of rationals as an incomplete ordered field.

UNIT-II: Cardinal Numbers.

Countable and uncountable sets, examples, cardinal numbers and its arithmetic, interpretation of α^{β}, proof of Schroeder-Bernstein theorem, proof of $N_0 < c < f$, symbols having their usual meanings, Cantor's theorem and continuum hypothesis, Zorn's lemma, axiom of choice and well ordering principle and their equivalence.

UNIT-III: Monotone Class

Rings and σ-rings of subsets of a set, algebra and σ-algebra, rings and, σ-rings generated by sets, Borel subsets of R, monotone class, Lemma on monotone classes, semialgebra of sets.

UNIT-IV Convergence of Series

Absolute and conditional convergence of series, Riemann's rearrangement of series, Abel's and Dirichlet's test for product of series, double sequences and double series and their convergences, sum by rows, columns, squares, triangles and rectangles, absolute convergence of double series.

Unit –V Differentiations

Discontinuities of a monotonic function, function of bounded variation, total variation and its properties, relation of a function of bounded variation or monotone functions, continuous functions of bounded variation.

UNIT-VI: Integration

Function defined by integrable function, its continuity and bounded variationness, its differentiability, absolute continuity, equivalence of indefinite integral and absolute continuity.

RECOMMENDED BOOKS

TEXT BOOKS	1. Principles of Mathematical Analysis: Walter Rudin Mc Graw Hill, Singapopre. 2. Mathematical Analysis: Tom M Apostol Narosa book distributors pvt Ltd, India 3. Measure and integration: S K Berberian Chelsea publishing company, New York. .
REFERENCES	1. Real analysis: H L Royden: The Macmillan Company, New york. 2. The Real numbers & Real analysis: Ethan D Bloach Springer, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30

3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x			x	x	

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Algebra

L	T	P
4	1	0

MODULE CODE	MATH5102
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To achieve knowledge and understanding of finite abelian groups, their various properties and capabilities to solve wide range of problems in science and technology.
2. To get familiar with concepts of solvable groups and develop ability to solve simple and complex problems.
3. To understand Euclidean domains and their applications in mathematical sciences.
4. To learn basic concepts of Unique factorization domain and field Extensions.
5. To acquire knowledge of galois theory.

LEARNING OUTCOMES:

1. Able to work comfortably with finite abelian groups.
2. Exposure to solvable groups and their compatibilities.
3. Enhance the knowledge regarding Euclidean domains and its application.
4. Able to understand Unique factorization domain and field extensions.
5. Ability to acquire knowledge of Galois theory.

MODULE CONTENT:

UNIT-I: Finite Abelian Groups Direct products, finite abelian groups, its fundamental theorem, group actions.
UNIT-II: Solvable groups. Solvable groups, normal series, Jordan-Holder theorem, nilpotent groups.
UNIT-III: Eucledian domains Greatest common divisor, units in a commutative ring, principle ideal domains, Euclidean domains, prime and irreducible elements, polynomial rings. .
UNIT-IV Unique factorization domain Definition and examples of unique factorization domain, equivalent conditions, primitive polynomials, Gauss lemma, ireducible polynomials, Eisenstein's criterion for- irreducibility, Noetherian rings, Artinian rings.

Unit –V Field extensions Prime subfields, simple roots, separable polynomials, irreducible polynomial, separable extension, perfect field, normal extension and normal closure of a field, algebrically closed fields and algebric closure, product of fields.
UNIT-VI: Galois theory Automorphisms of field extensions, Dedekind and Artin's theorems, simple extensions, primitive element, Galois theory, roots of unity, Galois fields, solution of polynomial equations by radicals.

RECOMMENDED BOOKS

TEXT BOOKS	1. Topics in algebra: I N Herstein John Wiley and Sons, New York. 2. Linear algebra: Kenneth Hoffman, Ray Kunze Pearson education inc, India. 3. Linear algebra and its applications: David C Lay Pearson education, India. .
REFERENCES	1. Linear algebra: Stephen H Friedberg, Arnold J Insel, Lawrence E Spence Prentice- Hall of India pvt ltd, New Delhi.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2, 5	3,4	1,2, 4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x		x	x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

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PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

Fluid Mechanics

L	T	P
4	1	0

MODULE CODE	MATH5103
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of motion of fluid, their various properties and capabilities to solve wide range of problems in science and technology.
2. To get familiar with types of fluid motion and their applications in Physical sciences.
3. To learn vortex motion and their applications in Science & Technology.
4. To know basic concepts of wave motions and their application in Scientific problems.
5. To acquire knowledge of viscus fluid.

LEARNING OUTCOMES:

6. Able to work cozily with motion of fluids.
7. Exposure to various types of fluid motions and their compatibilities.
8. Enhance the knowledge regarding vortex motion and its application.
9. Able to understand concepts of wave motion.
10. Ability to acquire knowledge of viscus fluid.

MODULE CONTENT:

UNIT-I: Motion of Fluid

Lagrangian and Eulerian methods of description, governing equations of fluid motion, stream line; velocity potential, path line, velocity and circulation; equations of continuity in Lagrangian and Eulerian methods.

UNIT-II: Types of Motion.

Equivalence of the two forms of equations of continuity, boundary surface, acceleration, Euler's equations of motion, integrals of Euler's equations of motion, Lagrange's equations of motion, Cauchy's integrals, equation of energy.

UNIT-III: Motions in two dimensions

Motion in two dimensions, stream function, complex potential, source, sink and Doublet, image, images in two dimensions, images of a source with regard to a plane, a circle and a sphere, image of a doublet, circle theorem; theorem of Blasius.

UNIT-IV Vortex motion

Vortex motion, Helmholtz properties of vortices, velocity in a vortex field, motion of a circular vortex, infinite rows of vortices, Ka'rma'n vortex street.

Unit –V Viscus fluid

Viscous fluid, stokes-navier equations, diffusion of vorticity, dissipation of energy, steady motion of a viscous fluid between two parallel planes, steady flow through cylindrical pipes, Reynolds' number.

UNIT-VI: Wave motion

Waves motion in a gas, speed of sound; equation of motion of a gas; subsonic, sonic and supersonic flows of a gas, isentropic gas flow, flow through a nozzle, shock formation, elementary analysis of normal and oblique shock waves.

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RECOMMENDED BOOKS

TEXT BOOKS	1. An introduction to fluid dynamics, G K Batchelor Cambride University Press, London. 2. Fluid and particle dynamics, James L Tilton Mcgraw Hill, New York. 3. Fluid dynamics for physicists, T E Fabler Cambridge University press, London. .
REFERENCES	1. Text book of fluid dynamics, F Chorlton, Van Nostrand Reinhold Co., London.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,5	2, 5	3,4	1, 3,4	2,3	3,4	2,3	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment		x	x	x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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Topology

L	T	P
4	1	0

MODULE CODE	MATH5104
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C.

OBJECTIVES:

1. To obtain knowledge of topological spaces and their various properties.
2. To get familiar with continuity of functions and their applications in Physical sciences.

3. To learn connectedness and its various properties.
4. To know basic concepts of compactness and their application in Scientific problems.
5. To acquire knowledge of covering axioms.

LEARNING OUTCOMES:

1. Able to work easily with topological spaces.
2. Exposure to continuity and their compatibilities.
3. Increase the knowledge regarding connectedness and its application.
4. Able to understand concepts of compactness.
5. Ability to acquire knowledge of covering axioms.

MODULE CONTENT:

UNIT-I: Topological spaces Topological spaces, basis and subbasis, order topology, subspace topology, product topology on X× Y, neighbourhood and interior points, closed sets and limit points, Kuratowski closure axioms.
UNIT-II: Continuity. Continuous functions, equivalent conditions, open and closed maps, Homeomorphisms, pasting lemma, projection mappings, product topology on $\pi_\infty x_\infty$, embedding, Quotient spaces and quotient topology.
UNIT-III: connectedness Separation of a topological space, connected spaces, union, intersection and product of connected spaces, components, local connectedness, path-connectedness.
UNIT-IV Separation T_0, T_1 and Hausdorff (T_2) spaces, regular spaces, normal spaces, Urysohn's characterization of normality, Tietze's characterization of normality, covering characterization of normality, completely regular spaces.

Unit –V Compactness Compactness, sequences and nets, finite intersection property, various characterization of compactness, compactness and separability, relative compactness, countable compactness, local compactness, Pseudocompact, Tychnoff's theorem.
UNIT-VI: Covering axioms The countability axioms, first and second countable spaces, separable and Lindeloff spaces, covering of spaces, paracompact spaces, its properties. .

RECOMMENDED BOOKS

TEXT BOOKS	1. Topology, a first course: J R Munkres Prentice-Hall of India Ltd., New Delhi. 2. General Topology: J L Kelley Springer Verlag, New York. 3. An introduction to general Topology*:* K D Joshi Wiley Eastern Ltd., New Delhi. .
REFERENCES	1. General Topology: J Dugundji Universal book stall, New Delhi. 2. Foundations of general Topology: W J Pervin Academic press, New York. 3. General Topology: S Willard Addison-Wesley publishing company, Massachusetts, U, S, A.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	2,5	2, 5	3,4	1,2,3	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

SEMESTER - II

Functional Analysis

L	T	P
4	1	0

MODULE CODE	MATH5105
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To achieve knowledge and understanding of Banach spaces, their various properties and capabilities to solve wide range of problems in mathematical sciences.
2. To get familiar with concepts of embedded of a normed linear spaces.
3. To understand L^p spaces and their applications in mathematical sciences.
4. To learn basic concepts of Hilbert space.
5. To acquire knowledge of orthogonal sets and operators.

LEARNING OUTCOMES:

1. Able to work comfortably with Banach spaces.
2. Exposure embedded of a normed linear spaces and their compatibilities.
3. Enhance the knowledge regarding L^p spaces and its application.
4. Able to understand Hilbert space and its applications.
5. Ability to acquire knowledge of orthogonal sets and operators.

MODULE CONTENT:

UNIT-I: General Banach spaces General Banach spaces – definition and examples, continuous linear transformations between normed linear spaces, Hahn-Banach theorem and its consequences.
UNIT-II: Embedded of a normed linear space. Embedding of a normed linear space in its second conjugate space, strong and weak topologies, open mapping theorem, closed graph theorem; uniform boundedness theorem, conjugate of an operator.
UNIT-III: L^p Spaces L^p spaces, Holder's inequality, Minkowski's inequality, convergence and completeness, Riesz-Fischer theorem, bounded linear functional on L^p spaces, Riesz representation theorem.
UNIT-IV Hilbert space Hilbert's space, examples and simple properties, orthogonal complements, orthonormal set, Bessel's inequalities.
Unit –V Orthogonal sets Complete orthonormal sets, gram-schmidt orthogonalization process, Self adjoint operators.
UNIT-VI: Operators Normal and unitary operators, projections, spectrum of an operator, spectral theorem for a normal operator on a finite dimensional Hilbert space.

RECOMMENDED BOOKS

TEXT BOOKS	1. Real Analysis*:* H L Royden Macmillan publishing co. inc, New York. 2. Introduction to Topology and Modern analysis*:* G F Simmons Tata McGraw -Hill Ltd., India. 3. Functional analysis: W Rudin Tata McGraw Hill book company, India. .
REFERENCES	1. Functional Analysis: B V Limaye Willy Eastern Ltd., New delhi. 2. First course in functional analysis: C Goffman, G Pedrick Prentice-Hall of India pvt. Ltd, New Delhi.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

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Differential Geometry

L	T	P
4	1	0

MODULE CODE	MATH5106
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To achieve knowledge and understanding of curves in space, their various properties and capabilities to solve wide range of problems in science and technology.

2. To get familiar with concepts of frenet formulas and develop ability to solve simple and complex problems.
3. To understand surfaces and their applications in mathematical sciences.
4. To learn basic concepts of curvature.
5. To acquire knowledge of tensors.

LEARNING OUTCOMES:

1. Able to work comfortably with curves in space.
2. Exposure to frenet formulas and their compatibilities.
3. Enhance the knowledge regarding surfaces and its application.
4. Able to understand curvature.
5. Ability to acquire knowledge of tensors.

MODULE CONTENT:

UNIT-I: curves in space Parametric representation of curves, Helix, curvilinear coordinates in e_3. tangent and first curvature vector.
UNIT-II: Frenet formulas. Frenet formulas for curves in space, Frenet formulas for curve in e_n. intrinsic differentiation, parallel vector fields, geodesic.
UNIT-III: Surfaces Parametric representation of a surface, tangent and normal vector field on a surface, the first and second fundamental tensor, geodesic curvature of a surface curve, the third fundamental form, Gaussian curvature.
UNIT-IV Curvature Isometry of surfaces, developable surfaces, Weingarten formula, equation of Gauss and Codazzi, principal curvature, normal curvature, Meusnier's theorem.
Unit –V Tensors Tensor and their transformation laws, tensor algebra, contraction, quotient law, reciprocal tensors, Kronecker delta, symmetric and skew- symmetric tensors.

UNIT-Vi Types of Tensors Metric tensor, Riemannian space, Christoffel symbols and their transformation laws covariant differentiation of a tensor, Riemannian curvature tensor and its properties, Bianchi identities, Ricci-tensor, scalar curvature, Einstein space.

RECOMMENDED BOOKS

TEXT BOOKS	1. Applied differential geometry: Vladimir G Ivancevic, Tijana T Ivancevic World scientific, London. 2. Differential geometry: R W Sharpe Springer, New York. 3. A course in differential geometry, Thierry Aubin American mathematical society, U.S.A. .
REFERENCES	1. Differential geometry: Jesus A Alvarez Lopez, Eduardo Garcia Rio, World scientific, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30

3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x			x	x	

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

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- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Complex Analysis

L	T	P
4	1	0

MODULE CODE	MATH5107
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

OBJECTIVES:

1. To obtain knowledge of power series, their various properties and capabilities to solve wide range of problems in science and technology.
2. To get familiar with primitive and their applications in Physical sciences.
3. To learn Cauchy's theorem and their applications in Science & Technology.
4. To know basic concepts of residues and their application in Scientific problems.
5. To acquire knowledge of conformal maps and transformation.

LEARNING OUTCOMES:

1. Able to work cozily with power series.
2. Exposure to primitive and their compatibilities.
3. Enhance the knowledge regarding Cauchy's theorem and its application.
4. Able to understand concepts of residues.
5. Ability to acquire knowledge of conformal maps and transformation.

MODULE CONTENT:

UNIT-I: Power series Analytic functions, Cauchy-Riemann equations, Harmonic functions, brief survey of formal power series, radius of convergence of power series, circle of convergence, exponential, cosine and sine, logarithm functions introduced as power series, their elementary properties.
UNIT-II: Primitive Integration of complex-valued functions and differential 1-forms along a piecewise differentiable path, primitive, local primitive and primitive along a path of a differential 1-form, homotopic paths, simply connected domains, index of a closed path, holomorphic functions, Cauchy's theorem and its consequences.
UNIT-III: Cauchy's theorem Cauchy's integral formula, Taylor's expansion of holomorphic functions, Cauchy's estimate, Liouville's theorem, fundamental theorem of algebra, zeros of an analytic function and related results, maximum modulus theorem; Schwarz' lemma.

UNIT-IV Residues Laurents's expansion of a holomorphic function in an annulus, singularities of a function, removable singularities, poles and essential singularities; extended plane and stereographic projection, residues, calculus of residues; evaluation of definite integrals; argument principle, Rouche's theorem.
Unit –V Conformal maps Complex form of equations of straight lines, half planes, circles, etc., analytic (holomorphic) function as mappings; conformal maps.
UNIT-VI: Transformation Mobius transformation, cross ratio; symmetry and orientation principle, examples of images of regions under elementary analytic function. .

RECOMMENDED BOOKS

TEXT BOOKS	1. Functions of one complex variable: J B Conway Narosa publishing house, New Delhi. 2. Elementary theory of analytic functions of one or several complex variables: H Cartan Courier dover publications, New york. 3. Complex analysis*:* L V Ahlfors, McGraw-Hill, Singapore.
REFERENCES	1. An introduction to the theory of functions of a complex variable: E T Copson, Oxford university press, London. 2. An introduction to complex analysis: A R Shastri Macmillan India Ltd.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2, 4	2,3	3,4	2, 5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and

- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Symbolic Computing and Numerical Analysis

L	T	P
4	1	0

MODULE CODE	MATH5108
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of mathematica and its application in symbolic computing.
2. To get familiar with Matlab and its applications in Sciences and Engineering.
3. To learn non linear equations and its various properties.
4. To know basic concepts of interpolation and their application in Scientific problems.
5. To acquire knowledge of ordinary differential equations.

LEARNING OUTCOMES:

1. Able to work easily with mathematica software.
2. Exposure to matlab and its compatibilities.
3. Increase the knowledge regarding non linear equations and its application.
4. Able to understand concepts of interpolation.
5. Ability to acquire knowledge of ordinary differential equations.

MODULE CONTENT:

UNIT-I: Introduction to Mathematica

Introduction to mathematica, programming in mathematica, numeric calculation using mathematica, symbolic computing with mathematica.

UNIT-II: Programming in Matlab Programming in matlab, Built-in functions, application to linear algebra, curve fitting and interpolation.
UNIT-III: Non Linear equations Solution of transcendental and algebraic equations: Bisection, secant, Regula Falsi, Fixed-point, Newton-Raphson, Graffe's methods.
UNIT-IV Interpolation Difference schemes, interpolation formulas using differences, Lagrange and Newton interpolation, Hermite interpolation, divided differences.
Unit –V Numerical Differentiation and Integration Numerical differentiation: methods based on interpolations. methods based on finite differences. Numerical integration: Trapezoidal, Simpson's, and Weddle's rules, Gauss quadrature formulas.
UNIT-VI: Ordinary Differential Equations Ordinary differential equations: Euler's method, Single-step methods, Runge-Kutta's method, Multi-step methods. .

RECOMMENDED BOOKS

TEXT BOOKS	1. Applied numerical methods using Matlab: Won Young Yang, Tae-Sang Chung, JohnMorris John Wiley and Sons, New Jersey, U, S.A 2. A guide to Matlab: Brian R Hunt, Ronald L Lipsman, Jonathan M Rosenberg Cambridge University Press, London. Mathematica: Paul R Wellin, Wolfram Research inc, U.S.A..

REFERENCES	1. Practical Matlab applications for engineers: Misza Kalechman CRC Press, London. 2. Numerical methods for scientific and engineering computation: M K Jain, S R K Iyenger, R K Jain New Age International (p) Ltd., New Delhi.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3	2,3	3,4	3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

SEMESTER - III

Measure Theory

L	T	P
4	1	0

MODULE CODE	MATH6101
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To achieve knowledge and understanding of signed measure, their various properties and capabilities to solve wide range of problems in mathematical sciences.
2. To get familiar with concepts of Lebesgue Stieljes integral.
3. To understand double integration and their applications in sciece and technology.
4. To learn basic concepts of compact spaces.
5. To acquire knowledge of continuous functions.

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LEARNING OUTCOMES:

1. Able to work comfortably with signed measure.
2. Able to recognise the concept of Lebesgue Stieljes integral.
3. Enhance the knowledge regarding double integration and its application.
4. Able to understand compact spaces and its applications.
5. Ability to acquire knowledge of continuous functions.

MODULE CONTENT:

UNIT-I: Signed measure Measures and measure spaces, signed measure, Hahn Decomposition theorem, mutually singular measures, Radon-Nikodym theorem.
UNIT-II: Lebesgue Stieljes integral Lebesgue decomposition theorem, Riesz representation theorem, extension theorem (Caratheodory), Lebesgue Stieljes integral.
UNIT-III: Double Integration Product measure, Fubini's theorem, differentiation and integration.
UNIT-IV Compact spaces Measure on locally compact spaces, Borel sets, Baire sets, Baire Sandwich theorem, Borel and Baire measure.
Unit –V Regularity of measures Regularity of measures, regular Borel extension of a Baire measure, completion.
UNIT-VI: Continuous functions Continuous functions with compact support, integration of continuous functions with compact support, Riesz-Markoff theorem.

RECOMMENDED BOOKS

TEXT BOOKS	1. Real Analysis: H L Royde Mcmillian publ. Co, New York. 2. Real and Complex analysis: Walter Rudin Tata McGraw Hill publ. co. Ltd., New Delhi. 3. Measure theory and integration: G De Barra Wiley Eastern Ltd, India. .
REFERENCES	1. Lebesgue measure and integration: P K Jain, V P Gupta New Age Int. (p) Ltd., New Delhi.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

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MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x			x	x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Optimization Theory

L	T	P
4	1	0

MODULE CODE	MATH6102
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To achieve knowledge of convex sets and convex functions, their various properties and capabilities to solve wide range of problems in science and technology.
2. To get familiar with concepts of Line search and develop ability to solve simple and complex problems.

3. To understand constrained optimization and their applications in mathematical sciences.
4. To learn basic concepts of dynamic programming.
5. To acquire knowledge of quadratic programming.

LEARNING OUTCOMES:

1. Able to work comfortably with convex sets and convex functions.
2. Exposure to line search and their compatibilities.
3. Enhance the knowledge regarding constrained optimization and its application.
4. Able to understand dynamic programming.
5. Ability to acquire knowledge of quadratic programming.

MODULE CONTENT:

UNIT-I: Convex sets and Convex functions Convex sets, convex functions, separation and support of of convex sets, optimality conditionsfor unconstrained case, structure of optimization methods.
UNIT-II: Line search Introduction, convergence theory for exact line search, section Method-Golden section method, Fibonacci method, interpolation Method-Quadratic interpolation method, cubic interpolationj method, inexact line search Technique-Armijo and Goldstein rule, Wolfe-Powel rule.
UNIT-III: Theory of constrained optimization Constrained optimization problems, first-order optimality conditions, second-order optimality conditions, duality.
UNIT-IV Dynamic programming Introduction, multistage decision processes and examples, representation of a multistage decision process, conversion of a nonserial system to a serial system, types of multistage decision problems, concept of suboptimization and principle of optimality.

Unit –V Quadratic programming Optimality for quadratic programming, duality for quadratic programming, equality constrained quadratic programming, active set methods, dual method, interior ellipsoid method, primal-dual interior-point method.
UNIT-Vi Optimal control and optimality criterio method Necessary conditions for optimal control, necessary conditions for a general problem, optimal criterio with a single displacement constraint, optimal criterio with a multiple displacement constraint, reciprocal approximations.

RECOMMENDED BOOKS

TEXT BOOKS	1. Nonlinear programming analysis & methods: Mordecal avriel Dover publication, inc., Englewood Mineola, New York. 2. Introduction to optimization: E M L Beale John Wiley & Sons, New York. 3. Optimal control theory: D E Kirk Dover publication, New York. .
REFERENCES	1. Introduction to optimal control theory: J Macki, A Strauss Springer Verlag, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2, 5	3,4	1,2,3	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x	x			x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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Module Theory

L	T	P
4	1	0

MODULE CODE	MATH6103
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of ring and ideals, their various properties and capabilities to solve wide range of problems in science and technology.
2. To get familiar with modules and their applications in Physical sciences.
3. To learn tensor products and their applications in Science & Technology.
4. To know basic concepts of condition on ring and their application in Scientific problems.
5. To acquire knowledge of fractional ideals.

LEARNING OUTCOMES:

1. Able to work easily with ring and ideals.
2. Exposure to modules and their compatibilities.
3. Enhance the knowledge regarding tensor products and its application.
4. Able to understand concepts of condition on ring.
5. Ability to acquire knowledge of fractional ideals.

MODULE CONTENT:

UNIT-I: Ring and Ideals

Brief review of rings and ideals, Nilradical and Jacobson radicals, extension and contraction.

UNIT-II: Modules Basic theory of modules, submodules and quotient modules, module homomorphisms, annihilators, torsion submodules, irreducible modules.
UNIT-III: Properties of Modules Schur's lemma, direct sum and product of modules, free modules, localization, Nakayama's lemma.
UNIT-IV Tensor products Exact sequences, short and split exact sequences, projective modules, injective modules, Baer's criterion for injective modules, tensor product of modules, universal property of tensor product, exactness property of tensor products.
Unit –V Conditions on Ring Flat modules, chain conditions on rings, Noetherian rings, Hilbert basis theorem, Artinian rings, discrete valuation rings.
UNIT-VI: Fractional ideals Dedekind domains, fractional ideals, ideal class groups.

RECOMMENDED BOOKS

TEXT BOOKS	1. Introduction to commutative algebra: M F Atiyah, I G Macdonald Addison Wesley, New York. 2. Abstract Algebra: D S Dummit, R M Foote John Wiley & Sons, inc., New york. 3. Module and Rings: John Dauns Cambridge university press, London.

REFERENCES	1. Abstract Algebra: P A Grillet Springer, New York. 2. Algebra: T W Hungerford Springer, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;

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Combinatorial Mathematics

L	T	P
4	1	0

MODULE CODE	MATH6104
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of subsets and its application in scientific problems.
2. To get familiar with inclusion and exclusion.
3. To learn counting and its various properties.
4. To know basic concepts of triple system and their application in Scientific problems.
5. To acquire knowledge of pigeonhole principle.

LEARNING OUTCOMES:

1. Able to work easily with subsets.
2. Exposure to inclusion and exclusion and its compatibilities.
3. Increase the knowledge regarding counting and its application.
4. Able to understand concepts of triple system.
5. Ability to acquire knowledge of pigeonhole principle.

MODULE CONTENT:

UNIT-I: Subsets General principles of enumeration, counting of sub-sets, partitions, bionomial theorem.
UNIT-II: Inclusion and Exclusion Multinomial theorem. principles of inclusion and exclusion, derangements, rook polynomials, arrangement with forbidden positions.
UNIT-III: Counting General principles of enumeration, counting. latin square, quasi-group, orthogonal latin square.
UNIT-IV Triple system Steiner triple systems, packing and covering, Ramsey's theorem.
Unit –V Pigeonhole principle Pigeonhole principle, bounds for Ramsey number, design, Fisher's inequality, linear code, error correcting code, hamming code.
UNIT-VI: Generating function Generating function, recurrence relations, solutions of recurrence relations by generating functions method. .

RECOMMENDED BOOKS

TEXT BOOKS	1. Combinatorics – topics, techniques, algorithms: Peter J Cameron Cambridge University press, London. 2. A course in combinatorics: J H Lint, R M Wilson Cambridge University Press, London.

REFERENCES	1. Discrete mathematics for computer scientists & mathematicians: Joe L Mott, Abraham Kandel, Theodore P Baker Prentice Hall of India.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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SEMESTER - IV

Theory of Operators

L	T	P
4	1	0

MODULE CODE	MATH6105
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge and understanding of bounded linear operators, their various properties and capabilities to solve wide range of problems in mathematical sciences.
2. To get familiar with concepts of numerical range.
3. To understand compact linear operators and their applications in sciece and technology.
4. To learn basic concepts of alternative theorem.
5. To acquire knowledge of self adjoint and normal operators.

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LEARNING OUTCOMES:

1. Able to work comfortably with bounded linear operator.
2. Able to recognise the concept of numerical range.
3. Enhance the knowledge regarding compact linear operators and its application.
4. Able to understand alternative theorem and its applications.
5. Ability to acquire knowledge of self adjoint and normal operators.

MODULE CONTENT:

UNIT-I: Bounded linear operators Resolvent set, spectrum, point spectrum, continuous spectrum, residual spectrum, approximate point spectrum, spectral radius, spectral properties of a bounded linear operator, spectral mapping theorem for polynomials.
UNIT-II: Numerical range Numerical range, numerical radius, convexity of numerical range, closure of numerical range contains the spectrum, relation between the numerical radius and norm of abounded linear operator.
UNIT-III: Compact linear operators Spectral properties of compact linear operators on a normed linear space, operator equations involving compact linear operators.
UNIT-IV Alternative theorem Fredholm alternative theorem, Fredholm alternative for integral equations, specrtral theorem for compact normal operators.
Unit –V Self adjoint operators Spectral properties of bounded self adjoint linear operators on a complex Hilbert space, positive operators, square root of a positive operator, projection operators. Spectral family of a bounded selfadjoint linear operator and its properties, spectral theorem for a bounded selfadjoint linear operator.

UNIT-VI: Normal operators Spectral properties for bounded normal operators, spectral theorem for bounded normal operators.

RECOMMENDED BOOKS

TEXT BOOKS	1. Introductory functional analysis with applications: Erwin Kreyszig, John Wiley and Sons, New York. 2. Functional analysis: G Bachman, L Narici, Dover publications, New York. 3. Linear operators: N Dunford, J T Schwarts John Wiley and Sons, New York. .
REFERENCES	1. Introduction to Hilbert space and the theory of spectral multiplicity: P R Halmos Chelsea publishing co., New York

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

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MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x			x	x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
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Probability Theory

L	T	P
4	1	0

MODULE CODE	MATH6106
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To attain knowledge of random variables, their various properties and capabilities to solve wide range of problems in science and technology.

2. To get familiar with concepts of parameters of distribution and develop ability to solve simple and complex problems.
3. To understand Characteristic functions and their applications in mathematical sciences.
4. To learn basic concepts of probability distribution.
5. To acquire knowledge of limit theorems.

LEARNING OUTCOMES:

1. Able to work comfortably with random variables.
2. Exposure to parameters of distribution and their compatibilities.
3. Enhance the knowledge regarding characteristic functions and its application.
4. Able to understand probability distribution.
5. Ability to acquire knowledge of limit theorem.

MODULE CONTENT:

UNIT-I: Random events and random variables Random events, probability axioms, combinatorial formulae, conditional probability, Bayes theorem, independent events, random variables, distribution function, joint distribution, marginal distribution, conditional distribution, independent random variables, functions of random variables.
UNIT-II: Parameters of the distribution Expectation- moments, the Chebyshev inequality, absolute moments, order parameters, moments of random vectors, regression of the first and second types.
UNIT-III: Characteristic functions Properties of characteristic functions, characteristic functions and moments, semi-invariants, characteristic function of the sum of the independent random variables, determination of distribution function by the characteristic function, characteristic function of multidimensional random vectors, probability generating functions.
UNIT-IV Some probability distribution One point, two point, binomial, hypergeometric, poisson (discrete) distributions, uniform, normal gamma, beta, Cauchy and Laplace (continuous) distributions.

Unit –V Limit theorems Stochastic convergence, Bernoulli law of large numbers, convergence of sequence of distribution functions, Levy-Cramer theorems, De Moivre, Laplace theorem, poisson, Chebyshev, Khintchine weak law of large numbers.
UNIT-Vi Lindberg therem Lindberg theorem, Lyapunov theroem, Borel-Cantelli lemma, Kolmogorov inequality and Kolmogorov strong law of large numbers.

RECOMMENDED BOOKS

TEXT BOOKS	1. Probability theory and mathematical statistics: M Fisz John Wiley and Sons, New York. 2. Modern probability theory: B R Bhat New Age international (p)ltd, New Delhi. .
REFERENCES	1. Real analysis and probability: R B Ash Academic press, New York. 2. A course in probability: K L Chung Academic press, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x		x	x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Fuzzy Sets and Fuzzy Logic

L	T	P
4	1	0

MODULE CODE	MATH6201
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C.

OBJECTIVES:

1. To obtain knowledge of Fuzzy sets, their various properties and capabilities to solve wide range of problems in science and technology.
2. To get familiar with operations on Fuzzy sets and their applications in Physical sciences.
3. To learn Fuzzy arithmatic and their applications in Science & Technology.
4. To know basic concepts of Fuzzy relations and their application in Scientific problems.
5. To acquire knowledge of Fuzzy logic.

LEARNING OUTCOMES:

1. Able to work easily with Fuzzy sets.
2. Exposure to operations on Fuzzy sets and their compatibilities.
3. Enhance the knowledge regarding Fuzzy arithmatic and its application.
4. Able to understand concepts of Fuzzy relations.
5. Ability to acquire knowledge of Fuzzy logic.

MODULE CONTENT:

UNIT-I: Introduction to Fuzzy sets From classical (crisp) sets to fuzzy sets, introduction of crisp sets, an overview, basic concepts in fuzzy sets, convex fuzzy sets.
UNIT-II Operations on Fuzzy sets Fuzzy sets versus crisp sets, additional properties of α – cuts, representation of fuzzy sets, decomposition theorems, operations on fuzzy sets, types of operations, fuzzy complement (axioms and theorems).
UNIT-III: Fuzzy intersections t- norms, fuzzy unions, t – co norms, combinations of operations, aggregation of operations.

UNIT-IV Fuzzy arithmatic Fuzzy numbers, linguistic variables, arithmetic operations on intervals of real numbers, arithmetic operations on fuzzy numbers.
Unit –V Fuzzy relations Introduction, fuzzy relations, operations on fuzzy relations; **α** - cuts of a fuzzy relation, composition of fuzzy relations, fuzzy relation on a domain.
UNIT-VI: Fuzzy logic Introduction; three valued logics, infinite valued logic, fuzzy proposition and their interpretations in terms of fuzzy sets, fuzzy rules and their interpretations in terms of fuzzy relations. .

RECOMMENDED BOOKS

TEXT BOOKS	1. Fuzzy sets and systems: Didier Dubois, Henri Prade Academic press, inc., London. 2. Fuzzy sets and fuzzy logic: George J Klir, Bo Yuan Prentice hall, New York. 3. Fuzzy sets and their applications: Lotfi A Zadeh, King Sun Fu, Kokichi Tanaka, Masamichi Simura Academic press, inc, New York.
REFERENCES	1. Fuzzy set theory: H J Zimmermann Kluwer Academic Publishers, The Netherlands.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

Outcomes											

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

Computational Methods of Partial Differential Equations

L	T	P
4	1	0

MODULE CODE	MATH6202
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C.

OBJECTIVES:

1. To obtain knowledge of partial differential equations and its application in scientific problems.
2. To get familiar with elliptic differential equations.
3. To learn parabolic differential equations and its various properties.
4. To know basic concepts of hyperbolic differential equations and their application in Scientific problems.
5. To acquire knowledge of wave equations and its application in Engineering and Tecnology.

LEARNING OUTCOMES:

1. Able to work easily with partial differential equations.
2. Exposure to elliptical differential equations and its compatibilities.
3. Increase the knowledge regarding parabolic differential equations and its application.
4. Able to understand concepts of hyperbolic differential equations.
5. Ability to acquire knowledge of wave equation.

MODULE CONTENT:

UNIT-I: Partial differential equations of first order

Formation and solution of partial differential equation, integral surfaces, Cauchy problem, order equation, orthogonal surfaces, first order non-linear, characteristics, compatible system, Charpits method.

UNIT-II: Fundamentals Classification of second order partial differential equation, canonical forms, adjoint operators, Riemans method.
UNIT-III: Elliptical differential equations Derivation of Laplace and Poisson equation, BVP, separation of variables, Dirichlet's problem and Newmann problem for a rectangle, solution of Laplace equation in cylindrical and spherical coordinates, examples.
UNIT-IV Parabolic differential equations Formation and solution of diffusion equation, Dirac-delta function, separation of variables method, solution of diffusion equation in cylindrical and spherical coordinates, examples.
Unit –V Hyperbolic differential equations Formation and solution of one-dimensional wave equation, canocical reduction, ivp-D'alembert's solution, IVP and BVP for two-dimensional wave equation.
UNIT-VI: Wave equation Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems systems, uniqueness of the solution for the wave equation, Duhamel's principle, examples.

RECOMMENDED BOOKS

TEXT BOOKS	1. Introduction to partial differential equations: K Sankar Rao Prentice Hall of india, New Delhi. 2. Partial differential equations: R C Mcowen Pearson eduction, New Delhi.
REFERENCES	1. Elements of partial differential equations: I N. Sneddon McGraw Hill, Singapore.

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
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PDM UNIVERSITY
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Dynamical Oceanography

L	T	P
4	1	0

MODULE CODE	MATH6203
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of sea water, their various properties and capabilities to solve wide range of problems in oceanography.
2. To get familiar with concepts of fluid at rest and develop ability to solve simple and complex problems.
3. To understand about moving fluid and their applications in science and technology.
4. To learn basic concepts of gravity waves in a rotating fluid.
5. To acquire knowledge of forced motion.

LEARNING OUTCOMES:

1. Able to work comfortably with sea water.
2. Exposure to fluid at rest and their compatibilities.
3. Enhance the knowledge regarding moving fluid and its application.
4. Able to understand gravity waves in rotating fluid.
5. Ability to acquire knowledge of forced motion.

MODULE CONTENT:

UNIT-I: Properties of sea water

The equation of state. quantities related to density, expansion co0efficient, specific heat, potential temperature, speed of sound, freezing point of sea water, heat balance of the ocean, surface density changes and the thermo-haling circulation of the ocean.

UNIT-II: Properties of fluid at rest

Equation of state, Thermodynamic variables, balance of forces in a fluid at rest, static stability.

UNIT-III: Equations satisfied by moving fluids

Mass conservation equation, balance for a scalar quantity like salinity, internal energy (or heat) equation, the equation of motion, mechanical energy equation, total energy equation, Bernoulli's equation, adjustment under gravity in a non-rotating system, adjustment to equilibrium, perturbation from the rest state for a homogenous inviscid fluid, surface gravity waves , dispersion, short-wave and long-wave approximations, shallow water equations derived using the hydrostatic approximation,energetics of shallow water motion.

UNIT-IV Adjustment under gravity of a density stratified fluid

Introduction. the case of two superposed fluids of different density, Baroclinic mode and rigid lid approximation, adjustments within a continuously stratified incompressible fluid, internal gravity waves, dispersion, energy of internal waves, internal waves generated at a horizontal boundary, free waves in the presence of boundaries, waves of large horizontal scale, resolution into normal modes for the ocean.

Unit –V Gravity waves in a rotating fluid

Effects of rotation on surface gravity wave, vertically propagating internal gravity wave in a rotating fluid, energetic, internal wave spectrum in the ocean.

UNIT-Vi Forced motion

Forced motion due to surface stress, Ekman transport, Ekman pumping, laminal Ekman layer, tide producing forces, barotropic motion in the sea, forced shallow water equation.

RECOMMENDED BOOKS

TEXT BOOKS	1. Dynamics of the upper ocean: O M Philips Cambridge University press, London. 2. Geophysical fluid dynamics: J Pedlosky Springer, New York. 3. Descriptive physical oceanography: G P Pickand Oxford Pergaman press, London. .
REFERENCES	1. Atmospheric ocean dynamics: A E Gill Academic press, New Delhi.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

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MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Plasma Mechanics

L	T	P
4	1	0

MODULE CODE	MATH6204
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C.

OBJECTIVES:

1. To obtain knowledge of plasma, their various properties and capabilities to solve wide range of problems in science and technology.

2. To get familiar with kinetic theory and their applications in Physical sciences.
3. To learn derivations and their applications in Science & Technology.
4. To know basic concepts of frozen in effect and their application in Scientific problems.
5. To acquire knowledge of orbit theory.

LEARNING OUTCOMES:

1. Able to work easily with plasma.
2. Exposure to kinetic theory and their compatibilities.
3. Enhance the knowledge regarding derivations and its application.
4. Able to understand concepts of frozen in effect.
5. Ability to acquire knowledge of orbit theory.

MODULE CONTENT:

UNIT-I: Defination of Plasama Definition of plasma as an ionized gas, Saha's equation of ionization, occurrence of plasma in nature, plasma as mixture of different species of charged particles.
UNIT-II Elements of kinetic theory Elements of kinetic theory (statistical approach), single particle phase space, volume elements distribution function, characterization of plasma with respect to the nature of the distribution function, homogeneous, inhomogeneous, isotropic, anisotropic.
UNIT-III: Derivations Derivation of Boltzmann equation, average values and macroscopic variables, derivation of macroscopic equations (moment equations), equation of continuity, equation of motion, equation of energy, assumption on the nature of the distribution function to form a closed and consistent system of macroscopic equations (equation of state), cold plasma limit, the equilibrium state, Maxwellian distribution, Debye shielding, the plasma parameter and the criteria for plasma formation.
UNIT-IV Plasama-single fluid approach Approximation for MHD, basic equations for MHD, conservation of mass, conservation of momentum, conservation of energy, conservation of magnetic flux.

Unit –V Frozen-in-effect Frozen-in-effect, Alfven theorem, generalized Ohm's law, MHD equilibrium, the theta pinch, the Z – pinch, axisymmetric toroidal equilibria, linear stability, the energy principle of ideal MHD, the Rayleigh – Taylor instability.
UNIT-VI: First order orbit theory First order orbit theory (single particle motion): uniform **E** and **B** fields, larmor orbits and guiding centers, the magnetic moment and the magnetization current, non-uniform **B** field, non-uniform **E** field, time varying **e** field, time varying **B.** .

RECOMMENDED BOOKS

TEXT BOOKS	1. Plasma physics and controlled fusion: F F Chen, Plenum press, New York. 2. Fundamental of plasma physics: J A Bittencourt Pergamon press, London.
REFERENCES	1. Theory of plasma waves: T H Stix McGraw Hill, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test		x	x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Approximation theory

L	T	P
4	1	0

MODULE CODE	MATH6205
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

PDM UNIVERSITY
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INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of linear operators and its application in scientific problems.
2. To get familiar with approximation theorems.
3. To learn about existence of polynomials and its various properties.
4. To know basic concepts of application of convexity and their application in Scientific problems.
5. To acquire knowledge of interpolation and its application in Engineering and Tecnology.

LEARNING OUTCOMES:

1. Able to work easily with linear operators.
2. Exposure to approximation theorems and its compatibilities.
3. Increase the knowledge regarding existence of polynomials and its application.
4. Able to understand concepts of convexity.
5. Ability to acquire knowledge of interpolation.

MODULE CONTENT:

UNIT-I: Linear operators Linear operators, examples, Bernstein polynomials, Fourier series.
UNIT-II: Approximation theorems Approximation theorems, Bohman and Korvokin's theorems and its applications, theorem of Stone.
UNIT-III: Existence of polynomials Existence of polynomials of best approximation, characteristics of polynomials of best approximation.

UNIT-IV Applications of convexity Applications of convexity, Chebyshev system, uniqueness of polynomial of best approximation.
Unit –V Interpolation Chebyshev theorem, Chebyshev polynomial, interpolation.
UNIT-VI: Polynomials Algebraic polynomials, trigonometric polynomials.

RECOMMENDED BOOKS

TEXT BOOKS	**1.** Approximation of functions: G G Lorentz, Holt Tinehart Winston, inc, New York. .
REFERENCES	**1.** Fundamentals of approximation theory: N Hrushikesh, M Haskar, D V Pai Narosa publishing house, New Delhi. **2.** Approximation of functions theory and numerical methods: G Meinnardus Springer Verlag, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

Banach Algebra

L	T	P
4	1	0

MODULE CODE	MATH6206
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	40
SUMMATIVE ASSESMENT MARKS	60
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

PDM UNIVERSITY
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INSTRUCTIONS: In total EIGHT questions will be set. Question ONE will be compulsory from Section-A and will cover all units. Remaining seven questions are to be set taking three questions from Section-B and four question from Section-C

OBJECTIVES:

1. To obtain knowledge of Banach algebra, their various properties and capabilities to solve wide range of problems in oceanography.
2. To get familiar with transforms and develop ability to solve simple and complex problems.
3. To understand C* algebras and their applications in science and technology.
4. To learn basic concepts of homomorphisms.
5. To acquire knowledge of operator topologies and functional calculus.

LEARNING OUTCOMES:

1. Able to work comfortably with Banach algebras.
2. Exposure to transforms and their compatibilities.
3. Enhance the knowledge regarding C* algebra and its application.
4. Able to understand homomorphisms.
5. Ability to acquire knowledge of operator topologies and functional calculus.

MODULE CONTENT:

UNIT-I: Defination of Banach algebra Definition of banach algebra and examples, singular and non-singular elements, the abstract index, the spectrum of an element, the spectral radius.
UNIT-II: Transforms Gelfand formula, multiplicative lilnear, functionals & the maximal ideal space, Gleason-Kahane-Zelazko theorem, the Gelfand transforms. the spectral mapping theorem, isometric Gelfand transform. maximal ideal spaces for disc algebra.
UNIT-III: C Algebras* C*-algebras-definition and examples, self adjoint, unitary, normal positive and projection elements in C* algebras, commutative C*-algebras.

UNIT-IV C Homomorphisms* C*- homomorphisms, representation of commutative C*-algebra sub algebras and the; spectrum, the spectral theorem, the continuous functional calculus, positive linear functional and states in C*- algebras, the GNS construction.
Unit –V Operator topologies Strong and weak operator topologies, Von Neumann algebras, monotone sequence of operators, range projections, the commutant theorem, the Kaplansky density theorem L as Von Neumann maximal abelian algebras, cyclic and separating vectors.
UNIT-Vi Functional calculus Representation of abelian Von Neumann algebras, the L functional calculus, connectedness of the unitary group, the projection lattice, Kaplansky's formula, the centre of a Von Neumann algebras, various types of. projections centrally orthogonal projections, type decomposition.

RECOMMENDED BOOKS

TEXT BOOKS	1. An introduction to operator algebras: Kehe Zhu CRC press, London. 2. Introduction to C*algebras: W Arveson Springer-Verlag, New york. .
REFERENCES	1. A groupoid approach to C* algebras: Jean Renault Springer, New York.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2,5	2, 5	3,4	1,2,3,4	2,3	3,4	2,3,5	1,3	4,5	1,2	1,3

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 100 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	End Semester Exam	1	60

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x		x	
Quiz			x		x	x
Assignment	x	x		x		

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
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PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

Project

L	T	P
0	0	15

MODULE CODE	MATH6107
CREDIT POINTS	7.5
FORMATIVE ASSESMENT MARKS	80
SUMMATIVE ASSESMENT MARKS	120
END SEMESTER PRESENTATION	0.5 hrs
LAST REVISION DATE	

1. Topic of the project would be decided by the Supervisor himself. However, it would be among one of the thrust areas out lined by the Department of Science and Technology (DST) and related to the industry.

2. The supervisor, after the extensive survey and in collaboration with industry (if possible) shall state the problem for the M. Sc. Dissertation.

3. M. Sc. Student shall devote his time for solving this problem (which ultimately may be published as research work.)

4. Project title and/or problem would be such that it can be extended at Ph. D level (if the student whishes to pursue his Ph. D.)

5. Finally, the project report would be submitted in the form of M. Sc. Dissertation.