PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

SEMESTER - I

Calculus

L	T	P
4	0	0

MODULE CODE	MATH1101
CREDIT POINTS	6
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 Applying rules of limits to calculate limits.
2. To get familiar with concepts of differentiation and Solve problems involving rates of change of variables subject to a functional relationship.
3. To understand critical points, and use them to locate maxima and minima.
4. To learn basic concepts of Differentiations and Integrations.
5. To acquire knowledge of Vector calculus.

LEARNING OUTCOMES:

1. Able to work comfortably with limits.
2. Exposure to conics and their formation.
3. Enhance the knowledge regarding vector calculus.
4. Able to understand Differentiations and Integrations and their applications.
5. Ability to acquire knowledge reduction formulaes.

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

MODULE CONTENT:

UNIT-I Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{(ax+b)}$sinx, $e^{(ax+b)}$cosx, $(ax+b)^n$ sinx, $(ax+b)^n$cosx, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.
UNIT-II Reduction formulae, derivations and illustrations of reduction formulae of the type *sin nx dx, cosnx dx, tan nxdx, sec nx dx, log x dx*, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.
UNIT-III Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.
UNIT-IV Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

RECOMMENDED BOOKS

TEXT BOOKS	1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005. 2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
REFERENCES	1. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002. 2. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

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	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.

Calculus Practical

L	T	P
0	0	4

MODULE CODE	MATH1102
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	15
SUMMATIVE ASSESMENT MARKS	35
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

List of Practicals (using any software)

(i) Plotting of graphs of function e^{ax} + b, log (ax + b), 1/ (ax + b), sin (ax + b), cos (ax + b), |ax + b| and to illustrate the effect of a and b on the graph.

(ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(iii) Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).

(iv) Obtaining surface of revolution of curves.

(v) Tracing of conics in cartesian coordinates/ polar coordinates.

(vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.

(vii) Matrix operation (addition, multiplication, inverse, transpose).

RECOMMENDED BOOKS

TEXT BOOKS	1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005. 2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.

REFERENCES	1. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002. 2. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type of Assessment	Per Semester	Maximum Mark
1.	Mid Semester Exam	1	15
2.	End Semester Exam	1	35

Algebra

L	T	P
4	2	0

MODULE CODE	MATH1103
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 complex numbers.
2. To get familiar with concepts of functions and their types.
3. To understand linear dependence and linear independent concept.
4. To learn basic concepts of Matrix and linear transformation
5. To acquire knowledge of eigen values and eigen vectors.

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

LEARNING OUTCOMES:

1. Able to work comfortably with functions and equivalence relations.
2. Exposure to sets and well ordering principle.
3. Enhance the knowledge regarding characterization of matrices.
4. Able to understand subspace of Rn.
5. Ability to acquire knowledge regarding eigen values and eigen vectors.

MODULE CONTENT:

UNIT-I Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications.
UNIT-II Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.
UNIT-III Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax=b$, solution sets of linear systems, applications of linear systems, linear independence.
UNIT-IV Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of Rn, dimension of subspaces of Rn and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

RECOMMENDED BOOKS

TEXT BOOKS	1. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

REFERENCES	1. TituAndreescu and DorinAndrica, Complex Numbers from A to Z, Birkhauser, 2006. 2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

SEMESTER - II

Real Analysis

L	T	P
4	2	0

MODULE CODE	MATH1104
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 countable and uncountable sets.
2. To get familiar with concepts of bounded and unbounded sets.
3. To understand series and their convergence.
4. To learn basic concepts of sequence, subsequence and Bolzano Weierstrass theorem for sequences.
5. To acquire knowledge of Cauchy's Convergence Criterion.

LEARNING OUTCOMES:

1. Able to work comfortably with sets.
2. Exposure to series and convergence.
3. Enhance the knowledge regarding sequences and types.
4. Able to understand the concept of convergence of series.
5. Ability to acquire knowledge of Archimedean property.

MODULE CONTENT:

UNIT-I

Review of Algebraic and Order Properties of R, neighbourhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima,

UNIT-II The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano Weierstrass theorem for sets.
UNIT-III Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.
UNIT-IV Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

RECOMMENDED BOOKS

TEXT BOOKS	1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002. 2. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
REFERENCES	1. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001. 2. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

Differential Equations

L	T	P
4	0	0

MODULE CODE	MATH1105
CREDIT POINTS	6
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 ordinary differential equation, and partial differential equation and their various properties to solve wide range of problems in science and engineering.
2. To use differential equations in coordinate geometry.
3. To obtain the solution of the applications differential equation in a variety of real worldproblems such as growth and decay problems.
4. To relate a general life situation to a mathematical model
5. To understand the concept of phase-plane and its analysis
6. Able to understand the concept of compartmental model.

LEARNING OUTCOMES:

1. Able to work comfortably with differential equations.
2. Exposure to various mathematical models and their analysis.
3. Able to find the Solution by Method of Undetermined Coefficients and variation of parameters.
4. Ability to acquire knowledge of equilibrium points and phase plane.

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

MODULE CONTENT:

UNIT-I: Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.
UNIT-II: Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.
UNIT-III: General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.
UNIT-IV: Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

RECOMMENDED BOOKS

TEXT BOOKS	1. Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab: Belinda Barnes and Glenn R. Fulford, Taylor and Francis group, London and New York. 2. Differential Equations and Boundary Value problems Computing and Modeling: C.H. Edwards and D.E. Penny, Pearson Education India. 3. Differential Equations: S.L. Ross, John Wiley and Sons, India.

REFERENCES	1. Differential Equations with MATHEMATICA: Martha L Abell, James P Braselton, Elsevier Academic Press. 2. Ordinary Differential Equations: Vladimir Arnold, Springer-Verlag

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.

Differential equations Practical

L	T	P
0	0	4

MODULE CODE	MATH1106
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	15
SUMMATIVE ASSESMENT MARKS	35
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

List of Practicals (using any software)

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
9. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
10. Battle model (basic battle model, jungle warfare, long range weapons).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy's root test by plotting nth roots.

16. Ratio test by plotting the ratio of nth and (n+1) th term.

RECOMMENDED BOOKS

TEXT BOOKS	4. Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab: Belinda Barnes and Glenn R. Fulford, Taylor and Francis group, London and New York. 5. Differential Equations and Boundary Value Problems Computing and Modeling: C.H. Edwards and D.E. Penny, Pearson Education India. 6. Differential Equations: S.L. Ross, John Wiley and Sons, India.
REFERENCES	3. Differential Equations with MATHEMATICA: Martha L Abell, James P Braselton, Elsevier Academic Press. 4. Ordinary Differential Equations: Vladimir Arnold, Springer-Verlag

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type of Assessment	Per Semester	Maximum Mark
1.	Mid Semester Exam	1	15
2.	End Semester Exam	1	35

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

SEMESTER - III

Theory of Real Functions

L	T	P
4	2	0

MODULE CODE	MATH2101
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 limits, their various properties and capabilities to solve wide range of problems in science and engineering.
2. To get familiar with concepts of continuity and differentiability and develop ability to solve simple and complex problems.
3. To understand Mean value theorem and their applications in mathematical sciences.
4. To learn basic concepts of relative extremas.
5. To acquire knowledge of Taylor's series and Maclaurin's series expansions of some important functions.

LEARNING OUTCOMES:

1. Able to work comfortably with limits.
2. Exposure to continuity and differentiability and their important results.
3. Enhance the knowledge regarding Rolle's, Mean value and Intermidate value theorem and its application.
4. Able to understand the concepts of relative extremas.
5. Ability to acquire knowledge of Taylor's series and Maclaurin's series.

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

MODULE CONTENT:

UNIT-I: Limits of functions (approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity.
UNIT-II: Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.
UNIT-III: Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.
UNIT-IV: Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/ax+b$ and $(1 +x)^{n.}$

RECOMMENDED BOOKS

TEXT BOOKS	1. Introduction to Real Analysis: R. Bartle and D.R. Sherbert, John Wiley and Sons. 2. Introduction to Analysis: A. Mattuck, Prentice Hall. 3. A Course in Calculus and Real Analysis: S.R. Ghorpade and B.V. Limaye, Springer.

REFERENCES	1. Real analysis: H L Royden: The Macmillan Company, New york. 2. Elementary Analysis: K.A. Ross, The Theory of Calculus, Springer.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Group Theory-I

L	T	P
4	2	0

MODULE CODE	MATH2102
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 assess properties implied by the definitions of groups.
2. Toanalyze and demonstrate examples of subgroups, normal subgroups and quotient groups.
3. To use the concepts of isomorphism and homomorphism for groups.
4. To produce rigorous proofs of propositions arising in the context of abstract algebra.
5. To relate a general life situation to a mathematical model
6. To understand the concept of external direct product of finite number of groups.
7. Able to understand the concept of group theory.

LEARNING OUTCOMES:

1. Able to work comfortably with groups.
2. Exposure to various mathematical problems and their analysis.
3. Able to study groups in details and to introduce the concepts of rings.
4. Ability to acquire knowledge of cyclic groups.

MODULE CONTENT:

UNIT-I: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.
UNIT-II: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups. Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations
UNIT-III: Alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem. External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.
UNIT-IV: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

RECOMMENDED BOOKS

TEXT BOOKS	1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. 3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
REFERENCES	1. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995. 2. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning	1,2	2, 5	3,4	1,2,3	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

PDE and Systems of ODE

L	T	P
4	0	0

MODULE CODE	MATH2103
CREDIT POINTS	6
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 the construction and Geometrical Interpretation of partial differential equationsand their various properties to solve wide range of problems in science and engineering.
2. To understand various partialdifferential equations encountered in physical applications in which thedomain of interest is finite.
3. To acquire knowledge to solve various initial boundary problems which arises inmany practical problems.
4. To understand Heat, Wave and Laplace equations and their applications in mathematical sciences.
5. To acquire knowledge of the method of successive approximations.

LEARNING OUTCOMES:

1. Able to work comfortably with partial differential equations.
2. Exposure to the general solution of quasi linear and non-linear.
3. Enhance the knowledge regarding the initial boundary value problems.
4. Able to understand Heat, Wave and Laplace equations and their applications.
5. Ability to acquire knowledge of the method of successive approximations.

MODULE CONTENT:

UNIT-I Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. FirstOrder Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.
UNIT-II Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.
UNIT-III The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end, Equations with non-homogeneous boundary conditions, NonHomogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem, Solving the Heat Conduction Problem Systems of linear differential equations.
UNIT-IV Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method.

RECOMMENDED BOOKS

TEXT BOOKS	1. Linear Partial Differential Equations for Scientists and Engineers: TynMyint-U and LokenathDebnath, Springer, India 2. Differential equations: S.L. Ross, John Wiley and Sons, India. 3. Elements of Partial Differential Equations:Sneddon, I.N., McGraw-Hill, New York. 4. Differential equations with MATHEMATICA: Martha L Abell, James P Braselton, Elsevier Academic Press, 2004.

REFERENCES	1. Differential Equations and Boundary Value Problems Computing and Modeling: C.H. Edwards and D.E. Penny, Pearson Education India. 2. Partial Differential Equations Methodsand Applications: Robert C. McOwen, Pearson.

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.

PDE & System of ODE Practical

L	T	P
0	0	4

MODULE CODE	MATH2104
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	15
SUMMATIVE ASSESMENT MARKS	35
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

List of Practicals (using any software)

(i) Solution of Cauchy problem for first order PDE.

(ii) Finding the characteristics for the first order PDE.

(iii) Plot the integral surfaces of a given first order PDE with initial data.

(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) $u(x,0) = \phi(x), \quad u_t(x,0) = \psi(x), \quad x \in R, \ t > 0$

(b) $u(x,0) = \phi(x), \quad u_t(x,0) = \psi(x), \quad u(0,t) = 0, \ x \in (0,\infty), \ t > 0$

(c) $u(x,0) = \phi(x), \quad u_t(x,0) = \psi(x), \quad u_x(0,t) = 0, \ x \in (0,\infty), \ t > 0$

(d) $u(x,0) = \phi(x), \quad u_t(x,0) = \psi(x), \quad u(0,t) = 0, \quad u(l,t) = 0, \quad 0 < x < l, \ t > 0$

(v) Solution of wave equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) $u(x,0) = \phi(x), \ u(0,t) = a, \ u(l,t) = b, \ 0 < x < l, \ t > 0$

(b) $u(x,0) = \phi(x), \quad x \in R, \quad 0 < t < T$

(c) $u(x,0) = \phi(x), \quad u(0,t) = a, \quad x \in (0,\infty), \ t \geq 0$

RECOMMENDED BOOKS

TEXT BOOKS	1. Linear Partial Differential Equations for Scientists and Engineers: TynMyint-U and LokenathDebnath, Springer, India 2. Differential equations: S.L. Ross, John Wiley and Sons, India. 3. Elements of Partial Differential Equations:Sneddon, I.N., McGraw-Hill, New York. 4. Differential equations with MATHEMATICA: Martha L Abell, James P Braselton, Elsevier Academic Press, 2004.
REFERENCES	1. Differential Equations and Boundary Value Problems Computing and Modeling: C.H. Edwards and D.E. Penny, Pearson Education India. 2. Partial Differential Equations Methodsand Applications: Robert C. McOwen, Pearson.

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type of Assessment	Per Semester	Maximum Mark
1.	Mid Semester Exam	1	15
2.	End Semester Exam	1	35

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

SEMESTER - IV

Numerical Methods

L	T	P
4	0	0

MODULE CODE	MATH2105
CREDIT POINTS	6
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 different types of error, interpolation, extrapolation and capabilities to solve by different methods with wide range of problems in science and engineering.
2. To get familiar with concepts of nonlinear equations and develop ability to solve simple Complex problems.
3. To understand direct and indirect methods solve simultaneous linear equations and their applications in engineering problems.
4. To learn basic concepts of area, solve by integration and its application in realistic decision making.
5. To acquire knowledge of ordinary and partial differential equations solve by different methods and assess their effectiveness in problem solving.

LEARNING OUTCOMES:

1. Able to understand the evolution of techniques and basic terminology.
2. Exposure to various methods and techniques and their compatibilities.
3. Enhance the knowledge regarding different types of error, linear, non-linear and ordinary and partial differential equations.
4. Able to understand the basic techniques and start to implement in real life.
5. Ability to find the largest Eigen valuesand corresponding Eigen vector.

MODULE CONTENT:

UNIT-I Algorithms, Convergence, Errors: Relative, Absolute, round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods.
UNIT-II System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.
UNIT-III Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.
UNIT-IV Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

RECOMMENDED BOOKS

TEXT BOOKS	1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007. 2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007. 3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
REFERENCES	1. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013. 2. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

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.

Numerical Methods Practical

L	T	P
0	0	4

MODULE CODE	MATH2106
CREDIT POINTS	4.5
FORMATIVE ASSESMENT MARKS	15
SUMMATIVE ASSESMENT MARKS	35
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

List of Practicals (using any software)

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.

(ii) To find the absolute value of an integer.

(iii) Enter 100 integers into an array and sort them in an ascending order.

(iv) Bisection Method.

(v) Newton Raphson Method.

(vi) Secant Method.

(vii) RegulaiFalsi Method.

(viii) LU decomposition Method.

(ix) Gauss-Jacobi Method.

(x) SOR Method or Gauss-Siedel Method.

(xi) Lagrange Interpolation or Newton Interpolation.

(xii) Simpson's rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

RECOMMENDED BOOKS

TEXT BOOKS	1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007. 2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007. 3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
REFERENCES	1. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013. 2. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type of Assessment	Per Semester	Maximum Mark
1.	Mid Semester Exam	1	15
2.	End Semester Exam	1	35

Riemann Integration and Series of Functions

L	T	P
4	2	0

MODULE CODE	MATH2107
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 achieve knowledge and understanding of Riemann integration, their various properties and capabilities to solve wide range of problems in science and engineering.

2. To get familiar with concepts of Riemann integrability of monotone and continuous functions and develop ability to solve simple and complex problems.
3. To understand Pointwise and uniform convergence of sequence of functionsand their applications in mathematical sciences.
4. To learn basic concepts of Limit superior and Limit inferior.
5. To acquire knowledge of Convergence of Beta and Gamma functions.

LEARNING OUTCOMES:

1. Able to work comfortably with Riemann integration.
2. Exposure to Riemann integrability of monotone and continuous functions.
3. Enhance the knowledge regarding Pointwise and uniform convergence of sequence of functions.
4. Able to understand Limit superior and Limit inferior.
5. Ability to acquire knowledge of Convergence of Beta and Gamma functions.

MODULE CONTENT:

UNIT-I: Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability.Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions.
UNIT-II: Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus. Improper integrals; Convergence of Beta and Gamma functions.
UNIT-III: Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

UNIT-IV: Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

RECOMMENDED BOOKS

TEXT BOOKS	1. Principles of Mathematical Analysis: Walter RudinMcGraw Hill, Singapopre. 2. Elementary Analysis, The Theory of Calculus, K.A. Ross: Undergraduate Texts in Mathematics, Springer (SIE), India. 3. Introduction to Real Analysis: R.G. Bartle D.R. Sherbert, John Wiley and Sons (Asia) Pvt. Ltd., Singapore.
REFERENCES	1. Real analysis: H L Royden: The Macmillan Company, New york. 2. Elements of Real Analysis: Charles G. Denlinger, Jones & Bartlett

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	20

2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Ring Theory and Linear Algebra-I

L	T	P
4	2	0

MODULE CODE	MATH2108
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 achieve knowledge and understanding of ring theory.
2. To get familiar with concepts of ring homomorphism.
3. To understand algebra of linear transformation.
4. To learn basic concepts of vector space.
5. To acquire knowledge of isomorphism.

LEARNING OUTCOMES:

1. Able to work comfortably with integral domain and field.
2. Exposure to algebra of subspace.
3. Enhance the knowledge regarding vectors and their linear combination.
4. Able to understand ideal, prime and maximal ideal.
5. Ability to acquire knowledge regarding basis and dimension of subspace.

MODULE CONTENT:

UNIT-I Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.
UNIT-II Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.
UNIT-III Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

UNIT-IV Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

RECOMMENDED BOOKS

TEXT BOOKS	1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. 3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., PrenticeHall of India Pvt. Ltd., New Delhi, 2004. 4. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999. 5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
REFERENCES	1. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007. 2. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India,1999. 3. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971. 4. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

SEMESTER - V

Multivariate Calculus

L	T	P
4	2	0

MODULE CODE	MATH3101
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 applying rules to find function of several variables.
2. To get familiar with concepts of directional derivatives.
3. To understand double integral.
4. To learn basic concepts of Differentiations and Integrations.
5. To acquire knowledge of triple integral.

LEARNING OUTCOMES:

1. Able to work comfortably with change of variables.
2. Exposure triple integral and their application.
3. Enhance the knowledge regarding double integral.
4. Able to understand vector field, divergence and curl.
5. Ability to acquire knowledge reduction stroke's theorem.

MODULE CONTENT:

UNIT-I

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability.

UNIT-II Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.
UNIT-III Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.
UNIT-IV Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

RECOMMENDED BOOKS

TEXT BOOKS	1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005. 2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
REFERENCES	1. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005. 2. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

Group Theory-II

L	T	P
4	2	0

MODULE CODE	MATH3102
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 assess properties implied by the definitions of groups.
2. To analyze and demonstrate examples of automorphism and inner automorphism.
3. To use the concepts of factor groups to automorphism groups and characteristics subgroups.
4. To produce rigorous proofs of propositions arising in the context of abstract algebra.
5. To relate a general life situation to a mathematical model
6. To understand the concept of group actions, stabilizers and kernels.
7. Able to understand the concept of Sylow's theory.

LEARNING OUTCOMES:

1. Able to work comfortably with groups.
2. Exposure to various mathematical problems and their analysis.
3. Able to study groups in details and to introduce the concepts of rings.
4. Ability to acquire knowledge of group actions.

MODULE CONTENT:

UNIT-I:

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

UNIT-II Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.
UNIT-III: Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem
UNIT-IV: Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for n $\geq$ 5, non-simplicity tests.

RECOMMENDED BOOKS

TEXT BOOKS	1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. 3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
REFERENCES	1. David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004. 2. J.R. Durbin, Modern Algebra, John Wiley & Sons, New York Inc., 2000. 6. D. A. R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

PortfoliaOptimization (Discipline Specific Elective I)

L	T	P
4	2	0

MODULE CODE	MATH3205
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100

PDM UNIVERSITY
DEPARTMENT OF MATHEMATICS

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 assess properties implied by the Financial markets.
2. To analyze and demonstrate examples of Types of risks.
3. To use the concepts,Mean-variance portfolio optimization.
4. To produce rigorous proofs of propositions arising in the context of abstract algebra.
5. To relate a general life situation to a mathematical model
6. To understand the concept of Portfolios with short sales.

LEARNING OUTCOMES:

1. Able to work comfortably with Investment objectives.
2. Exposure to various methods of Risk free assets.
3. Able to study aboutDiversification.
4. Ability to acquire knowledge ofbeta of a portfolio.

MODULE CONTENT:

UNIT-I: Financial markets. Investment objectives. Measures of return and risk. Types of risks. Risk free assets.
UNIT-II Mutual funds. Portfolio of assets. Expected risk and return of portfolio. Diversification.
UNIT-III: Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem, risk-free assets and one fund theorem, efficient frontier. Portfolios with short sales. Capital market theory.

UNIT-IV: Capital assets pricing model- the capital market line, beta of an asset, beta of a portfolio, security market line. Index tracking optimization models. Portfolio performance evaluation measures.

RECOMMENDED BOOKS

TEXT BOOKS	1. F. K. Reilly, Keith C. Brown, *Investment Analysis and Portfolio Management*, 10th Ed., South-Western Publishers, 2011. 2. H.M. Markowitz, *Mean-Variance Analysis in Portfolio Choice and Capital Markets*, Blackwell, New York, 1987.
REFERENCES	1. M.J. Best, *Portfolio Optimization*, Chapman and Hall, CRC Press, 2010. 2. D.G. Luenberger, *Investment Science*, 2nd Ed., Oxford University Press, 2013.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Number Theory (Discipline Specific Elective I)

L	T	P
4	2	0

MODULE CODE	MATH3206
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 achieve knowledge and understanding of Linear Diophantine equation, prime counting function and capabilities to solve wide range of problems in science and engineering.
2. To get familiar with concepts of Goldbach conjecture, linear congruencesand develop ability to solve simple and complex problems.
3. To understand Fermat's Little theorem andits applications in mathematical sciences.
4. To learn basic concepts of Dirichlet product.
5. To acquire knowledge of RSA encryption and decryption.

LEARNING OUTCOMES:

1. Able to work comfortably with complete set of residues.
2. Exposure to Number theoretic functions.
3. Enhance the knowledge regarding Mobius Inversion formula and its application.
4. Able to understand primitive roots for primes and their applications.
5. Ability to acquire knowledge of Fermat's Last theorem.

MODULE CONTENT:

UNIT-I: Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.
UNIT-II Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.
UNIT-III: Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity.

UNIT-IV: quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

RECOMMENDED BOOKS

TEXT BOOKS	1. David M. Burton, *Elementary Number Theory,* 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.
REFERENCES	1. Neville Robinns, *Beginning Number Theory,* 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Analytical Geometry (DSE I)

L	T	P
4	2	0

MODULE CODE	MATH3207
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 Techniques for sketching parabola.
2. To get familiar with concepts of ellipse and hyperbola and develop ability to solve simple and complex problems.

3. To understand Fermat's Little theorem andits applications in mathematical sciences.
4. To learn basic concepts of Reflection properties of parabola.
5. To acquire knowledge of Cylindrical surfaces.

LEARNING OUTCOMES:

1. Able to work comfortably with ellipse and hyperbola.
2. Exposure to representing lines.
3. Enhance the knowledge regarding ellipse and hyperbolaand its application.
4. Able to understand Illustrations of graphing standard quadric surfaces and their applications.
5. Ability to acquire knowledge of ellipsoid.

MODULE CONTENT:

UNIT-I: Techniques for sketching parabola, ellipse and hyperbola.
UNIT-II Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.
UNIT-III: Spheres, Cylindrical surfaces.
UNIT-IV: Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

RECOMMENDED BOOKS

TEXT BOOKS	1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005. 2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) Pvt. Ltd. 2002.

REFERENCES	1. S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company, London. 2. R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Industrial Mathematics (DSE II)

L	T	P
4	2	0

MODULE CODE	MATH3208
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 Medical Imaging and Inverse Problems and capabilities to solve wide range of problems in medical sciences.
2. To get familiar with concepts of complex numbers and matrices.
3. To understand Geological anomalies in Earth's interior.
4. To learn basic concepts of Radon Transform.
5. To acquire knowledge of Fourier transforms and applications.

LEARNING OUTCOMES:

1. Able to work comfortably with Tomography.
2. Exposure to X-ray behavior and Beers Law.

3. Enhance the knowledge regarding Phantomand its application.
4. Able to understand Back Projection.
5. Ability to acquire knowledge of CT Scan.

MODULE CONTENT:

UNIT-I: Medical Imaging and Inverse Problems. The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices.
UNIT-II Introduction to Inverse problems: Why should we teach Inverse Problems? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth's interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.
UNIT-III: X-ray: Introduction, X-ray behavior and Beers Law (The fundament question of image construction) Lines in the place. Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms). Back Projection: Definition, properties and examples.
UNIT-IV: CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

RECOMMENDED BOOKS

TEXT BOOKS	1. Timothy G. Feeman, The Mathematics of Medical Imaging, A Beginners Guide, Springer Under graduate Text in Mathematics and Technology, Springer, 2010. 2. C.W. Groetsch, Inverse Problems, Activities for Undergraduates, The Mathematical Association of America, 1999.

REFERENCES	1. Andreas Kirsch, An Introduction to the Mathematical Theory of Inverse Problems, 2nd Ed., Springer, 2011.

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Boolean Algebra and Automata Theory (DSE II)

L	T	P
4	2	0

MODULE CODE	MATH3209
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 basic properties of ordered sets.
2. To get familiar with concepts of duality principle.
3. To understand Boolean algebras.
4. To learn basic concepts of Finite Automata and Regular Languages.
5. To acquire knowledge of Turing Machines and applications.

LEARNING OUTCOMES:

1. Able to work comfortably with lattices as algebraic structures.
2. Exposure to switching circuits and applications of switching circuits.
3. Enhance the knowledge regarding deterministic and non-deterministic finite automata.
4. Able to understand pumping lemma.
5. Ability to acquire knowledge of variants of Turing machine and their equivalence.

MODULE CONTENT:

UNIT-I:

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sub lattices, products and homomorphisms.

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

UNIT-II

Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

UNIT-III:

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

UNIT-IV:

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems About CFGs.

RECOMMENDED BOOKS

TEXT BOOKS	1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990. 2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003. 3. Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004. 4. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, 2nd Ed., Addison-Wesley, 2001.
REFERENCES	1. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, Elements of the Theory of Computation, 2nd Ed., Prentice-Hall, NJ, 1997. 2. J.A. Anderson, Automata Theory with Modern Applications, Cambridge University Press, 2006.

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	20
2.	Sessional Test	2	30

3.	End Semester Exam	1	100

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.

Probability and Statistics (DSE II)

L	T	P
4	2	0

MODULE CODE	MATH3210
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 probability axioms.
2. To get familiar with concepts of mathematical expectation.
3. To understand Joint cumulative distribution function.
4. To learn basic concepts of bivariate normal distribution.
5. To acquire knowledge of Chapman-Kolmogorov equations.

LEARNING OUTCOMES:

1. Able to work comfortably with cumulative distribution function.
2. Exposure to continuous distributions.
3. Enhance the knowledge regarding joint probability density functions.
4. Able to understand joint moment generating function (jmgf) and calculation of covariance.
5. Ability to acquire knowledge of Markov Chains.

MODULE CONTENT:

UNIT-I: Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.
UNIT-II Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations.
UNIT-III: Independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.
UNIT-IV: Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

RECOMMENDED BOOKS

TEXT BOOKS	1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007. 2. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.
REFERENCES	1. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. 2. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw-Hill, Reprint 2007

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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

SEMESTER - VI

Metric Spaces and Complex Analysis

L	T	P
4	2	0

MODULE CODE	MATH3103
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 assess properties implied by the definitions of metric spaces.
2. To analyze and demonstrate examples of analytic functions.
3. To use the concepts of factor groups to automorphism groups and characteristics subgroups.
4. Towork with compact spaces in Euclidean spaces.
5. To have familiarity with continuous maps.
6. To understand the concept of connectedness.
7. Able to understand the concept of Laurent's series and its examples.

LEARNING OUTCOMES

1. Able to introduce the basic ideas of metric spaces.
2. Exposure to various mathematical problems and their analysis.
3. Able to study continuity and limits in details and to introduce the concepts of analytic functions.
4. Ability to acquire knowledge of convergence of power series.

MODULE CONTENT:

UNIT-I: Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor's theorem. Subspaces, dense sets, separable spaces.
UNIT-II Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed Point Theorem. Connectedness, connected subsets of R. Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.
UNIT-III: *Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. CauchyGoursat theorem, Cauchy integral formula.*
UNIT-IV: Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series.

RECOMMENDED BOOKS

TEXT BOOKS	1. SatishShirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006. 2. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011. 3. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.

REFERENCES	1. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw – Hill International Edition, 2009. 2. Joseph Bak and Donald J. Newman, Complex Analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Ring Theory and Linear Algebra-II

L	T	P
4	2	0

MODULE CODE	MATH3104
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 assess properties implied by the definitions of polynomial rings over commutative rings.
2. To analyze and demonstrate examples of irreducible polynomials.
3. To use the concepts of factor groups to automorphism groups and characteristics subgroups.
4. To study divisibility in integral domains.
5. To have familiarity with vector spaces.
6. To understand the concept of linear transformation.
7. Able to understand the concept of orthogonal projections and spectral theorem.

LEARNING OUTCOMES

1. Able to introduce the basic ideas of ring theory and linear algebra.
2. Exposure to various mathematical problems and their analysis.
3. Able to study inner product spaces and norms in details and to introduce the concepts of gram-schmidtorthogonalization process.
4. Ability to acquire knowledge of normal and self -adjoint operators.

MODULE CONTENT:

UNIT-I: Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion.
UNIT-II Unique factorization in Z[x]. Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.
UNIT-III: Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.
UNIT-IV: Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

RECOMMENDED BOOKS

TEXT BOOKS	1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. 3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999. 4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., PrenticeHall of India Pvt. Ltd., New Delhi, 2004. 5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
REFERENCES	1. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007. 5. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999. 6. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971. 2. S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Theory of Equations (DSE III)

L	T	P
4	2	0

MODULE CODE	MATH3211
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 assess properties implied by the definitions of General properties of polynomials.
2. To analyze and demonstrate examples of General properties of equations.
3. To use the concepts of Symmetric functions.
4. To study Newton's theorem on the sums of powers of roots.
5. To have familiarity with homogeneous products.
6. To understand the concept of Separation of the roots of equations.

LEARNING OUTCOMES

1. Able to introduce Graphical representation of a polynomial.
2. Exposure to Transformation of equations.
3. Able to study limits of the roots of equations.
4. Ability to acquire knowledge Strums theorem.

MODULE CONTENT:

UNIT-I: General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.
UNIT-II Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.
UNIT-III: Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.
UNIT-IV: Separation of the roots of equations, Strums theorem, Applications of Strum's theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

RECOMMENDED BOOKS

TEXT BOOKS	1. W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
REFERENCES	1. C. C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Bio Mathematics (DSE III)

L	T	P
4	2	0

MODULE CODE	MATH3212
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 assess properties implied by the definitions of modeling process.
2. To analyze and demonstrate examples of Malthus model.
3. To use the concepts of Numerical solution of the models and its graphical representation
4. To study Conditions for diffusive instability.
5. To have familiarity with Blood flow in circulatory system

LEARNING OUTCOMES

1. Able to introduce Holling type growth.
2. Exposure to LotkaVolterra equations.

3. Able to study Phase plane methods and qualitative solutions.
4. Ability to acquire knowledge of Discrete Prey-Predator models.

MODULE CONTENT:

UNIT-I: Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and LotkaVolterra equations.
UNIT-II Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.
UNIT-III: Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population.
UNIT-IV: Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

RECOMMENDED BOOKS

TEXT BOOKS	1. L.E. Keshet, Mathematical Models in Biology, SIAM, 1988. 2. J. D. Murray, Mathematical Biology, Springer, 1993. 3. Y.C. Fung, Biomechanics, Springer-Verlag, 1990.

REFERENCES	1. F. Brauer, P.V.D. Driessche and J. Wu, Mathematical Epidemiology, Springer, 2008. 2. M. Kot, Elements of Mathematical Ecology, Cambridge University Press, 2001.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

Linear Programming (DSE III)

L	T	P
4	2	0

MODULE CODE	MATH3213
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 linear programming problem.
2. To get familiar with two-phase method and their applications in sciences.
3. To learn primal-dual relationships.
4. To know basic concepts of Game theory.
5. To acquire knowledge of linear programming solution of games.

LEARNING OUTCOMES:

1. Able to work easily with optimality and unboundedness.
2. Exposure to Duality.
3. Increase the knowledge regarding algorithm for solving transportation problem.
4. Able to understand concepts of Hungarian method for solving assignment problem.
5. Ability to acquire knowledge of formulation of two person zero sum games.

MODULE CONTENT:

UNIT-I: Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.
UNIT-II Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual. Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution.
UNIT-III: Algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.
UNIT-IV: Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

RECOMMENDED BOOKS

TEXT BOOKS	1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004. 2. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009.
REFERENCES	1. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006. 2. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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

Mathematical Modelling (DSE IV)

L	T	P
4	2	0

MODULE CODE	MATH3214
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 Power series solution of a differential equation about an ordinary point.
2. To get familiar with Bessel's equation and Legendre's equation and their applications in sciences.
3. To learn Laplace transform and inverse transform.
4. To know basic concepts of Generating Random Numbers.
5. To acquire knowledge of Linear Programming Model.

LEARNING OUTCOMES:

1. Able to work easily with solution about a regular singular point.
2. Exposure to application of initial value problem.
3. Increase the knowledge regarding algorithm for solving Monte Carlo Simulation Modeling.
4. Able to understand concepts of linear congruence.
5. Ability to acquire knowledge of sensitivity analysis.

MODULE CONTENT:

UNIT-I:

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation.

UNIT-II Laplace transform and inverse transform, application to initial value problem up to second order.
UNIT-III: Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence
UNIT-IV: Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis.

RECOMMENDED BOOKS

TEXT BOOKS	1. TynMyint-U and LokenathDebnath, Linear Partial Differential Equation for Scientists and Engineers, Springer, Indian reprint, 2006.
REFERENCES	1. Frank R. Giordano, Maurice D. Weir and William P. Fox, A First Course in Mathematical Modeling, Thomson Learning, London and New York, 2003.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

DSE IV Mechanics

L	T	P
4	2	0

MODULE CODE	MATH3215
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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:

OBJECTIVES:

1. To obtain knowledge of couple and couple moment.
2. To get familiar with distributed force system and their applications in sciences.
3. To learn transmission of power through belts.
4. To know basic concepts of Conservative force field.
5. To acquire knowledge of Chasles' theorem.

LEARNING OUTCOMES:

1. Able to work easily with free body diagram.
2. Exposure to first moment of an area and the centroid.
3. Increase the knowledge regarding transfer theorems.
4. Able to understand concepts of work energy equation.
5. Ability to acquire knowledge of translation and rotation of rigid bodies.

MODULE CONTENT:

UNIT-I:

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two-point equivalent loading, problems arising from structures, static indeterminacy.

UNIT-II Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.
UNIT-III: Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles.
UNIT-IV: Translation and rotation of rigid bodies, Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

RECOMMENDED BOOKS

TEXT BOOKS	1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
REFERENCES	1. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 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	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.

DSE IV Differential Geometry

L	T	P
4	2	0

MODULE CODE	MATH3216
CREDIT POINTS	6
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
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 Space curves and their applications.
2. To get familiar with Osculating circles and their applications in sciences.
3. To learn Developables.
4. To know basic concepts of Geodesic curvature.
5. To acquire knowledge of Algebra of tensors and contraction.

LEARNING OUTCOMES:

1. Able to work easily with Existence of space curves.
2. Able to knowFirst and second Fundamental forms.
3. Increase the knowledge regarding Minimal surfaces.
4. Able to understand concepts of Contra-variant and Covariant vectors.
5. Ability to acquire knowledge of Divergence and Laplacian operators in tensor form.

MODULE CONTENT:

UNIT-I: Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.
UNIT-II Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines. Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces.
UNIT-III: Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

UNIT-IV: Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

RECOMMENDED BOOKS

TEXT BOOKS	1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012. 2. B. O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006. 3. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003. 4. D.J. Struik, Lectures on Classical Differential Geometry, Dover Publications, 1988.
REFERENCES	1. S. Lang, Fundamentals of Differential Geometry, Springer, 1999. 2. B. Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003.

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1,2	2	3,4	1,2,3,4	2,3	3,4	2,3	1,3	4	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	20
2.	Sessional Test	2	30
3.	End Semester Exam	1	100

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.