Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

<table>
<tr><td>Course Title</td><td colspan="5">A Potpourri of Mathematics</td></tr>
<tr><td>Course Level (tick (√) in the relevant option)</td><td colspan="3">100 √☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd √☐ Even ☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="3">BSMS √☐ Int. PhD. ☐ Ph.D. ☐</td><td colspan="2"></td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core √☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐
Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory √☐ Lab ☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit Structure</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>Course Code:</td><td colspan="5">MS101</td></tr>
<tr><td>Names of faculties who can teach the course</td><td colspan="5">All faculties of the Department of Mathematical Sciences</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">No</td></tr>
</table>

Learning Objective(s):

The aim of this course is to cultivate a strong foundation in basic concepts of mathematics and introduce students to some flavours of mathematics.

Expected Learning Outcome(s):

By the end of this course, the students will have a better understanding of the basics of mathematics and will be able to apply these concepts whenever needed. Also, students will have a good idea about different possibilities offered by mathematics.

Contents of the course:

- Function: injections, surjections, bijections, composition of functions, inverse function, graph of a function.
- Countable and uncountable sets: definitions and examples, countability of Q, uncountability of R.
- Matrices: definition and examples, determinant, inverse of a matrix and system of linear equations.
- Elements of Number Theory: divisibility, prime numbers and their properties, modular arithmetic, Euler totient functions, RSA cryptosystem.
- Graph Theory: definition, isomorphisms, connectivity, trees, Eulerian graphs, Applications of graph theory, statement of four color theorem.
- Geometry: Parametrization of a curve, planar symmetry.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Function: injections, surjections, bijections, composition of functions, inverse function, graph of a function.	**4**
2	Countable and uncountable sets: definitions and examples,	**3**
3	Countability of Q, uncountability of R	**3**
4	Matrices: definition and examples, determinant,	**5**
5	Inverse of a matrix and system of linear equations	**5**
6	Elements of Number Theory: divisibility, Prime numbers and their properties, Modular arithmetic,	**4**
7	Euler totient functions, sigma functions, Mobius function and their properties	**3**
8	Euler's Theorem, Fermat's little theorem as a corollary of Euler's theorem. RSA cryptosystem	**5**
9	Graph Theory: definition, isomorphisms, connectivity, trees, Eulerian graphs,	**4**
10	Applications of graph theory, statement of four color theorem.	**2**
11	Geometry: Parametrization of a curve, planer symmetry	**4**
	Total Lecture Hours	**42** (Including 6 h discussion sessions)

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

- Kenneth H. Rosen, Discrete Math and its Applications, McGraw Hill, 8th Edition, 2021.
- R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 4th Edition, 2011.

- David Burton, Elementary Number Theory and Applications, McGraw Hill, 2023.
- Rafael Pass, Wei-Lung Dustin Tseng, A Course in Discrete Structures (Lecture Notes).
- Tom M. Apostol, Calculus (Volume I), Willey, 2nd Edition, 2022.
- Ali Grami, Discrete Mathematics Essential and Applications, Academic Press,1st Edition, 2022.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): Evaluation will be as per the BS-MS manual, the instructor should declare all the details in the first lecture.

Additional Guidelines:

Name and Signature of course proposer(s):

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and

Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

Course Title	**Calculus Of One Variable**				
Course Level (tick (√) in the relevant option)	100 √☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even √☐ Either semester ☐	
Course applicable for	BSMS √☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core √☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory √☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	MS102				
Names of faculties who can teach the course	All faculties of the Department of Mathematical Sciences				
Will the course require participation of visiting faculties: No					
Prerequisites, if any Course code(s)	MS101				

Learning Objective(s):

This is a core mathematics course for second semester BS-MS students. The aim of this course is to introduce students to the concepts of limit, continuity, differentiation and integration, and their applications in various fields.

Expected Learning Outcome(s):

The students will be able to understand the concepts of continuity, differentiation and integration. They will be able to apply the learned concepts in the other branches of sciences when it is required.

Contents of the course:

- Sequence and series of real and complex numbers.
- Real number system, limit superior, limit inferior, supremum principle, limits and continuity, definitions, continuity and discontinuity of a function at a point, left and right continuity, examples of continuous and discontinuous functions, intermediate value theorem.
  (If time permits: boundedness of a continuous function on a closed interval.)
- Differentiation: definition and basic properties, Rolle's theorem, mean value theorem, Leibnitz's theorem on successive differentiation, Taylor's theorem.
- Integration: Riemann integral viewed as an area, partitions, upper and lower integrals, existence of the Riemann integral, basic properties, fundamental theorem of integral calculus, integration by parts.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Sequence of real and complex numbers	**3**
2	Series of real and complex numbers	**3**
3	Real number system, limit superior, limit inferior, supremum principle	**5**
4	Limits and continuity, definitions, continuity and discontinuity of a function at a point, left and right continuity,	**5**
5	Examples of continuous and discontinuous functions, intermediate value theorem. (If time permits: boundedness of a continuous function on a closed interval.)	**4**
6	Differentiation: definition and basic properties,	**4**
7	Rolle's theorem, mean value theorem, applications	**5**
8	Leibnitz's theorem on successive differentiation, Taylor's theorem	**4**
9	Integration: Riemann integral viewed as an area, partitions, upper and lower integrals,	**3**
10	Existence of the Riemann integral, basic properties	**3**
11	Fundamental theorem of integral calculus, integration by parts.	**3**
	Total Lecture Hours	**42** (Including 6 h discussion sessions)

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

- G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Indian student edition, Addison-Wesley, 1998.
- T. M. Apostol, Calculus (Volumes I and II), 2nd Edition, Wiley Eastern, 1980.
- R. Courant, F. John, Introduction to Calculus and Analysis (Volume I), Classics in Mathematics, Springer, 1989.
- Terrence Tao, Analysis I, 4th Edition, Hindustan Book Agency, 2022.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): Evaluation will be as per the BS-MS manual, the instructor should declare all the details in the first lecture.

Additional Guidelines:

Among the 42 lecture hours, the instructor may have a discussion session after every 5-6 lecture hours.

Name and Signature of course proposer(s):

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

Course Title	Writing Mathematics				
Course Level (tick (√) in the relevant option)	100√ ☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd √ ☐ Even ☐ Either semester ☐	
Course applicable for	BSMS √ ☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core √☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory √☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	1	0	0	1	
Course Code:	MS103				
Names of faculties who can teach the course	All faculties of the Department of Mathematical Sciences				
Will the course require participation of visiting faculties: No					
Prerequisites, if any Course code(s)					

Learning Objective(s):

The aim of this course is to make students able to communicate mathematical ideas in writing and to revise the basics of Mathematics. This will also serve as a bridge course for people with non-mathematical backgrounds.

Expected Learning Outcome(s):

By the end of this course, the students will be able to analyze and construct valid mathematical arguments using set theory, relations, functions, and various methods of proof.

Contents of the course:

- Mathematical statements and their validity.
- Set: union and intersection of sets, distributive laws, De Morgan's Law, finite and infinite sets.
- Relation: equivalence relation and equivalence classes.
- Function: injections, surjections, bijections, composition of functions.
- Logical Notations and method of Mathematical Proofs: Negation, Mathematical induction, construction, contradiction, contrapositive.

- Pigeonhole principle for finite sets, squaring a circle,
- Understanding infinity (Hilbert Hotel), some paradoxes.

Lecture Outline: (Not more than 6 lectures per module) NA

Module No	Topic	No. of Hours
1	Set: union and intersection of sets, distributive laws, De Morgan's Law, finite and infinite sets	2
2	Relation: equivalence relation and equivalence classes	2

3	Function: injections, surjections, bijections, composition of functions	2
4	Logical Notations and method of Mathematical Proofs: Negation, Mathematical induction	2
5	Proof by construction, contradiction, contrapositive.	2
6	Pigeonhole principle for finite sets, squaring a circle,	2
7	Understanding infinity (Hilbert Hotel), some paradoxes	2
	Total Lecture Hours	14

Brief Description of Tutorial Activities:

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours
	Total Lab Hours	

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

- Kenneth H. Rosen, Discrete Math and its Applications, 8th Edition, McGraw Hill, 2021.
- J.P. D'Angelo and D.B. West, Mathematical Thinking: Problem-Solving and Proofs, 2nd Edison, Pearson Publisher, 2019.
- M. Aigner and G. M. Ziegler, Proofs from THE BOOK, 6th Edition, Springer, 2018.
- Gary Chartrand, Albert D. Polimeni and Ping Zhang, Mathematical Proofs, 4th Edition, Pearson Publications, 2023.
- K. B. Sinha et all, Understanding Mathematics, University Press, 2003.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): There will be tests during mid semester and end semester examinations.

Additional Guidelines: This is mostly an interactive course in nature. The instructors are suggested to teach this course with this spirit.

Name and Signature of course proposer(s):

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC	Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

<table>
<tr><td>Course Title</td><td colspan="5">Linear Algebra</td></tr>
<tr><td>Course Level (tick (√) in the relevant option)</td><td colspan="3">100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd √☐ Even ☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="3">BSMS √☐ Int. PhD. ☐ Ph.D. ☐</td><td colspan="2"></td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core ☐ Professional (Department) Core √☐ Department Elective ☐ Open Elective ☐
Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory √☐ Lab ☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit Structure</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td></td></tr>
<tr><td>Course Code:</td><td colspan="5">MS201</td></tr>
<tr><td>Names of faculties who can teach the course</td><td colspan="5">All faculties of the Department of Mathematical Sciences</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">MS101</td></tr>
</table>

Learning Objective(s):

The goal of this core course is to introduce the notion of abstract vector space in the end beginning with the addition of vectors in higher dimensional Euclidean Spaces. The course also illustrates the connection between the study of matrices and vector spaces throughout and explores the solutions of systems of linear equations.

Expected Learning Outcome(s):

At the end of this course, the students will be able to solve system of linear equations through matrices. they will be able to use the eigenvalues and eigenvectors in diverse areas of mathematics.

Contents of the course:

- Review of complex numbers
- Matrices, matrix operations, special matrices (diagonal, triangular, symmetric, skew-symmetric, orthogonal, hermitian, skew hermitian, unitary, normal),
- Vectors in R^n and C^n, matrix equation Ax = b, row-reduced echelon form, row space, column space, and rank of a matrix.
- Determinants, systems of linear equations
- Vector space R^n, linear independence and dependence, linear span, linear subspaces, bases and dimensions
- Linear transformations, matrix of a linear transformation, rank-nullity theorem, Inner product spaces, orthonormal bases, Gram-Schmidt orthogonalization, projections
- Eigenvalues and eigenvectors of a linear operator, characteristic polynomial, diagonalizability of a linear operator, eigenvalues of the special matrices stated above,

- Spectral theorem for real symmetric matrices and its application to quadratic forms, positive definite matrices.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Review of complex numbers, Matrices, matrix operations,	3
2	Special matrices (diagonal, triangular, symmetric, skew-symmetric, orthogonal, hermitian, skew hermitian, unitary, normal),	3
3	Vectors in R^n and C^n, matrix equation Ax = b, row-reduced echelon form, row space, column space, and rank of a matrix.	5
4	Determinants, systems of linear equations	3
5	Vector space R^n, linear independence and dependence, linear span, linear subspaces, bases and dimensions	5
6	Linear transformations, matrix of a linear transformation, rank-nullity theorem,	5
7	Inner product spaces, orthonormal bases, Gram-Schmidt orthogonalization, projections	5
8	Eigenvalues and eigenvectors of a linear operator, characteristic polynomial,	5
9	Diagonalizability of a linear operator, eigenvalues of the special matrices stated above,	4
10	Spectral theorem for real symmetric matrices and its application to quadratic forms, positive definite matrices.	4
	Total Lecture Hours	42

Brief Description of Tutorial Activities:

Module No	Topic	No. of Hours
1	Matrices, matrix equation, echelon forms, Determinants, system of linear equations	5
2	Vector space R^n, Linear transformations, Rank-nullity theorem	5
3	Eigenvalues and eigenvectors, Spectral theorem	4
	Total Tutorial Hours	14

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

- T. M. Apostol, Calculus, Volume 2, 2nd edition, Wiley Eastern, 1980.
- H. Anton, Elementary linear algebra and applications, 8th edition, John Wiley, 1995.
- G. Strang, Linear algebra and its applications, 4th edition, Thomson, 2006.
- S. Kumaresan, Linear algebra - A Geometric Approach, Prentice Hall of India, 2000.
- R. Rao and P. Bhimasankaram, Linear Algebra, 2nd edition, Hindustan Book Agency, 2020.
- M. Artin, Algebra, Prentice-Hall of India, 1994.
- R. Bapat, Linear Algebra and Linear Models, HBA, 1999.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): Evaluation will be as per the BS-MS manual, the instructor should declare all the details in the first lecture.

Additional Guidelines:

Name and Signature of course proposer(s):

Similarity with the existing courses, if any:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Mathematical Methods	Not Available	Vector space with examples, Matrices, Eigenvalues and Eigenvectors, Transformation of matrices, Diagonalization of matrices	<10
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

Course Title	**Groups And Symmetry**				
Course Level (tick (√) in the relevant option)	100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even √☐ Either semester ☐	
Course applicable for	BSMS √☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☐ Professional (Department) Core √☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory √☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	MS202				
Names of faculties who can teach the course	All faculties of the Department of Mathematical Sciences				
Will the course require participation of visiting faculties: No					
Prerequisites, if any Course code(s)	MS101				

Learning Objective(s):

The aim of this course is to introduce the symmetries around and how these symmetries form a fundamental object in abstract algebra named groups.

Expected Learning Outcome(s):

After successful completion of the course, the students will develop understanding in mathematics through group theory. They will be able to use properties of groups in other areas of mathematics.

Contents of the course:

- Basic operations, row reduction, determinant and trace, Cramer's rule.
- Basic notions of groups, permutation groups.
- Group actions, prime-power groups.
- Finite Abelian groups.
- Matrix groups, SO(3) and rotations.
- Groups of symmetries of real plane and Platonic solids.
- Vector spaces and linear transformations, eigenvalues and eigenvectors, diagonalization.
- Application of Group Theory (Fermat's Little Theorem, Euler's Theorem).

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours

1	Basic operations, row reduction, determinant and trace, Cramer's rule.	**5**
2	Basic notions of groups, permutation groups.	**5**
3	Group actions, prime-power groups.	**5**
4	Finite Abelian groups.	**5**
5	Matrix groups, SO(3) and rotations.	**5**
6	Groups of symmetries of real plane and Platonic solids.	**5**
7	Vector spaces and linear transformations,	**4**
8	Eigenvalues and eigenvectors, diagonalization.	**3**
9	Application of Group Theory (Fermat's Little Theorem, Euler's Theorem)	**5**
	Total Lecture Hours	**42** (Including 6 h of discussion sessions)

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

- M. A. Armstrong, Groups and Symmetry, Springer, 1988.
- M. Artin, Algebra, Prentice-Hall of India, New Delhi, 1994.
- I. S. Luthar and I. B. S. Passi, Algebra Vol. I, Narosa Publishing House, 1996.
- J. A. Gallian, Contemporary Abstract Algebra, D. C. Heath Canada, 1986.
- Kristopher Tapp, Symmetry: A Mathematical Exploration, Springer, 2011.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): Evaluation will be as per the BS-MS manual, the instructor should declare all the details in the first lecture.

Additional Guidelines:

Among the 42 lecture hours, the instructor may have a discussion session after every 5-6 lecture hours.

Name and Signature of course proposer(s):

Similarity with the existing courses, if any: 10%

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Mathematical Methods I	PS203	Introduction to Groups, Finite Groups, Permutation Groups,	10%
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

Course Title	Introduction to Probability and Statistics				
Course Level (tick (√) in the relevant option)	100 ☐ 200 √☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd √ ☐ Even ☐ Either semester ☐	
Course applicable for	BSMS √☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☐ Professional (Department) Core √☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory √☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	MS203				
Names of faculties who can teach the course	Senthil Raani K S, R Sengupta				
Will the course require participation of visiting faculties: Yes					
Prerequisites, if any Course code(s)	MS101 and MS102				

Learning Objective(s):

This is an introductory course of Probability and Statistics. Various tools and techniques pertaining to this area will be introduced, mostly from a frequency-based point of view though with a little bit of continuous variable probability distribution.

Expected Learning Outcome(s):

On successful completion of this course, a student will be able to undertake the following works:

a) Understand the concept of the subject.
b) Use the tools in practical applications, in particular for non-mathematical subjects.
c) Because of the combination of statistics with the program R he/she will understand the assumptions and limitations of the standard Excel program used universally and mostly without any knowledge of the underlying assumptions.

Contents of the course:

- Definitions of statistics. Collection and presentation of data. Frequency distribution. Measures of central tendency. Measures of dispersions.
- Elementary probability theory. Theorems of probability of events. Limitations of frequency based approach (not rigorous). Axiomatic definition of probability. Conditional probability. Random variables and expectations and variance. Joint distributions of two random variables. Probability inequalities (Markov, Chebyshev, and its applications. Law of large numbers.
- Univariate theoretical distributions. Probability mass and probability density functions. Uniform, Bernoulli, binomial, Poisson distribution for discrete distributions and uniform, exponential, and Gaussian distribution for continuous cases. Moments of the same.
- Bivariate frequency distributions. More on stochastic independence. Correlation and regression line.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours

1	What is statistics, historical note, Data – Primary and secondary, collection and scrutiny of data. Diagrammatic presentation of data.	1
2	Summarisation of data, attributes and variables. Frequency distribution of attributes. Graphical representation of frequency distributions, frequency curve.	1
3	Meaning of dispersion, range, mean deviation standard deviation. Quartile deviation, measures of relative dispersions, curve of concentration, moments	3
4	Meaning of probability, Theorems of probability of events. Combinatorial method, along with examples.	3
5	Limitations of frequency based approach (not rigorous). Axiomatic definition of probability. Conditional probability, Bayes theorem	5
6	Random variables and expectations and variance. Uniform, Bernoulli, binomial, Poisson distribution and moments.	4
7	Probability inequalities (Markov, Chebyshev, and its applications. Weak law of large numbers. Extensive exercises.	5
8	Univariate theoretical distributions. Probability mass and probability density functions.	4
9	Uniform, exponential, and Gaussian distribution for continuous cases. Moments of the same.	4
10	Joint distributions of two random variables. Covariance and correlation. Bivariate frequency distributions. More on stochastic independence. Extensive exercises.	5
11	Correlation and regression line.	2
12	Programming in R	5
	Total Lecture Hours	42 (Including 6 h of discussion sessions)

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Siva Athreya, Deepayan Sarkar, and Steve Tanner-Probability and Statistics with Examples using R, 2024 (available in https://psweur.github.io/)

2. Alan Agresti, Christine A. Franklin, Bernhard Klingenberg- Statistics: The Art and Science of Learning from Data, 5th Edition, 2022.
3. Allen Craig, Robet V Hogg, Joseph W Mckean- Introduction To Mathematical Statistics, Pearson, 8th Edition, 2021.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): Same as in the BS-MS manual. A short portion on R will be initially taught by a guest faculty, until the department members take the full responsibility of the course.

Additional Guidelines:

Among the 42 lecture hours, the instructor may have a discussion session after every 5-6 lecture hours.

Name and Signature of course proposer(s):

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and

Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Mathematical Sciences

Course Title	Multivariable Calculus				
Course Level (tick (√) in the relevant option)	100 ☐ 200 √ ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even √ ☐ Either semester ☐	
Course applicable for	BSMS √☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ☐ Professional (Department) Core √☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory √☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	1		4	
Course Code:	MS204				
Names of faculties who can teach the course	All faculties of the Department of Mathematical Sciences				
Will the course require participation of visiting faculties: No					
Prerequisites, if any Course code(s)	MS102				

Learning Objective(s):

The aim of this course is to generalize the basic concepts of Calculus of one variable to R^2 and R^3.

Expected Learning Outcome(s):

After successful completion of the course, the students will know about the notion of continuity, differentiation and integration in R^2 and R^3. They will learn Green's Theorem, Divergence Theorem and Stoke's Theorem and will be able to apply them in different contexts.

Contents of the course:

- Vectors in R^2 and R^3, dot product of vectors, length of a vector, orthogonality of vectors, cross product of vectors
- Lines, planes, and quadric surfaces
- Continuity and differentiability of vector-valued functions, tangent vectors
- Functions of two or more variables, limits and continuity, partial derivatives, gradient, directional derivatives, maxima, minima and saddle points, Lagrange multipliers
- Double and triple integrals, change of coordinates, vector fields, line integrals, surface integrals, Green's theorem, Divergence theorem, Stokes' theorem
- First order ordinary differential equations: variables separable, homogeneous, linear and exact equations, Method of variation of parameter.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1	Vectors in R^2 and R^3, dot product of vectors, length of a vector, orthogonality of vectors, cross product of vectors	**3**
2	Lines, planes, and quadric surfaces	**2**

3	Continuity and differentiability of vector-valued functions, tangent vectors	4
4	Functions of two or more variables, limits and continuity, partial derivatives	6
5	Gradient, directional derivatives, maxima, minima and saddle points, Lagrange multipliers	6
6	Double and triple integrals, change of coordinates, vector fields, line integrals	6
7	Surface integrals, Green's theorem, Divergence theorem, Stokes' theorem	5
8	First order ordinary differential equations: Formation of ODE, Separation of variables, Homogeneous differential equations,	5
9	Linear and exact equations, Method of variation of parameter.	5
	Total Lecture Hours	42

Brief Description of Tutorial Activities:

Module No	Topic	No. of Hours
1	Dot product and cross product, lines, planes and quadric surfaces, Continuity	3
2	Differentiability, Partial derivatives, maxima and minima, Double and Triple integrals	4
3	Green's theorem, Divergence Theorem, Stoke's Theorem	3
4	Ordinary Differential Equations	4
		14
	Total Tutorial Hours	

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

- G. B. Thomas and R. L. Finney, *Calculus and Analytic Geometry,* Addison-Wesley, 9th edition, 1998.
- T. M. Apostol, *Calculus,* Volumes 1 and 2, Wiley Eastern, 2nd edition, 1980.
- J. E. Marsden and A. Tromba, *Vector Calculus,* W.H. Freeman & Company, 2004.
- R. Courant, F. John, *Introduction to Calculus and Analysis,* Vol. 2, Classics in Mathematics, Springer, 1989.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual): Evaluation will be as per the BS-MS manual, the instructor should declare all the details in the first lecture.
Additional Guidelines: Among the 42 lecture hours, the instructor may have a discussion session after every 5-6 lecture hours.

Name and Signature of course proposer(s):

Similarity with the existing courses, if any: <10%

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Mathematical Methods	Not Available	Ordinary differential equations (with constant coefficients)	<10
2				

Justification of new course proposal if cumulative similarity content is >30%:

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The

committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	