भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर

INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP-Mathematics

Core course for Mathematics Major/ Minor students.

Name of the Schools: proposed by SBS

1.	Course Title:	**CALCULUS AND ANALYTIC GEOMETRY**
2.	Subject Code:	MA1L301
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	1
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	54 APPROX
8.	Theory:	Calculus and Analytic Geometry
9.	(Autumn/ Spring):	Autumn
10.	Level:	1
11.	Pre- requisite:	Nil
12.	Lab:	NONE

14. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I: Limit and continuity, Sequence and sequential criterion for limit, Differentiation, Mean value theorems, Indeterminate forms and evaluation of limits using L'Hopital rule, Riemann Integration and fundamental theorem of calculus, Improper integrals.

Unit II. Asymptotes, Increasing and decreasing functions, Concavity and Convexity, Points of inflection, Tracing of curves.

Unit III. Taylor's expansion and error estimates, Power series and its convergence, Functions of two variables, Partial and directional derivatives, Gradient, Maxima and Minima, Lagrange's multiplier method.

Unit IV. Vectors in three dimensional space, dot and cross product, lines and planes in space, Tangent to curves, Normal, Green's theorem, Gauss divergence theorem, Stokes theorem.

15. Suggested Texts:

- G. B. Thomas, M. D. Weir, J. Hass and C. Heil, *Thomas' Calculus Early Transcendentals,* Pearson, 2014.
- G. B. Thomas and R. L. Finney, *Calculus and Analytic Geometry,* Narosa Publishing House, 1984.

16. Suggested References:

- T. M. Apostol, *Calculus-1*, Wiley, 2007.
- T. M. Apostol, *Mathematical Analysis*, Narosa Publishing House, 2002.
- W. Rudin, *Principles of Mathematical Analysis*, McGraw Hill, 1976.
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17 Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
1.	Limit-Continuity, Sequence	4	1
2.	Differentiation, Mean value theorems and Indeterminate forms	5	2
3.	Riemann Integration and Improper integrals	6	1
4.	Asymptotes, Increasing and decreasing functions, Concavity and Convexity, Points of inflection, Tracing of curves.	3	1
5.	Taylor's expansion and power series	3	1
6.	Functions of two variables, Partial derivatives	6	2
7.	Maxima-Minima, Lagrange's method	6	1
8.	Vectors, dot and cross products, lines and planes, tangent and normal	4	1
9.	Green, Gauss and Stokes theorems	5	2
		TOTAL 42	12

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP-Mathematics

Core course for Mathematics major/ minor students.

Name of the Schools: proposed by SBS

1.	Course Title:	**LINEAR ALGEBRA**
2.	Subject Code:	MA1L302
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	1
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Linear Algebra
9.	(Autumn/ Spring):	Autumn
10.	Level:	1
11.	Pre- requisite:	NONE
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. System of Linear Equations, Matrices and elementary row operations, Row reduced echelon form of matrices, Rank of matrices, Vector spaces, subspaces, bases and dimension, column and row spaces.

Unit II. Direct sum of vector space, quotient spaces, Linear Transformation and matrix representation of linear transformation, Rank-Nullity theorem, Dual spaces, transpose and determinants.

Unit III. Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem and Diagonalization

Unit IV. Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators

14. Suggested Texts:

1. K. Hoffman and R. Kunze*, Linear Algebra,* PHI Learning Private LTD, 2012.
2. S. Axler, *Linear Algebra Done Right*, UTM, Springer, 2015.

15. Suggested References:

1. G. Strang, *Introduction to Linear Algebra*, Wellesley Cambridge Press, 2016.
2. M. Artin, *Algebra*, Prentice Hall of India, 2015.
3. S. H. Friedberg, A. J. Insel, L. E. Spence, *Linear Algebra*, Prentice Hall, 1997.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
10.	System of Linear Equations, Matrices and elementary row operations, Rowreduced echelon form of matrices, Rank of matrics,	5	2
11.	Vector spaces, subspaces, bases and dimension, column and row spaces	5	2
12.	Direct sum of vector space, quotient spaces, Linear Transformation and matrix representation of linear transformation	6	2
13.	Rank-Nullity theorem, Dual spaces, transpose and determinants.	4	2
14.	Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials	6	2
15.	Cayley-Hamilton Theorem and Diagonalization	5	1
16.	Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections	5	1
17.	linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators	4	1
		TOTAL 40	13

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP-Mathematics

Core course for Mathematics major / minor students.

Name of the Schools: proposed by SBS

1.	Course Title:	**PROBABILITY AND STATISTICS**
2.	Subject Code:	MA1L303
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	2
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	52 APPROX
8.	Theory:	Probability and Statistics
9.	(Autumn/ Spring):	Spring
10.	Level:	1
11.	Pre- requisite:	None
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar
UNIT-1 Basic Probability concepts, Random variables: Concept, cumulative distribution function, discrete and continuous random variables. Discrete random variables: Bernoulli's trials, Binomial distribution, geometric distribution, Poisson distribution. Continuous random variables: Uniform distribution, exponential distribution, Gamma distribution, Normal distribution. Bivariate random variables: Joint distribution. **UNIT-2** Expected value of random variables: expectation, Raw and central moments of random variables, mean, variance, moment generating function, characteristics function, Median, Mode, covariance, correlation coefficient. Convergence in Probability: Tchebycheff's inequality, properties of convergence, laws of large numbers, central limit theorem, approximation of distributions. **UNIT-3** Population, Finite and Infinite Population. Pseudo random variable, Theory of Sampling, parameter and statistic, estimator, Chi-square distribution, distribution of sample mean and variance, good estimator, Consistent & Unbiased estimates of any Characteristic associated with distribution. Estimation of parameters: Maximum likelihood estimates, Confidence interval. **UNIT–4** Testing of hypothesis: Problem, Different types of hypothesis, Formation of the problem – Probability of Type – I error, Probability of Type – II error, Best Critical region, Likelihood ratio testing, examples. Chi-square test of goodness of fit.

14. Text Books:

1. *Probability and Random Processes*, Geoffrey R. Grimmett, David R. Stirzaker, Oxford University Press
2. *Applied Statistics and Probability for Engineers*, Douglas C. Montgomery and George C. Runger, Wiley
3. *Probability and Statistics for Engineers*, Miller & Freund's, 7th Edition, Pearson-Prentice Hall

15. Reference Books:

1. *A First Course in Probability*, Sheldon M. Ross, Prentice- Hall
2. *Introduction to Probability Theory and Statistical Inference*, Harold J. Larson, Wiley
3. *An Introduction to Probability and Statistics*, Vijay K. Rohatgi and A. K. Md. Ehsanes Saleh, John Wiley & Sons
4. *Introduction to Probability Theory and its applications*, W. Feller, Vol I, Wiley
5. *Fundamentals of Statistics*, A. M. Gun, M. K. Gupta, and B. Das Gupta
6. *Outline of Statistics*, A. M. Gun, M. K. Gupta, and B. Das Gupta

16. Break-up of lectures and tutorials

S.NO.	TOPIC	NO. OF LECTURE HOURS	TUTORIALS (IN HOURS)
1.	Basic Probability concepts, Random variables: Concept	3	1
2.	Cumulative distribution function, discrete and continuous random variables and various examples	5	2

3.	Bivariate random variables: Joint distribution	1.5	0
4.	Expected value of random variables, moment generating function, characteristics function	4	2
5.	Median, Mode, covariance, correlation coefficient	1.5	1
6.	Convergence in Probability: Tchebycheff's inequality, properties of convergence, LLNs, CLT	3	1
7.	Finite and Infinite Population. Pseudo random variable, Theory of Sampling	2	1
8.	parameter and statistic, estimator, Chi-square distribution, distribution of sample mean and variance, Consistent & Unbiased estimates of any Characteristic associated with distribution	5	2
9.	Estimation of parameters: Maximum likelihood estimates, Confidence interval	3.5	1
10.	Testing of hypothesis: Problem, Different types of hypothesis, Formation of the problem – Probability of Type – I error, Probability of Type – II error	3	1
11.	Best Critical region	3	1
12.	Likelihood ratio testing, examples. Chi-square test of goodness of fit	3.5	1
	TOTAL HOURS	38	14

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Name of the Program: ITEP-Mathematics

Core course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**REAL ANALYSIS**
2.	Subject Code:	MA1L304
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	2
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Analysis
9.	(Autumn/ Spring):	Spring
10.	Level:	1
11.	Pre- requisite:	Nil
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I: Real Number system, Supremum and Infimum, Archimedean property, Sequences and Series, Cauchy sequence and completeness, Convergence tests for series.

Unit II. Riemann Integral, Riemann Integrable functions, the fundamental theorems of calculus and their consequences, Improper Integrals.

Unit III. Sequence and series of functions, Uniform convergence and its relation with continuity, differentiability and integrability.

Unit IV. Metric spaces, Interior points and limit points, open, closed and perfect sets. Connected and compact sets, Bolzano-Weierstrass theorem.

14. Suggested Texts:

- R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, Wiley, 2011.
- T. M. Apostol, *Mathematical Analysis*, Narosa Publishing House, 2002.
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15. Suggested References:

- T. Tao, *Analysis-I*, TRIM 37, Hindustan Book Agency, 2022.
- W. Rudin, *Principles of Mathematical Analysis*, McGraw Hill, 1976.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
18.	Real number system, Supremum and Infimum, Archimedean property Sequences and series	4	1
19.	Cauchy sequences and convergence tests	6	2
20.	Riemann Integrals, Improper Integrals, Riemann Integrable functions, the fundamental theorems of calculus and their consequences,	6	1
21.	Sequence and series of functions, Uniform convergence and its relation with continuity, differentiability and integrability.	10	2
22.	Metric space and its topological properties	6	2
23.	Connectedness and compactness	10	3
		TOTAL 42	11

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Name of the Program: ITEP-Mathematics

Core course for Mathematics Major/ Minor students.

Name of the Schools: proposed by SBS

1.	Course Title:	**C-PROGRAMMING WITH LAB**
2.	Subject Code:	MA2L301
3.	L: T: P:	3-0-2
4.	Credit:	4
5.	Semester No:	3
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	C-Programming
9.	(Autumn/ Spring):	Autumn
10.	Level:	2
11.	Pre- requisite:	NONE
12.	Lab:	Yes

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit-I. Introduction to computer fundamentals, types of registers, memory unit, operating system, machine language, compiler, interpreter, Problem solving, algorithm and flowchart. Over view of C program, basic structure of C program, Constants, variables and data type.

Unit-II. Operators and expression: Arithmetic, relational and logical operations. Assignment statements, conditional operators. Input and output statements. Formatted input and output. Decision making and branching- if, else if and go to statements. Looping structure: while, Do while, for statements, nested control structures, switch, break and continue statements.

Unit-III. User defined function, types of functions, recursion, and concepts of parameter passing by values and by reference.

Unit IV. Arrays: single and multidimensional, searching and sorting. Characters and string and its manipulations, types of string functions. Introduction to pointers, pointer to pointer, pointer to array, pointer to strings.

14. Suggested Texts:

1. J E. Balaguruswamy, *Programming in ANSI C*, Tata McGraw-Hill, 2011.
2. Brain W. Kernighan and Dennis M. Ritchie, *The C programming Language*, Prentice Hall of India, 1978.

15. Suggested References:

1. B. Gottfried, *Schaum's Programming with C*, Tata McGraw-Hill, 1996.
2. Y. Kanetkar, *Let us C,* BPB publications, 2016.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	LAB
24.	Introduction to computer fundamentals, types of registers, memory unit, operating system, machine language, compiler, interpreter, Problem solving, algorithm and flowchart.	6	1
25.	Over view of C program, basic structure of C program, Constants, variables and data type.	4	1
26.	Operators and expression: Arithmetic, relational and logical operations. Assignment statements, conditional operators. Input and output statements. Formatted input and output. Decision making and branching- if, else if and go to statements.	6	2
27.	Looping structure: while, Do while, for statements, nested control structures, switch, break and continue statements.	6	2
28.	User defined function, types of functions, recursion, and concepts of parameter passing by values and by reference.	6	2

29.	Arrays: single and multidimensional, searching and sorting. Characters and string and its manipulations, types of string functions.	6	2
30.	Introduction to pointers, pointer to pointer, pointer to array, pointer to strings.	6	2
		TOTAL 38	12

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP-Mathematics

Core course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**DISCRETE MATHEMATICS**
2.	Subject Code:	MA2L302
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	3
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Discrete Mathematics
9.	(Autumn/ Spring):	Autumn
10.	Level:	2
11.	Pre- requisite:	NONE
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Set theory: Sets, relations, equivalence relations, partially ordered sets, functions, countability, lattices and Boolean algebras.

Unit II. Logic: Well-formed formula, interpretations, propositional logic, predicate logic, theory of inference for propositional logic and predicate logic.

Unit III. Combinatorics: Permutations, combinations, recurrences, generating functions, partitions, special numbers like Fibonacci, Stirling and Catalan numbers.

Unit IV. Graph Theory: Graphs and digraphs, special types of graphs, isomorphism, connectedness, Euler and Hamilton paths, planar graphs, graph colouring, trees, matching.

14. Suggested Texts:

1. Rosen K. H. *Discrete Mathematics & its Applications*, Tata McGraw-Hill, 2012.
2. J. P. Tremblay and R. Manohar, *Discrete Mathematics with Applications to Computer Science*, Tata McGraw-Hill, 1997.

15. Suggested References:

1. Grimaldi R. P. *Discrete and Combinatorial Mathematics*, Pearson Education, 2006.
2. Penner R. C., *Discrete Mathematics: Proof Techniques and Mathematical Structures*, World Scientific, 1999.
3. Balakrishnan V. K. *Introductory Discrete Mathematics*, Dover, 2012.
4. Deo N. *Graph Theory*, Prentice Hall of India, Indian Edition, 2012.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
31.	Set theory: Sets, relations, equivalence relations, partially ordered sets	5	1
32.	Functions, countability, lattices and Boolean algebras.	5	2
33.	Logic: Well-formed formula, interpretations, propositional logic, predicate logic, theory of inference for propositional logic and predicate logic.	10	3
34.	Combinatorics: Permutations, combinations, recurrences,	3	1
35.	Generating functions, partitions, special numbers like Fibonacci, Stirling and Catalan numbers.	6	2
36.	Graphs and digraphs, special types of graphs	4	1
37.	Isomorphism, connectedness, Euler and Hamilton paths	4	1
38.	Planar graphs, graph colouring, trees, matching	4	1
		TOTAL 41	12

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP-Mathematics

Core course Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**DIFFERENTIAL EQUATION**
2.	Subject Code:	MA2L303
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	3
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	52 APPROX
8.	Theory:	Differential Equations
9.	(Autumn/ Spring):	Autumn
10.	Level:	2
11.	Pre- requisite:	Calculus/Real Analysis
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Ordinary Differential Equations:

Unit I. First order differential equations, statement of existence and uniqueness theorem, exact, linear and Bernoulli's form, second order differential equations with constant coefficients, Euler's equations,

Unit II. Articular integrals by: variation of parameters, undetermined coefficients, operator method, Power series solution of ODE, Frobenius theorem, Bessel functions and Legendre polynomials. system of differential equations.

Partial Differential Equations:

Unit III. Formulation of partial differential equations by eliminating arbitrary constants and functions, linear and quasi-linear equations of first order. Classification of integrals, Pfaffian differential equation in three variables.

Unit IV. Lagrange's Method of solution and its geometrical interpretation, compatibility condition, Charpit's method, special types of first order equations.

14. Suggested Texts:

1. Kreyszig E. *Advanced Engineering Mathematics*, John Wiley & Sons
2. Coddington E. A. *An Introduction to Ordinary Differential Equations*, Prentice Hall
3. I N Sneddon : Elements of Partial Differential Equation : Dover Publication of 1957 books

15. Suggested References:

- Ross S. L. *Differential Equations*, Wiley
- Thomas G. B. and Finney R. L. *Calculus and Analytic Geometry*, Pearson
- Strauss W.A*. Partial Differential Equations: An Introduction*, John Wiley
- Partial Differential equations: classical theory with a modern touch, A K Nandakumaran and P. S Datti, Cambridge IISc Press.

16. Break-up of lectures and tutorials

S.NO.	TOPIC	NO. OF LECTURES	TUTORIALS
1.	First order differential equations, statement of existence and uniqueness theorem	2	1
2.	Exact, linear and Bernoulli's form	3	1
3.	Second order differential equations with constant coefficients, Euler's equations	4	2
4.	Particular integrals by: variation of parameters, undetermined coefficients	3	1
5.	Operator method	3	2
6.	Power series solution of ODE, Frobenius series, Bessel functions and Legendre polynomials.	5	2

7.	System of differential equations	2	1
8.	Formulation of partial differential equations by eliminating arbitrary constants and functions, linear and quasi-linear equations of first order.	4	1
9.	Classification of integrals, Pfaffian differential equation in three variables.	3	0
10.	Lagrange's Method of solution and its geometrical interpretation, compatibility condition	3	1
11.	Charpits method	3	1
12.	Special types of first order equations	3	1
		TOTAL 38	14

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course Mathematics major/ minor students.

Name of the Schools: proposed by SBS

1.	Course Title:	**NUMERICAL METHODS**
2.	Subject Code:	MA2L304
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	4
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	52 APPROX
8.	Theory:	Graph Theory
9.	(Autumn/ Spring):	Spring
10.	Level:	2
11.	Pre- requisite:	NONE
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Understanding sources of errors; round-off errors, truncation errors, floating point arithmetic, Convergence, Gauss elimination, Gauss Jordan elimination, Gauss-Seidel method, Diagonal dominance, Banded matrices, storage schemes for banded matrices, skyline solver.

Unit II. Newton Raphson method, Local and global minimum, rates of convergence, convergence criteria, conjugate gradient method.

Unit III. Taylor series, Euler method, Runge-Kutta method, Finite Difference Method

Unit IV. Finite Difference Method – Laplace equation, Poison equation, 1-D heat equation, 1-D wave equation.

14. Suggested Texts:

1. J S. D. Conte and C. de Boor, Elementary Numerical Analysis: An Algorithmic approach, 3rd edition, McGraw-Hill Book Company, New York, 1980
2. D. Dahlquist, and Å.Björck, Translated by Ned Anderson, Numerical Methods, 1stedition, Dover Publication, New York,2003

15. Suggested References:

1. K. E. Atkinson, Introduction to Numerical Analysis, 2nd Edition, John Wiley,New York, 1989
2. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, 5th edition, Addison Wesley, Massachusetts, 1994

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
39.	Understanding sources of errors; round-off errors, truncation errors, floating point arithmetic, Convergence	6	2
40.	Gauss elimination, Gauss Jordan elimination, Gauss-Seidel method, Diagonal dominance, Banded matrices, storage schemes for banded matrices, skyline solver.	8	3
41.	Newton Raphson method, Local and global minimum, rates of convergence, convergence criteria, conjugate gradient method.	8	3
42.	Taylor series, Euler method, Runge-Kutta method, Finite Difference Method	8	3
43.	Finite Difference Method – Laplace equation, Poison equation, 1-D heat equation, 1-D wave equation.	8	3
		TOTAL 38	14

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**ABSTRACT ALGEBRA**
2.	Subject Code:	MA2L305
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	4
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	52APPROX
8.	Theory:	Algebra
9.	(Autumn/ Spring):	Spring
10.	Level:	2
11.	Pre- requisite:	Nil
12.	Lab:	NONE

21. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Definition, examples and properties of groups, Subgroups, Normal Subgroups, Quotient groups, Homomorphism, Isomorphism theorems, Order of a subgroup, Lagrange's Theorem.

Unit II. Subgroups generated by subsets of a group, Cyclic group, Dihedral group, Group actions, Orbit-Stabilizer Theorem, Centralizer, Normalizer, Class Equation.

Unit III. Symmetric and Alternating groups, Simplicity of A_n, Cayley's Theorem, Automorphism groups, Direct product.

Unit IV. The Sylow Theorems, Structure theorem of finite abelian groups. Introduction to rings and fields with examples.

22. Suggested Texts:

1. J. A. Gallian, *Contemporary Abstract Algebra*, Boston, Houghton-Mufflin, 2002.
2. D. S. Dummit, R. M. Foote, *Abstract Algebra*, Wiley-India Edition, 2013.

23. Suggested References:

1. M. Artin, Algebra, Pearson Education, 2011.
2. I. N. Herstein, Topics in Algebra, New York: Wiley, 1975.

20. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
44.	Definition, Examples and properties of groups	2	1
45.	Subgroups, normal subgroups and Quotient groups	3	1
46.	Homomorhism, isomorphism theorems, order of subgroup, Lagrange's Theorem	4	1
47.	Subgroups generated by subsets of a group, Cyclic group, Dihedral group	4	2
48.	Group actions, Orbit-Stabilizer Theorem, Centralizer, Normalizer, Class Equation.	4	1
49.	Symmetric and Alternating groups, Simplicity of A_n	6	2
50.	Cayley's Theorem, Automorphism groups, Direct product.	4	1
51.	The Sylow Theorems	5	1
52.	Structure theorem of finite abelian groups	3	1
53.	Introduction to rings and fields with examples	4	2
		TOTAL 39	13

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**OPTIMIZATION TECHNIQUES**
2.	Subject Code:	MA2L306
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	4
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Optimization Techniques
9.	(Autumn/ Spring):	Spring
10.	Level:	2
11.	Pre- requisite:	Nil
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I: Overview of linear algebra: System of linear equations, consistent and inconsistent system. Basic solutions, degenerate solution, basic variables, basis of matrix.

Unit II. Convex set, extreme point. Single objective linear programming model. Graphical solution and its interpretation. Bounded and unbounded model. Feasible and infeasible solutions.

Unit III. Simplex method, revised simplex method, Duality, sensitive analysis, Complementary slackness theorem.

Unit IV. Transportation and assignment problems. Introduction to Nonlinear Optimization: Basic theories, method of Lagrange multipliers.

14. Suggested Texts:

- M. S. Bazarra, J. J. Jarvis and H. D. Sherali, *Linear Programming and Network Flows*, WSE.
- Edwin K. P. Chong and Stanislaw L. Zak, *An Introduction to Optimization*, 4th Edition. A John Wiely & Sons INC., Publication, 2017.
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15. Suggested References:

- D.G. Luenberger, *Linear and Nonlinear Programming*, 4nd Edition, Springer, 2015.
- S. S. Rao*, Optimization: Theory and applications*, Halsted Press, 1979.
- J. P. Ignizio, *Linear programming in single & multiple objective system*, Prentice Hall, 1982.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
54.	Overview of linear algebra: System of linear equations, consistent and inconsistent system. Basic solutions, degenerate solution, basic variables, basis of matrix.	6	1
55.	Convex set, linear programming model	3	1
56.	Properties of the model and its solutions	4	1
57.	Simplex method and revised simplex method	8	2
58.	Duality, sensitive analysis	10	3
59.	Transportation and assignment problems	6	2
60.	Nonlinear optimization	4	2
		TOTAL 41	12

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**ELEMENTARY NUMBER THEORY**
2.	Subject Code:	MA3L301
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	5
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	54 APPROX
8.	Theory:	Number Theory
9.	(Autumn/ Spring):	Autumn
10.	Level:	3
11.	Pre- requisite:	Nil
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Review of Arithmetic in **Z**: Divisibility, gcd and lcm, Division algorithm, Euclidean algorithm. Prime numbers, Fundamental theorem of Arithmetic, Goldberg conjecture, Euclid's and Euler's proof of infinitude of primes, twine prime conjecture (statement only).

Unit II. Modular Arithmetic: Congruence relations - linear and polynomial, Fermat's little theorem, Euler's theorem, Wilson's theorem, Chinese Remainder Theorem, Solutions of $X^n = 1$.

Unit III. Arithmetic functions: Definition and examples of arithmetic functions like Mobius functions, Euler's ϕ-function, Divisor function, the prime counting function π(x). Dirichlet multiplication and Mobius inversion formula, Multiplicative functions, Dirichlet series and Euler product.

Unit IV. Quadratic Residue and Diophantine Equations: Primitive roots, index arithmetic, structure of unit group of **Z**/n**Z.** Quadratic residue, Legendre and Jacobi symbols, Quadratic Reciprocity law (statement only); Sums of two squares and four squares. Linear Diophantine equations, Pythagorean triples, Fermat's last theorem; Continued fractions and rational approximations.

14. Text Books:

1. D. M. Burton, Elementary Number Theory, McGraw Hill, 2011.
2. T. Koshy, Elementary number theory, Academic Press, 2007.

15. Reference Books:

1. T. M. Apostol, Introduction to Analytic number theory, Springer-Verlag, 1976.
2. G. E. Andrews, Number Theory, Dover Publication, 1971.
3. I. Niven, H. S. Zukerman and H. L. Montgomery, An introduction to the theory of Numbers, Wiley, 1991.
4. K. Ireland and M. Rosen, A classical introduction to modern number theory, GTM 84, Springer-Verlag, 1990.
5. G. H. Hardy and E. M. Wright, An introduction to the theory of Numbers, Oxford University Press, 2008.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
61.	Divisibility, gcd and lcm, Division algorithm, Euclidean algorithm	3	2
62.	Prime numbers, Fundamental theorem of Arithmetic	1	1
63.	Goldberg conjecture, Euclid's and Euler's proof of infinitude of primes, twine prime conjecture (statement only).	1	1
64.	Congruence relations - linear and polynomial	3	2
65.	Fermat's little theorem, Euler's theorem, Wilson's theorem, Chinese Remainder Theorem, Solutions of $X^n = 1$.	2	2

66.	Definition and examples of arithmetic functions like Mobius functions, Euler's ϕ-function, Divisor function, the prime counting function $\pi(x)$.	6	3
67.	Dirichlet multiplication and Mobius inversion formula, Multiplicative functions, Dirichlet series and Euler product	5	2
68.	Primitive roots, index arithmetic, structure of unit group of $\mathbf{Z}/n\mathbf{Z}$	3	2
69.	Quadratic residue, Legendre and Jacobi symbols, Quadratic Reciprocity law (statement only); Sums of two squares and four squares.	3	2
70.	Linear Diophantine equations, Pythagorean triples, Fermat's last theorem	3	1
71.	Continued fractions and rational approximations.	4	2
		TOTAL 34	20

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**GRAPH THEORY**
2.	Subject Code:	MA3L302
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	5
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Graph Theory
9.	(Autumn/ Spring):	Autumn
10.	Level:	3
11.	Pre- requisite:	NONE
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Isomorphism, incidence and adjacency matrices, Sperner lemma, Trees, Cayley formula, connector problem, connectivity, constructing reliable communication network.

Unit II. Euler tours, Hamilton cycle, Chinese postman and traveling salesman problems.

Unit III. Matchings and coverings, perfect matchings, edge colouring, Vizing Theorem, time table problem, Independent sets, Ramsey theorem, Turan theorem, Schur theorem, vertex colouring, Brook theorem, Hajos conjecture, chromatic polynomials, storage problem.

Unit IV. Planarity, dual graphs, Euler formula, Kuratowski theorem, five colour theorem, history of four colour theorem, nonhamiltonian planar graphs, planarity algorithm, directed graphs, job sequencing, one way road system, ranking participants in tournaments.

14. Suggested Texts:

1. J. A. Bondy and U. S. R. Murty. *Graph Theory with Applications*.North-Holland, 1976.
2. D. B. West, *Introduction to Graph Theory*, Pearson; 2nd edition, 2000.

15. Suggested References:

1. J. M. Aldous. *Graphs and Applications*. Springer, LPE, 2007.
2. F. Harary, *Graph Theory*, Narosa Publishing House, 2001.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
72.	Isomorphism, incidence and adjacency matrices	4	1
73.	Sperner lemma, Trees, Cayley formula, connector problem, connectivity, constructing reliable communication network.	4	1
74.	Direct sum of vector space, quotient spaces, Linear Transformation and matrix representation of linear transformation	6	2
75.	Euler tours, Hamilton cycle, Chinese postman and traveling salesman problems.	4	2
76.	Matchings and coverings, perfect matchings, edge colouring, Vizing Theorem, timetable problem,	6	2
77.	Independent sets, Ramsey theorem, Turan theorem, Schur theorem, vertex colouring, Brook theorem, Hajos conjecture, chromatic polynomials, storage problem.	6	1
78.	Planarity, dual graphs, Euler formula, Kuratowski theorem, five colour theorem, history of four colour theorem,	5	1
79.	Nonhamiltonian planar graphs, planarity algorithm, directed graphs, job sequencing, one way road system, ranking participants in tournaments.	6	2
		TOTAL 41	12

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Elective course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**FUNCTIONS OF SEVERAL VARIABLES**
2.	Subject Code:	MA3L303
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	5
6.	Core/Elective/Breadth:	Elective
7.	Contact Hours:	54 APPROX
8.	Theory:	Functions of Several Variables
9.	(Autumn/ Spring):	Autumn
10.	Level:	3
11.	Pre- requisite:	Basic Calculus and Real Analysis or Mathematics-I or equivalent
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I: Vector functions and space curves, Arc length and curvature, Motion in space, Cylindrical and spherical coordinates, Limits and continuity for functions of several variables.

Unit II. Partial derivatives, Taylor series expansion in two variables, Tangent planes and differentials, The chain rule and implicit differentiation, Directional derivatives and the gradient vector, Total derivative, Local and absolute extrema for functions of several variables.

Unit III. Double and iterated integrals including polar coordinates, Applications of double integrals, Triple and iterated integrals, including cylindrical and spherical coordinates, Change of variable in multiple integrals.

Unit IV. Vector fields and line integrals, The fundamental theorem for line integrals, Curl and divergence of vector fields, Green's theorem, Gauss divergence Theorem, Stokes Theorem.

14. Suggested Texts:

- G.B. Thomas Jr., M.D. Weir and J.R. Hass, *Thomas Calculus*, Pearson Education, 2009.
- Terence Tao, *Analysis II*, Hindustan Book Agency, 3rd Edition, 2015.
- Tom M. Apostol, *Mathematical Analysis*, Narosa Publishing House, 2nd Edition, 2002.

15. Suggested References:

- E. Kreyszig, *Advanced Engineering Mathematics*, 10th Ed., John Willey & Sons, 2010.
- N. Piskunov, *Differential and Integral Calculus Vol. 1-2*, Mir Publishers, 1974.
- Tom M. Apostol, *Calculus Vol 2*, 2nd Edition, Wiley & Sons, 1975.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
80.	Vector functions, curvature	3	1
81.	Motion in space and various coordinate systems	3	0
82.	Limit-continuity for functions of severable	3	1
83.	Unit II	10	3
84.	Double and iterated integrals	3	1
85.	Applications of multiple integrals and change of variables in multiple integrals	9	3
86.	Vector fields, line integrals and fundamental theorems of line integrals	3	1
87.	Curl and divergence of vector fields	2	0
88.	Theorems of Green, Gauss and Stokes	6	2
		TOTAL 42	12

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Elective course for Mathematics major students

Name of the Schools: proposed by SBS

1.	Course Title:	**FLUID DYNAMICS**
2.	Subject Code:	MA3L304
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	5
6.	Core/Elective/Breadth:	Elective
7.	Contact Hours:	52 APPROX
8.	Theory:	Fluid Dynamics
9.	(Autumn/ Spring):	Autumn
10.	Level:	3
11.	Pre- requisite:	Calculus, Differential Equation
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Kinematics of Fluid Motion

Solids, Liquids and Gases, Continuum hypothesis, Velocity at a point of a fluid, Lagrangian and Eulerian approaches, streamlines, pathlines and streak lines, Acceleration at a point of a fluid, Equation of continuity, Reynolds Transport theorem.

Unit II. Mechanics of Fluid Motion

Pressure (static and dynamic), Boundary conditions, Euler's equation of motion of an ideal fluid, Bernoulli's Equation, Kelvin's circulation theorem, Vorticity equation, Energy equation.

Unit III. Potential Flow

Analysis of Local fluid motion: Translation, Rotation, and Deformation, Vorticity, potential flow, Mean value of the velocity potential, Uniform flow, Axially symmetric flows, Sphere at rest in a uniform stream, Impulsive motion, Sphere in motion on fluid at rest at infinity.

Unit IV. Two-Dimensional Flows

Two-Dimensional Flow, stream function, complex potential, complex velocity potential, sources, sinks, doublets, Milne-Thomson Circle Theorem, theorem of Blasius.

14. Suggested Texts:

1. M. E. O'Neill and F. Chorlton. *Ideal and incompressible Fluid dynamics*, John Wiley & Sons publishers
2. F. Chorlton. *Text Book of Fluid Dynamics*, C.B.S. Publishers, Delhi.
3. Shanti Swarup. *Fluid Dynamics*, Krishna Prakashan Media publishers, Meerut.

15. Suggested References:

- N. Curle and H J Davies. *Modern fluid dynamics*, The New University Mathematics Series.
- G. K. Bachelor. *An Introduction to Fluid Dynamics*. Cambridge University Press. London.
- Z.U.A. Warsi. *Fluid Dynamics, Theoretical and Computational Approaches*, C.R.C. Press.

16. Break-up of lectures and tutorials

S.NO.	TOPIC	NO. OF LECTURES	TUTORIALS
13.	Solids, Liquids and Gases, Continuum hypothesis, Velocity at a point of a fluid	2	1
14.	Lagrangian and Eulerian approaches	3	1
15.	Streamlines, pathlines and streak lines, Acceleration at a point of a fluid	4	2
16.	Equation of continuity, Reynolds Transport theorem	3	1

17.	Pressure (static and dynamic), Boundary conditions	3	1
18.	Euler's equation of motion of an ideal fluid, Bernoulli's Equation, Kelvin's circulation theorem	4	2
19.	Vorticity equation, Energy equation	2	1
20.	Analysis of Local fluid motion: Translation, Rotation, and Deformation	3	1
21.	Vorticity, potential flow, Mean value of the velocity potential, Uniform flow	3	0
22.	Axially symmetric flows, Sphere at rest in a uniform stream, Impulsive motion, Sphere in motion on fluid at rest at infinity	4	1
23.	Two-Dimensional Flow, stream function	2	1
24.	complex potential, complex velocity potential, sources, sinks, doublets	3	1
25.	Milne-Thomson Circle Theorem, theorem of Blasius	2	1
	TOTAL	38	14

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Elective course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**TOPOLOGY**
2.	Subject Code:	MA3L305
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	5
6.	Core/Elective/Breadth:	Elective
7.	Contact Hours:	53 APPROX
8.	Theory:	Topology
9.	(Autumn/ Spring):	Autumn
10.	Level:	3
11.	Pre- requisite:	Real Analysis
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Set theory and logic, Fundamental concepts, Functions and relations, Cartesian products, Countable and uncountable sets, Definitions and examples of topological spaces, Open sets, Basis for a topology.

Unit II. Order topology, Product topology on X×Y, Subspace topology, Closed sets and limit points, Continuous functions, Homeomorphisms.

Unit III. Metric topology, Examples and properties of metric spaces, Hausdorff spaces, Uniform limit theorem, Quotient map, Definition and examples of quotient topology.

Unit IV. Definition and examples of connected spaces, Intermediate value theorem, Path connectedness, Compact spaces, Tube lemma, Heine-Borel theorem, Extreme value theorem, Uniform continuity theorem.

14. Text Books:

1. J. R. Munkres, Topology, Pearson Education, 2003.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education, 2017.

15. Reference Books:

1. M. A. Armstrong, Basic Topology, Springer, 1997.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
89.	Set theory and logic, Fundamental concepts, Functions and relations, Cartesian products, Countable and uncountable sets	2	1
90.	Definitions and examples of topological spaces, Open sets	2	1
91.	Basis for a topology	2	1
92.	Order topology, Product topology on X×Y, Subspace topology	3	1
93.	Closed sets and limit points	3	2
94.	Continuous functions, Homeomorphisms.	3	1
95.	Metric topology, Examples and properties of metric spaces, Hausdorff spaces, Uniform limit theorem	7	3
96.	Quotient map, Definition and examples of quotient topology	4	1

97.	Definition and examples of connected spaces, Intermediate value theorem and Path connectedness	6	2
98.	Compact spaces, Tube lemma, Heine-Borel theorem, Extreme value theorem, Uniform continuity theorem.	6	2
		TOTAL 38	15

Subject Code: ITEP-MA3S301	Subject Name: Seminar	L-T-P: 0-0-0	Credit: 2
Pre-requisite(s):			
Literature survey on assigned topic and presentation.			
Text/Reference Books: NA			

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**COMPLEX ANALYSIS**
2.	Subject Code:	MA3L306
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	6
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Complex Analysis
9.	(Autumn/ Spring):	Spring
10.	Level:	3
11.	Pre- requisite:	Real Analysis
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Complex Functions, Limit, continuity, and differentiability, Cauchy-Riemann Equations, Analytic Functions.

Unit II. Power Series, Radius of convergence, Complex Integration, Line or Path Integral, Cauchy Theorem, Cauchy Integral Formula, and their consequences.

Unit III. Elementary Conformal Mappings, Mobius Maps, Maximum Modulus Principle, Liouville Theorem, Fundamental Theorem of Algebra (proof).

Unit IV. Laurent Series, Classification of singularities: Isolated Singularities, Removable, Pole, and Essential, Residue Theorem and evaluation of certain improper integrals.

14. Text Books:

1. James W. Brown and Ruel V. Churchill, *Complex Variables and Applications*, 9th Edition, McGraw Hill Education, 2014
2. S. Ponnusamy and H. Silverman, *Complex variables with applications*, Birkhauser, 2005.

15. Reference Books:

1. John B. Conway, *Functions of One Complex Variable,* 2nd Edition, Narosa Publishing House, New Delhi, 1996.
2. Elias M. Stein and Rami Shakarchi, *Complex Analysis*, Princeton Lectures in Analysis II, 2010.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
99.	Complex Functions, Limit	3	1
100.	Continuity, and differentiability, Cauchy-Riemann Equations, Analytic Functions.	5	2
101.	Power Series, Radius of convergence	2	2
102.	Complex Integration, Line or Path Integral, Cauchy Theorem, Cauchy Integral Formula, and their consequences	8	2
103.	Elementary Conformal Mappings, Mobius Maps	4	1
104.	Maximum Modulus Principle, Liouville Theorem, Fundamental Theorem of Algebra (proof)	7	3
105.	Laurent Series, Classification of singularities: Isolated Singularities, Removable, Pole, and Essential	3	2
106.	Residue Theorem and evaluation of certain improper integrals	7	3
	TOTAL	39	14

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COURSE DETAILS FOR VARIOUS ACADEMIC PROGRAMME

Name of the Program: ITEP - Mathematics

Core course for Mathematics major students.

Name of the Schools: proposed by SBS

1.	Course Title:	**RINGS AND FIELDS**
2.	Subject Code:	MA3L307
3.	L: T: P:	3-1-0
4.	Credit:	4
5.	Semester No:	5
6.	Core/Elective/Breadth:	Core
7.	Contact Hours:	53 APPROX
8.	Theory:	Algebra
9.	(Autumn/ Spring):	Autumn
10.	Level:	3
11.	Pre- requisite:	Abstract Algebra
12.	Lab:	NONE

13. Details of Course:

Suggested Syllabus for IIT Bhubaneswar

Unit I. Definition, examples and properties of rings, Subrings, Ideals, Prime and maximal ideals, Ring homomorphism, Isomorphism theorems.

Unit II. Quotient Rings, Rings of fractions, Chinese Remainder Theorem, Polynomial Rings, Integral domain, Euclidean Domain, Principal Ideal Domain, Unique Factorization Domain, Gauss' Lemma, Irreducibility criterion, Eisenstein's criterion,

Unit III. Definition, examples and properties of fields, Characteristic of a field, Field extensions, Algebraic and transcendental elements.

Unit IV. Splitting fields, Separable and normal extensions, Primitive roots of unity, Cyclotomic polynomials, Finite fields.

14. Suggested Texts:

3. J. A. Gallian, *Contemporary Abstract Algebra*, Boston, Houghton-Mufflin, 2002.
4. D. S. Dummit, R. M. Foote, *Abstract Algebra*, Wiley-India Edition, 2013.

15. Suggested References:

3. M. Artin, Algebra, Pearson Education, 2011.
4. I. N. Herstein, Topics in Algebra, New York: Wiley, 1975.
5. C. Musili, Introduction to rings and modules, Narosa Publishing House, 1994.

16. Break-up of lectures and tutorials

S. NO.	TOPIC	NO. OF LECTURES	TUTORIALS
107.	Definition, examples and properties of rings, Subrings	1	1
108.	Ideals, Prime and maximal ideals	2	1
109.	Ring homomorphism, Isomorphism theorems	3	1
110.	Quotient Rings, Rings of fractions, Chinese Remainder Theorem	4	1
111.	Polynomial Rings	2	1
112.	Integral domain, Euclidean Domain, Principal Ideal Domain, Unique Factorization Domain	5	2
113.	Gauss' Lemma, Irreducibility criterion, Eisenstein's criterion	2	1
114.	Definition, examples and properties of fields, Characteristic of a field	2	1

115.	Field extensions, Algebraic and transcendental elements.	5	2
116.	Splitting fields, Separable and normal extensions	4	1
117.	Primitive roots of unity, Cyclotomic polynomials	4	2
118.	Finite fields	3	2
		TOTAL 37	16

Subject Code: ITEP-MA3D301	Subject Name: Project	L-T-P: 0-0-3	Credit: 2
Pre-requisite(s): NA			
Project in one assigned topic under the guidance of one faculty.			