DEPARTMENT OF MATHEMATICS

COURSE OUTCOMES (COREWISE)

Mathematics is an indispensable tool for much of science andengineering. It provides the basic language for understanding the world and lends precision to scientific thought. The mathematics program at Universities of Odisha aims to provide a foundation for pursuing research in Mathematics as well as to provide essential quantitative skills to those interested in related fields. With the maturing of the Indian industry, there is a large demand for people with strong analytical skills and broad-based background in the mathematical sciences.

CORE – I : (CALCULUS)

The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of mathematical nature as well as practical problems. Main target of this course is to explore the different tools for higher order derivatives,to plot the various curves / functions like exponential, logarithmic, trigonometric, polynomial, modulus, parametric curves, tracing of conics in cartesian co-ordinates / polar coordinates, sketching of ellipsoid, hyperboloid of one and two sheets andto solve the problems associated with differentiation andintegration of vector functions by MATLAB Programming.

After completing the course, students are expected to be able to useLeibnitz's rule to evaluate derivatives of higher order, able to study the geometry of varioustypes of functions, evaluate the area, volume using the techniques of integrations, able toidentify the difference between scalar and vector, acquired knowledge on some the basicproperties of vectorfunctions by this programming language.

CORE – II (DISCRETE MATHEMATICS)

This is a preliminary course for the basic courses in mathematics and all itsapplications. The objective is to acquaint students with basic counting principles, set theory andlogic, matrix theory and graph theory.

After completing the course, the students acquired knowledge in simple mathematicalmodelling. They can study advance courses in mathematical modelling, computer science,statistics, physics and engineering etc.

CORE – III & CORE – V (Real Analysis)

The objective of the course isto have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weierstrass Theorem, sequences and convergence of sequences, series of real numbers and its convergence etc. Studying limit of functions, continuity of functions and its properties, uniform continuity, differentiability of functions, algebra of functions and Taylor's theorem and, its applications. The student how to deal with real functions and understands uniform continuity, mean value theorems also.

On successful completion of this course, students will be able tohandle fundamental properties of the real numbers that lead to the formal development of realanalysis and understand limits and their use in sequences, series, differentiation andintegration. Students will appreciate how abstract ideas and rigorous methods in mathematicalanalysis can be applied to important practical problems. Student will have working knowledge on the concepts and theorems of the elementary calculus of functions of one real variable. They will work out problems involving derivatives of function and their applications. They can use derivatives to analyse and sketch the graph of a function of one variable, can also obtain absolute value and relative extrema of functions. This knowledge is basic and students can take all other analysis courses after learning this course.

CORE – IV& VII (Differential Equations, Partial Differential Equations & System of Ordinary Differential Equations)

Differential Equations introduced by Leibnitz in 1676 models almost all Physical,Biological, Chemical systems in nature. The objective of this course is to familiarize thestudents with various methods of solving differential equations and to have a qualitative application through models. The students have to understand basic methods for solving Partial Differential Equations of first order and second order. In the process, students will be exposed to Charpit's Method, Jacobi Method and solve wave equation, heat equation, Laplace Equationetc. They will also learn classification of Partial Differential Equations and system of ordinary differential equations.

A student completing the course is able to solve differential equationsand is able to model problems in nature using Ordinary Differential Equations. This is alsoprerequisite for studying the course in Partial Differential Equations and models dealing withPartial Differential Equations. Lastly a student will be able to take more courseson wave equation, heat equation, diffusion equation, gas dynamics, non-linear evolutionequations etc. All these courses are important in engineering and industrial applications forsolving boundary value problem and solve the problems by MATLAB Programming.

CORE – VI, X, XIV (Group Theory – I,II and Ring Theory)

Group theory and Ring theory are one of the building blocks of modern algebra. Objective of thiscourse is to introduce students to basic concepts of group theory and examples of groups andtheir properties. This course will lead to future basic courses in advanced mathematics, such asGroup theory-I, Group theory-II and ring theory.

The objective of this course **i**s to be exposed to more advanced results in group theory after completing a basic course. The course introduces results on automorphism, commutator subgroup, group action Sylow theorems etc.

This is a second course in modern algebra which deals with ring theory. Some basics of ring theory like rings, subrings, ideals, ring homomorphisms and their properties and this course is an integral part of any course on Modern algebra the others being Group theory and Field Theory.A student learning this course gets idea on concept and examples ofgroups and their properties. He understands cyclic groups, permutation groups, normalsubgroups and related results.

After this course he can opt for courses in ring theory, fieldtheory, commutative algebras, linear classical groups etc. and can be apply this knowledge toproblems in physics, computer science, economics and engineering.The knowledge of automorphism helps to study more on field theory. Students learn on direct products, group actions, class equations and their applications with proof of all results. This course helps to opt for more advanced courses in algebra and linear classical groups also this course will help for students to continue more courses in advanced Ring theory modules, Galois groups.

CORE – VIII(NUMERICAL METHODS & SCIENTIFIC COMPUTING)

Calculation of error and approximation is a necessity in all real life, industrial andscientific computing. The objective of this course is to acquaint students with variousnumerical methods of finding solution of different type of problems, which arises in differentbranches of science such as locating roots of equations, finding solution of systems of linearequations and differential equations, interpolation, differentiation, evaluating integration.

Students can handle physical problems to find an approximated solution.After getting trained a student can opt for advance courses in Numerical analysis in highermathematics. Use of good mathematical software will help in getting the accuracy one needfrom the computer and can assess the reliability of the numerical results, and determine theeffect of round off error or loss of significance and solve the problems and plot the graphsby MATLAB Programming.

CORE – IX(TOPOLOGY OF METRIC SPACES)

This is an introductory course in topology of metric spaces. The objective of thiscourse is to impart knowledge on open sets, closed sets, continuous functions, connectednessand compactness in metric spaces.
On successful completion of the course students will learn to work withabstract topological spaces. This is a foundation course for all analysis courses in future.

CORE – XI (MULTIVARIABLE CALCULUS)

The objective of this course to introduce functions of several variable to a student after he has taken a course in one variable calculus. The course will introduce partial derivativesand several of its consequences and will introduce double and triple integrals along with lineintegrals which are fundamental to all streams where calculus can be used.

After completion of this course a student will be able to calculate partialderivatives,directional derivatives,extremum values and can calculate double, triple and lineintegrals. He will have idea of basic vector calculus including green's theorem, divergencetheoremand stokes theorem. He can take courses in calculus on manifolds, Differentialgeometry and can help in numerical computations involving several variables.

CORE – XII(LINEAR ALGEBRA)

Linear algebra is a basic course in almost all branches of science. A full course in Undergraduate program will help students in finding real life applications later.
The objective of this course is to introduce a student the basics of linear algebra and some of its applications.
The student will use this knowledge wherever he/she goes after undergraduate program. It has applications in computer science, finance mathematics, industrial mathematics, bio mathematics.

CORE – XIII (COMPLEX ANALYSIS)

The objective of the courses aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity and complex integration are presented. The Cauchy's theorem and its applications, the calculus of residues and its applications are discussed in detail.
Students will be able to handle certain integrals not evaluated earlier and will know a technique for counting the zeros of polynomials. This course is prerequisite to many other advance analysis courses.

DSE – I (LINEAR PROGRAMMING)

The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications. Also, students will know the application of linear Programming method in Game Theory.
More knowledge on this topic in higher studies will help students to dealindustrial models. This is also prerequisite for studying advanced courses in NonlinearProgramming Problems, Inventory Control Problem and Queuing Theory etc.

DSE – II(PROBABILITY & STATISTICS)

The objective of the course is to expertise the student to the extensive role ofstatistics in everyday life and computation, which has made this course a core course in allbranches of mathematical and engineering sciences.
The students shall learn probability and statistics for various randomvariables, multivariate distributions, correlations and relations. He shall learn law of largenumbers and shall be able to do basic numerical calculations.

DSE – III(DIFFERENTIAL GEOMETRY)

After learning methods on curve tracing andAnalytic Geometry, the objective of thiscourse is to teach Differential geometry of curves and surfaces which trains a student using tools in calculus to derive intrinsic properties of plain curves and space curves.

After completing this course, a student will learn on Serret-Frenetformulae, relation between tangent, normal and binormals, first and second fundamental forms and ideas on various curvatures. He has scope to take more advanced courses in surface theoryand geometry.

DSE – IV (NUMBER THEORY)

The main objective of this course is to build up the basic theory of the integers,primenumbers and their primitive roots, the theory of congruence, quadratic reciprocity lawand number theoretic functions, Fermat's last theorem, to acquire knowledge in cryptography specially in RSA encryption and decryption.

Upon successful completion of this course students will able to know thebasic definitions and theorems in number theory, to identify order of an integer, primitive roots,Euler's criterion, the Legendre symbol, Jacobi symbol andtheir properties, to understandmodular arithmetic number-theoretic functions and apply them to cryptography.

OR

DSE – IV (PROJECT)

1. A student registering for doing project is to inform the HOD, Mathematics the name of his/her project supervisor(s) at the time of pre-registration.
2. The student must submit the "Project RegistrationForm'', appended as Annexure-I to this document, to the HOD, Mathematics.
   This formrequires
   a) A project title,
   b) The signature of the student
   c) Signature(s) of the supervisor(s)
   d) The signature of the HOD, Mathematics of the college/university.
3. The project supervisor(s) should be a faculty member(s) of the Department ofMathematics and the topic of the project should be relevant to Mathematical Sciences. Ifa student desires to have a Project Supervisor from another department of the institute,the prior approval for the same should be sought from the HOD,Mathematics.

4. A student may have atmost two Project Supervisors. If a student desires to have twosupervisors, at least one of these should be from the Department of Mathematics.
5. The student(s) will be required to submit
   a) **First progress report** - 20%

   (Project progress reports should normally be no longer than 250 words)

   b) **Second / Final report** of theProject to the HOD, Mathematics.- 30% The hard copy and an electronic version of the second / final report of the project should be submitted two weeks before the end semester examination in which the project is undertaken.

   (Second / Final progress reportshould not be longer than 40 A4 size pages in double spacing. Each final project reportneeds to contain the following:

   (i) Abstract (ii) Table of contents (iii)Review of literature (iv) Main text(v) List of references. It may be desirable to arrange the main text as anintroduction, the main body and conclusions.)

   c) **Oral Presentation** in front of a committee **(**Under Graduate (B.A./B.Sc.) Mathematics (Honours) (Project committee of the college in which supervisor is one of the members)constituted for this purpose by the Department of Mathematics of the college – 30%
6. The student is to devote about 100 hours. The project will be evaluated by acommittee of faculty members at the end of the sixth semester. The committee will beconstituted by the Under Graduate (B.A./B.Sc.) Mathematics(Honours) Projectcommittee of the college keeping in mind the areas of project they will cover.
7. In each semester the grade of a student will be awarded by the committeewith his/her project supervisor(s). The project is evaluated on the basis of the followingcomponents:
   First Progress Reports: 20%;
   Second/Final Report: 30%;
   Presentation:30%;
   Viva:20%.

GUIDELINES FOR STRUCTURING CONTENTS

Sequence of Contents:

The following sequence for the thesis should be followed:

(i) Preliminaries :

Title Page

Certificate

Abstract/Synopsis

Acknowledgement and / or Dedication

Table of Contents

List of Figures, Tables, Illustrations,

Symbols, etc (wherever applicable)

(ii) Text of Thesis Introduction :

The body of the thesis, summary and conclusions

(iii) Reference Material List of References, Bibliography

(iv) Appendices

Upon successful completion of this course students will able to know how the research work can be done in higher studies.