

**Govt. College for Women,  
Parade Ground, Jammu  
Autonomous College under University of Jammu**



**Learning Outcomes based Curriculum Framework  
(LOCF)**

**B.A./B.Sc./B.C.A. (CBCS) with Mathematics as a Subject  
(Session 2020, 2021 and 2022)**

## **Preamble**

The objective of any university/college programme is to prepare students to be upright and productive citizens. Need of hour is to develop students by inculcating in them creative and reasoning abilities so that they will give their positive contribution for the development of the society in particular and country as a whole.

The learning outcomes of each paper are designed so that these may help learners to understand the main objectives of studying the course. This will enable learners to select elective papers depending on the individual inclinations and contemporary requirements.

The objectives of LOCF are to mentally prepare the students to learn Mathematics leading to graduate degree with Mathematics as a subject. These syllabi in Mathematics under CBCS are recommended keeping in view of the wide applications of Mathematics in science, engineering, social science, business and a host of other areas.

The study of the syllabi will enable the students to be equipped with the state of the art of the subject and will empower them to get jobs in technological and engineering fields as well as in business, education and healthcare sectors. The text books mentioned in references are denotative/ demonstrative. The divisions of each paper in units are specified to the context mentioned in courses. These units will help the learners to complete the study of concerned paper in certain periods and prepare them for examinations. The papers are organized considering the credit load in a particular semester. The core papers of general interest are suggested for semesters I to VI. The elective courses and generic courses are proposed for the students of semesters V & VI and skill based courses for semesters III to VI.

The Mathematics is a vast subject with immense diversity. Hence it is very difficult for every student to learn each branch of mathematics, even though each paper has its unique importance. Under these circumstances, LOCF in Mathematics suggests a number of elective papers along with compulsory papers. A student can select elective papers as per her needs and interests.

In this direction, the college offers learning outcome-based curriculum framework (LOCF) for its entire undergraduate programme. LOCF is intended to provide Focused outcome-based syllabi at the undergraduate level to make the whole teaching- learning experiences as much student-centric as possible. These programmes will enhance student's intellectual competences, skills and readiness to face the world to make them socially aware and responsible citizens. The new curriculum of B.A./B.Sc./B.C.A. Semester I & II in Mathematics has the aim to enable students not only to seek but also to create scientific skill among them. The LOCF curriculum takes into consideration the requirement of the present as well as the future time. It offers training that is comparable to that of an undergraduate student at the national level. College hopes that LOCF approach of the programme will be of great help to the students in deciding their goal and field of further education.

## **1. Course structure**

### **1.1 Alignment with CBCS**

The undergraduate course in Mathematics is aligned with Choice Based Credit System (CBCS) adopted by Government College for Women, Parade, Jammu.

### **1.2 Types of Courses**

1. Core Courses
2. Disciplines Specific Electives
3. Skill enhancement Courses
4. Generic courses

## Courses Offered by Department of Mathematics

### The Examination to be held in the Session 2020, 2021, 2022.

#### **Core Courses B.A./B.Sc./B.C.A.(Prog.) Mathematics**

##### **Semester: I**

Title: Differential Calculus  
Course Number: UMATC-101

##### **Semester: II**

Title: Differential Equations  
Course Number: UMATC-201

##### **Semester: III**

Title: Real Analysis  
Course Number: UMATC-301

##### **Semester: IV**

Title: Abstract Algebra  
Course Number: UMATC-401

#### **Discipline Specific Elective (DSE) B.A./B.Sc./B.C.A.(Prog.) Mathematics**

##### **Semester: V**

Title: Linear Algebra  
Course Number: UMATDSE-501  
or

##### **DSE-2**

Title: Matrices  
Course Number: UMATDSE-502

##### **Semester: VI**

Title: Numerical Methods  
Course Number: UMATDSE-601  
or

##### **DSE-2**

Title: Complex Analysis  
Course Number: UMATDSE-602

#### **Generic Elective (GE) B.A. (Prog.) Mathematics**

##### **Semester: V**

Title: Numerical Ability-I  
Course Number: UMATGE-501

##### **Semester: VI**

Title: Numerical Ability-II  
Course Number: UMATGE-601

#### **Skill based Papers B.A./B.Sc./B.C.A.(Prog.) Mathematics**

##### **Semester: III**

Title: Logics, Sets and Relation  
Course Number: UMATS-301

##### **Semester: IV**

Title: Vector Analysis  
Course Number: UMATS-401

##### **Semester: V**

Title: Probability and Statistics  
Course Number: UMATS-501

##### **Semester: VI**

Title: Analytic Geometry  
Course Number: UMATS-601

# Learning Outcomes-based Curriculum Framework in B.A./B.Sc./B.C.A. with Mathematics as a subject

## 1. Introduction

One of the significant reforms in the undergraduate education is to introduce the Learning outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. Outcome based learning is the principal end of pedagogical transactions in higher education in today's world in the light of exponential changes brought about in science and technology, especially in Mathematics, and the prevalent utilitarian world view of the society. The learning outcomes are attained by students through skills acquired during a programme of study. Programme learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies. It would also focus on knowledge and skills that prepare students for further study, employment, and citizenship. They help ensure comparability of learning levels and academic standards across colleges/universities and provide a broad picture of the level of competence of graduates.

The quality education in a subject like Mathematics is a very challenging task for Higher Education System in India. UGC has already taken an appropriate measure to define the minimum levels of learning for Mathematics courses for undergraduate and post-graduate levels. The quality of higher education in Mathematics should be improved in such a manner that young minds are able to compete in this field globally in terms of their knowledge and skills in the globalised era of the date. Also, there is an urgent need of sustained initiatives to be taken by colleges/institutes/universities for outcome-oriented higher education in Mathematics so that graduates are enabled to enhance the chances of employability. Presently, the goal of higher education in mathematics may be achieved using the following measures:

- i) Curriculum reform based on a learning outcomes-based curriculum framework
- ii) Improving learning environment and academic resources.
- iii) Elevating the quality of teaching and research.
- iv) Involving students in discussions, problem-solving and out of box thinking about various ideas of mathematics and their applicability, which may lead to empowerment and enhancement of the social welfare at large.
- v) Encouraging the learners to make use of LOCF to learn Mathematics through distance education.
- vi) Motivating the learners to understand various concepts of Mathematics keeping in view the regional context.
- vii) Enabling learners to create research atmosphere in Mathematical sciences in their colleges/institutes/universities.
- viii) Teach courses of mathematics based on Choice Based Credit System (CBCS).

One of the benchmarks to measure the progress of a country is the advancement of the knowledge of Mathematics. Hence, innovative measures should be taken to improve the quality of mathematical knowledge in our society. This is also because Mathematics has wide ranging applications in engineering, technology and a host of other areas.

## 2. Learning Outcomes-based approach to Curriculum Planning

The Bachelor's Degree in B.A./B.Sc./B.C.A. with Mathematics as a subject, is awarded to the students on the basis of knowledge, understanding, skills, attitudes, values and academic achievements sought to be acquired by learners at the end of these programmes. Hence, the learning outcomes of mathematics for these courses are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for knowledge of Mathematics.

The LOCF in Mathematics has designed courses in the light of graduate attributes, description of qualifications, courses and programme learning outcomes. The committee has tried to frame the syllabi of mathematics in such a way that it may lead to all round development and delivery of complete curriculum planning. Hence, it provides specific guidelines to the learners to acquire sufficient knowledge during this programme.

The objectives of LOCF (Mathematics) is to prepare the syllabi having standard level of study. It is also aimed at prescribing standard norms for teaching-learning process and examination pattern. Hence, the programme has been chalked out in such manner that there is scope of flexibility and innovation in

- i. modifications of prescribed syllabi.
- ii. teaching-learning methodology.
- iii. assessment technique of students and knowledge levels.
- iv. learning outcomes of courses.
- v. inclusion of new elective courses subject to availability of experts in colleges/institutes/universities across the country.

### 2.1. Nature and extent of Bachelor's Degree Programme

Mathematics is the study of quantity, structure, space and change. It has very broad scope in science, engineering and social sciences. The key areas of study in Mathematics are:

1. Calculus
2. Algebra
3. Geometry
4. Differential Equations
5. Analysis
6. Numerical Methods
7. Statistics and Probability
8. Logic

The depth and breadth of study of individual topics depend on the nature and devotion of learners in specific mathematics programmes. As a part of effort to enhance employability of mathematics graduates, the courses have been designed to include learning experiences, which offer them opportunities in various sectors of human activities. In this context, the experience of the project work in the areas of applications of mathematics has a key role.

### 2.2. Aims of Bachelor's degree programme in Mathematics

The overall aims of B.A./B.Sc./B.C.A. with Mathematics as a subject are to

- create deep interest in learning Mathematics.

- develop broad and balanced knowledge and understanding of definitions, concepts, principles and theorems.
- familiarize the students with suitable tools of Mathematical analysis to handle issues and problems in mathematics and related sciences.
- enhance the ability of learners to apply the knowledge and skills acquired by them during the programme to solve specific theoretical and applied problems in Mathematics.
- provide students/learners sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas on multiple disciplines concerned with Mathematics.
- encourage the students to develop a range of generic skills helpful in employment, internships and social activities.

### **2.3. Key outcomes underpinning curriculum planning and development**

The LOCF in Mathematics desires to propose the courses of Mathematics for B.A./B.Sc./ B.C.A. with Mathematics as a subject, based on the expected learning outcomes and academic standards which are necessary for the graduates after completing these programmes. The committee considered and discussed the following factors seriously:

- i. Framing of syllabi
- ii. Learners attributes
- iii. Qualification descriptors
- iv. Programme learning outcomes
- v. Course learning outcomes
- vi. Necessity of having elective courses
- vii. Applications of mathematics
- viii. Employability in banking, finance and other sectors.

## **3. Graduate Attributes in Mathematics**

The graduate attributes in mathematics are the summation of the expected course learning outcomes mentioned in the beginning of each course. Some of them are stated below.

### **3.1. Disciplinary knowledge:**

Capability of demonstrating comprehensive knowledge of Mathematics and understanding of one or more disciplines which form a part of an undergraduate programme of study.

### **3.2. Communications skills:**

- i. Ability to communicate various concepts of Mathematics effectively using examples and their geometrical visualizations.
- ii. Ability to use Mathematics as a precise language of communication in other branches of human knowledge.
- iii. Ability to communicate long standing unsolved problems in Mathematics.
- iv. Ability to show the importance of Mathematics as precursor to various scientific developments since the beginning of the civilization.
- v. Ability to explain the development of Mathematics in the civilizational context and its role as queen of all sciences.

### **3.3. Critical thinking and analytical reasoning:**

- i. Ability to employ critical thinking in understanding the concepts in every area of Mathematics.
- ii. Ability to analyze the results and apply them in various problems appearing in different branches of Mathematics.

### **3.4. Problem solving:**

- i. Capability to solve problems in computer graphics using concepts of linear algebra.
- ii. Capability to solve various models such as growth and decay models, radioactive decay model, drug assimilation, LCR circuits and population models using techniques of differential equations.
- iii. Ability to solve linear system of equations, linear programming problems and network flow problems.
- iv. Ability to provide new solutions using the domain knowledge of Mathematics acquired during this programme.

### **3.5. Research-related skills:**

- i. Capability for inquiring about appropriate questions relating to the concepts in various fields of Mathematics.
- ii. To know about the advances in various branches of Mathematics.

### **3.6. Information/digital literacy:**

- i. Capability to use appropriate softwares to solve system of equations and differential equations.
- ii. Capability to understand and apply the programming concepts of C++ to Mathematical investigations and problem solving.

### **3.7. Self-directed learning:**

Ability to work independently and do in-depth study of various notions of Mathematics.

### **3.8. Moral and ethical awareness/reasoning:**

Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects.

### **3.9. Lifelong learning:**

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

## **4. Qualification descriptors for B.A./B.Sc./B.C.A. with Mathematics as a subject**

The qualification descriptor suggests the generic outcomes and attributes to be obtained while obtaining the degree of B.A./B.Sc./B.C.A. with Mathematics as a subject. The qualification descriptors indicate the academic standards on the basis of following factors:

- i. Level of knowledge



- ii. Understanding
- iii. Skills
- iv. Competencies and attitudes
- v. Values.

These parameters are expected to be attained and demonstrated by the learners after becoming graduates in these programmes. The colleges/institutes/universities should consider the above mentioned parameters at the time of designing, approving, assessing and reviewing academic programmes containing common courses for B.A./B.Sc./B.C.A. with Mathematics as a subject. The learning experiences and assessment procedures should be so designed that every graduate with mathematics may achieve the programme learning outcomes with equal opportunity irrespective of the class, gender, community and regions. Each graduate in Mathematics should be able to:

- i. demonstrate fundamental systematic knowledge of mathematics and its applications in engineering, science, technology and mathematical sciences. It should also enhance the subject specific knowledge and help in creating jobs in various sectors.
- ii. demonstrate educational skills in areas of analysis, geometry, algebra, mechanics, differential equations etc.
- iii. apply knowledge, understanding and skills to identify the difficult/unsolved problems in Mathematics and to collect the required information in possible range of sources and try to analyse and evaluate these problems using appropriate methodologies.
- iv. fulfil one's learning requirements in mathematics, drawing from a range of contemporary research works and their applications in diverse areas of mathematical sciences.
- v. apply one's disciplinary knowledge and skills in mathematics in newer domains and uncharted areas.
- vi. identify challenging problems in mathematics and obtain well-defined solutions.
- vii. exhibit subject-specific transferable knowledge in mathematics relevant to job trends and employment opportunities.

## **5. Programme Learning Outcomes of B.A./B.Sc./B.C.A. with Mathematics as a Subject**

1. Bachelor's degree in mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of mathematics. This also leads to study of related areas like computer science and statistics. Thus, this programme helps learners in building a solid foundation for higher studies in mathematics.
2. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilised in modelling and solving real life problems.
3. Students undergoing this programme learn to logically question assertions, to recognise patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.
4. Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.
5. Completion of this programme will also enable the learners to join teaching profession in primary and secondary schools.

6. This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.



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For Examinations to be held in 2020, 2021, 2022

**Syllabus : Semester-I (CBCS) BA/BSc./BCA Mathematics**

**TITLE: Differential Calculus**

**CREDITS: 06**

**TIME DURATION:**

**TOTAL MARKS: 150**

**Sessional Exam: 1 hr**

**Sessional Assignment: 30**

**External Exam: 3hr**

**External Exam: 120**

**OBJECTIVES:** This course is intended to determine the stationary points of functions, in order to sketch their graphs. Calculating stationary points also lends itself to the solving of problems that require some variable to be maximised or minimised. It is used to create mathematical models in order to arrive into an optimal solution.

**Learning Outcomes**

- Use graphical and numerical evidence to estimate limits, and to identify situations where limits fail to exist.
- Apply rules of limits to calculate limits.
- Use the limit concept to determine where a function is continuous.
- Use the Intermediate Value Theorem to identify an interval where a continuous function has a root.
- Use critical points and signs of first and second derivatives to sketch graphs of functions.
- Use the first derivative to find intervals where a function is increasing or decreasing.
- Use the second derivative to determine concavity and find inflection points.
- Apply the first and second derivative tests to classify critical points and use them to locate maxima and minima.
- Use Differential Calculus to solve optimization problems.
- Polar coordinates are used often in navigation as the destination or direction of travel can be given as an angle and distance from the object being considered.

## **Syllabus**

**Unit 1:** Limit and continuity of function on  $\mathbf{R}$  ( $\epsilon - \delta$  definition), Algebra of Limits, Discontinuity and types of discontinuities. Differentiability of functions, successive differentiation, Leibnitz's Theorem. Examples and exercises based on these topics.

**Unit 2:** Indeterminate forms, Partial differentiation, Homogenous functions, Euler's Theorem on homogeneous functions of two variables, Maxima and Minima of functions of two variables. Examples and exercises based on these topics.

**Unit 3:** Envelopes, Concavity of functions, Asymptotes, Double point, curve tracing in Cartesian Coordinates. Examples and exercises based on these topics.

**Unit 4:** Polar Coordinates, Relation between Cartesian coordinates and Polar Coordinates. Angle between radius vector and tangent, Angle of intersection of two curves. Graphic Techniques in Polar coordinates for the curves.  $\mathbf{r = (a \pm b \cos \theta), r = (a \pm b \sin \theta), r = a \cos n\theta, r = a \sin n\theta}$  for  $\mathbf{n = 1, 2}$  only. Area in Polar Coordinates. Examples and exercises based on these topics.

**Unit 5:** Rolle's theorem, The Mean Value Theorems, Taylor's Theorem with Lagrange's and Cauchy's form of remainder. Taylor's series and Maclaurin's series of  $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $\sec x$ ,  $e^x$ ,  $\log(1 + x)$ ,  $(1 + x)^m$ ,  $a^x$ . Examples and exercises based on these topics.

### **Books Recommended:**

1. Calculus, H. Anton, I Birens and S. Davis, John Wiley and Sons, Inc 2002.
2. Calculus, G. B. Thomas and R L Finney, Pearson Education, 2007.
3. Differential Calculus, S. Nayan and P K Mittal, S. Chand Publisher.

### **Instructions for paper Setters and candidates**

#### **For External Examination**

The question paper for semester end examination will be of 120 marks and consist of three sections:

#### **Section A (30 marks);**

Five short answer type questions of 6 marks each, one from each unit. All questions will be compulsory.

#### **Section B (50 marks);**

Five medium answer type questions of 10 marks each, one from each unit. All questions will be compulsory.

**Section C (40 marks);**

Five long answer type questions of 20 marks each, one from each unit. Each question will have two or three parts. The students will have to attempt any two questions.

**For Internal Examination**

The internal assessment will be of thirty marks in which 7.5 marks are for attendance and 22.5 marks for internal test.

The test will comprise of eight questions of 4.5 marks each from 50% of the syllabus covered and candidate will have to attempt any five questions.



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For Examinations to be held in 2020, 2021, 2022

**Syllabus : Semester-II (CBCS) BA/Bsc./BCA Mathematics**

**TITLE: Differential Equation**

**CREDITS: 06**

**TIME DURATION:**

**TOTAL MARKS: 150**

**Sessional Exam: 1 hr**

**Sessional Assignment: 30**

**External Exam: 3hr**

**External Exam: 120**

**OBJECTIVES:** The objective of this course is to take your existing knowledge of calculus and apply it towards the construction and solution of mathematical models in the form of differential equation.

**Learning Outcomes:** By the end of the course you will be able to:

- Understand all of the concepts relating to the order and linearity of ODEs, analytic and computational solution methods for ODEs, and the real-world applications of ODEs.
- Apply your understanding of the concepts, formulas, and problem solving procedures to thoroughly investigate relevant physical models.
- Explain the concepts of linear systems, ODE solution methods, and related ideas at a fundamental level, as well as how and why we use the solution techniques that we use.
- Determine fundamental solutions and independence using the Wronskian.
- Uses the method "variations of parameters" to find to solution of higher-order linear differential equations with variable coefficients.
- Solve the Cauchy-Euler equations.

**Syllabus**

**Unit 1:** Linear and Bernoulli's equations, Exact and non- Exact equations. Rules for finding Integrating factor, Differential equations solvable for  $p$ ,  $x$  and  $y$ . Clairaut's equation and Equations reducible to Clairaut's form. Examples and exercises based on these topics.

**Unit 2:** Linear Differential equations of 2<sup>nd</sup> and higher order with constant coefficients of the type  $f(D)y = g(x)$ , where  $g(x) = e^{ax}, \cos ax, \sin ax, x^n$  their sum and product. Examples and exercises based on these topics.

**Unit 3:** Wronskian and its properties. Solution of differential equations by reducing its order, method of variation of parameters, Cauchy-Euler Equations, Legendre's Linear equation. Examples and exercises based on these topics.

**Unit 4:** Order and Degree of Partial differential equations, concept of linear and non-linear PDE forms, Linear PDE of first order, Lagrange's method, Charpit's method, four standard types. Examples and exercises based on these topics.

**Unit 5:** Homogeneous and non-homogeneous linear partial differential equations of 2<sup>nd</sup> and 3<sup>rd</sup> order with constant coefficients of the type  $f(D_x, D_y)z = g(x, y)$ , where  $g(x, y) = e^{ax+by}, \cos(ax + by), \sin(ax + by), x^m y^n, V e^{ax+by}$ , where V is a function of x, y and their sums. General method to find particular integral of partial differential equations of the form  $(D + m_1 D')(D + m_2 D')(D + m_3 D') = f(x, y)$ . Examples and exercises based on these topics.

### **Books Recommended:**

1. **Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand Publisher, New Delhi.**
2. **Differential Equation, S L Ross, Blaidell Publication 1994.**
3. **Elements of Partial differential Equations, I Sneddon, Mc Graw-Hill.**
4. **Ordinary and partial differential equation, M. D. Rai Singhania, S. Chand & Co., New Delhi.**

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