

# APPLIED MATHEMATICS

**Grade XII**



**CENTRAL BOARD OF SECONDARY EDUCATION**

Shiksha Sadan, 17, Rouse Avenue, New Delhi-110002

*Dedicated to:*



**Sh. Pramod Kumar T.K.**

**(15th April 1971 to 25th May 2021)**

**Joint Secretary (Academics)  
Central Board of Secondary Education**

*You will always be in our memories...*

# Applied Mathematics

**Class XII**

**Student Support Material**



**CENTRAL BOARD OF SECONDARY EDUCATION**

Shiksha Sadan, 17, Rouse Avenue, New Delhi-110002

## Applied Mathematics- Class XII

Student Support Material

Price: Unpriced e-Publication

First Edition: July 2021, CBSE, Delhi

“This material or part there of may not be reproduced by any person or agency in any manner.”

**Published by:**

Central Board of Secondary Education,  
Academic Unit, Shiksha Sadan,  
17, Rouse Avenue,  
New Delhi-110002

**Design & Layout:** Anand Book Binding House-1042/A-2,  
New Chand Mohalla Raghupura No-1, Gandhi Nagar, Delhi-110031  
Mbl.: 9891110888

# भारत का संविधान

## उद्देशिका

हम, भारत के लोग, भारत को एक सम्पूर्ण<sup>1</sup> प्रभुत्व-संपन्न समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य बनाने के लिए, तथा उसके समस्त नागरिकों को:

सामाजिक, आर्थिक और राजनैतिक न्याय,

विचार, अभिव्यक्ति, विश्वास, धर्म

और उपासना की स्वतंत्रता,

प्रतिष्ठा और अवसर की समता

प्राप्त कराने के लिए

तथा उन सब में व्यक्ति की गरिमा

<sup>2</sup>और राष्ट्र की एकता और अखंडता

सुनिश्चित करने वाली बंधुता बढ़ाने के लिए

दृढसंकल्प होकर अपने इस संविधान में आज तारीख 26 नवम्बर, 1949 ई० को एतद्वारा इस संविधान को अंगीकृत, अधिनियमित और आत्मार्पित करते हैं।

1. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 को धारा 2 द्वारा (3.1.1977) से "प्रभुत्व-संपन्न लोकतंत्रात्मक गणराज्य" के स्थान पर प्रतिस्थापित।

2. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 को धारा 2 द्वारा (3.1.1977) से "राष्ट्र की एकता" के स्थान पर प्रतिस्थापित।

## भाग 4 क

### मूल कर्तव्य

**51 क. मूल कर्तव्य**—भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह—

- (क) संविधान का पालन करे और उसके आदर्शों, संस्थाओं, राष्ट्र ध्वज और राष्ट्रगान का आदर करे;
- (ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रेरित करने वाला उच्च आदर्शों को हृदय में संजोए रखे और उनका पालन करे;
- (ग) भारत की प्रभुता, एकता और अखंडता की रक्षा करे और उसे अक्षुण्ण रखे;
- (घ) देश की रक्षा करे और आह्वान किए जाने पर राष्ट्र की सेवा करे;
- (ङ) भारत के सभी लोगों में समरसता और समान भ्रातृत्व की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग पर आधारित सभी भेदभाव से परे हों, ऐसी प्रथाओं का त्याग करे जो स्त्रियों के सम्मान के विरुद्ध हैं;
- (च) हमारी सामाजिक संस्कृति की गौरवशाली परंपरा का महत्त्व समझे और उसका परिक्षण करे;
- (छ) प्राकृतिक पर्यावरण की जिसके अंतर्गत वन, झील, नदी, और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणी मात्र के प्रति दयाभाव रखे;
- (ज) वैज्ञानिक दृष्टिकोण, मानववाद और ज्ञानार्जन तथा सुधार की भावना का विकास करे;
- (झ) सार्वजनिक संपत्ति को सुरक्षित रखे और हिंसा से दूर रहे;
- (ञ) व्यक्तिगत और सामूहिक गतिविधियों से सभी क्षेत्रों में उत्कर्ष की ओर बढ़ने का सतत प्रयास करे जिससे राष्ट्र निरंतर बढ़ते हुए प्रयत्न और उपलब्धि की नई उंचाईयों को छू ले;
- <sup>1</sup>(ट) यदि माता-पिता या संरक्षक है, छह वर्ष से चौदह वर्ष तक की आयु वाले अपने, यथास्थिति, बालक या प्रतिपाल्य के लिए शिक्षा के अवसर प्रदान करे।

1. संविधान (छयासीवां संशोधन) अधिनियम, 2002 की धारा 4 द्वारा प्रतिस्थापित।

# THE CONSTITUTION OF INDIA

## PREAMBLE

**WE, THE PEOPLE OF INDIA**, having solemnly resolve to constitute India into a <sup>1</sup>**SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC** and to secure to all its citizens :

**JUSTICE**, social, economic and political;

**LIBERTY** of thought, expression, belief, faith and worship;

**EQUALITY** of status and of opportunity; and to promote among them all

**FRATERNITY** assuring the dignity of the individual and the<sup>2</sup> unity and integrity of the Nation;

**IN OUR CONSTITUENT ASSEMBLY** this twenty-sixth day of November, 1949, do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

---

1. Subs, by the Constitution (Forty-Second Amendent) Act. 1976, sec. 2 for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)

2. Subs, by the Constitution (Forty-Second Amendent) Act. 1976, sec. 2 for "unity of the Nation" (w.e.f. 3.1.1977)

---

# THE CONSTITUTION OF INDIA

## Chapter IV A

### FUNDAMENTAL DUTIES

#### ARTICLE 51 A

**Fundamental Duties** - It shall be the duty of every citizen of India-

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the national constantly rises to higher levels of endeavour and achievement;
- <sup>1</sup>(k) who is parent or guardian to provide opportunities for education to his/her child or, as the case may be, ward between age 6 and 14 years.

---

1. Subs. By the Constitution Sec. 04 (Eighty-Six Amendment) Act, 2002

# Acknowledgements

## PATRONS

- Sh. Dharmendra Pradhan, Education Minister, Government of India
- Sh. Rajkumar Ranjan Singh, Minister of state for education, Government of India
- Smt. Annpurna Devi, Minister of state for education, Government of India
- Dr. Subhas Sarkar, Minister of state for education, Government of India
- Ms. Anita Karwal, IAS, Secretary Ministry of education, Government of India

## ADVISORY BOARD

- Sh. Manoj Ahuja, IAS, Chairman, CBSE Delhi
- Dr. Joseph Emmanuel, Director (Academic), CBSE, Delhi
- Dr. Biswajit Saha, Director (S.E. & Training), CBSE, Delhi

## CONTENT DEVELOPMENT TEAM:

- Dr. Jyoti Sharma, Professor, CIC, Delhi University, Delhi.
- Dr. Chaitanya Kumar Associate Professor, Delhi College of Arts & Commerce, Delhi.
- Ms. Shubhangi Srivastava, Assistant Professor Manav Rachna International Institute of Research and Studies, Faridabad, Haryana.
- Ms. Swarnima Luthra, Principal, ASN Sr. Secondary School, Mayur Vihar, Delhi.
- Sh. Rahul Sofat, Lecturer, Air Force Golden Jubilee Institute, Subroto Park, New Delhi.
- Ms. Gurpreet Bhatnagar, Ex Faculty (Maths) and CBSE Resource Person
- Sh. Ajay Marwaha, HOD (Maths), S.D.Public School, Pitampura.
- Sh. Anuj Manchanda, Headmaster, Sri Venkateshwar International School, New Delhi.
- Sh. Sanjay Kumar Sinha, PGT, Sanskriti School, Chanakyapuri, New Delhi-110021
- Sh. Anurag, Guest Faculty, CIC, Delhi University, Delhi.
- Sh. Arvind Kumar Yadav, PGT, Manikgarh Cement English School, Chandrapur, Maharashtra.
- Dr. Dipak M. Choudhari, PGT, Reliance Foundation School, Lodhivali, Maharashtra

## CURATOR AND CO-ORDINATOR

- Subhash Chand Garg, Deputy Secretary (Academics), CBSE, Delhi

## REVIEW TEAM

- Mr. Sanjay Kumar Sinha
- Ms. Gurpreet Bhatnagar
- Mr. Rahul Sofat
- Ms. Nirupama Mahapatra Das
- Ms. Surabhi Pandey
- Ms. Rama Srinivasan
- Mr. Ashwani Kumar Bakshi
- Ms. Sangeeta Gulati

## Note to the Users

Mathematical ideas have become more relevant with advances in technology, economy and social structure. A mathematically skilled workforce is necessary to make informed decisions in their personal lives, keeping in mind the strong and ever-growing mathematical influence over our lives.

Mathematics skills are essential in all fields be it art, literature or social sciences. This necessitates the creation of a mathematics curriculum that maps the country's need and spirit by using the rich and diverse landscape of illuminated mathematical contexts in India.

The present application-centric and problem-driven course of Applied Mathematics has been developed around key mathematical ideas with potential applications in entrance exams and practical life.

The course is divided into different units each focusing on numerical, algebraic or stoical applications. The scope of the course ranges from mathematical applications in the field of finance (including business and economics), pharmaceutical industry, hospitality and entertainment industry, advertisement and marketing sector, healthcare services including counselling service, agricultural sector, government-aided programs such as resources distribution, traffic management systems including air traffic management, infrastructure development, archaeological studies and studies on historiography, real-time data analysis and much more. Core mathematical ideas are presented keeping in mind these contexts.

The course aims to develop mathematical thinking skills by reasoning quantitative; constructing viable mathematical arguments; constructing new mathematical knowledge using problem-solving and learning to model with mathematics.

This student support material is divided into different units including a unit on the use of a spreadsheet for mathematical applications. Sequencing of units is done naturally starting from Quantification and Numerical applications, Algebraic Thinking, Calculus, Probability, Inferential statistics, Index Numbers Financial Mathematics and Linear Programming.

Each unit is divided into several sections having discrete exercises. Efforts are made to develop concepts around meaningful applications to foster inquisitiveness in learners. Teachers are encouraged to extend/adapt these examples to initiate investigations and stimulating discourse in the classrooms.

This support material should not be considered a textbook and teachers should avoid teaching the content as given in this material. It only gives certain directions to approach various topics. Teachers are advised to use multiple examples from sources such as newspapers, magazines and other online resources to help students reconcile different approaches to problem-solving and refining mathematical arguments.

We hope that this book will provide students with a real sense of the application of mathematics in different spheres of work and life. It is an invitation to reinvent mathematics and empower us to make more logical and informed decisions in our lives.

We look forward to suggestions from teachers, students and the whole learning community to make this book more adaptable for the Indian classroom. You may share your feedback to [subhash\\_garg@cbseshiksha.in](mailto:subhash_garg@cbseshiksha.in).

# Contents

Unit 1	Numbers, Quantification and Numerical Applications	1.1 – 1.36
Unit 2	Algebra	2.1 – 2.56
Unit 3a	Differentiation and its Applications	3a.1 – 3a.38
Unit 3b	Integration and its Applications	3b.1 – 3b.42
Unit 3c	Differential Equations and Modeling	3c.1 – 3c.23
Unit 4	Probability Distributions	4.1 – 4.34
Unit 5	Inferential Statistics	5.1 – 5.18
Unit 6	Index Numbers and Time Based Data	6.1 – 6.31
Unit 7	Financial Mathematics	7.1 – 7.28
Unit 8	Linear Programming Problem	8.1 – 8.24
Unit 9	Practical and Project Work	9.1 – 9.40

