



સૌરાષ્ટ્ર યુનિવર્સિટી

એકેડેમિક વિભાગ

યુનિવર્સિટી કેમ્પસ, યુનિવર્સિટી રોડ, રાજકોટ-૩૬૦૦૦૫

ફોન નં.(૦૨૮૧)૨૫૭૮૫૦૧ એક્સટે. નં.૨૦૨, ૩૦૪ ફેક્સ નં.(૦૨૮૧)૨૫૭૬૩૪૭ ઈ-મેઇલ : academic@sauuni.ac.in

નં.એકે/વિજ્ઞાન/૨૫૦૧૨૬૨/૨૦૨૪

તા. ૦૧/૦૪/૨૦૨૪

ગણિતશાસ્ત્ર

પરિપત્ર:-

સૌરાષ્ટ્ર યુનિવર્સિટીની વિજ્ઞાન વિદ્યાશાખા હેઠળની સ્નાતક કક્ષાના બી.એસસી (ગણિતશાસ્ત્ર)ના અભ્યાસક્રમ ચલાવતી સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓને આથી જાણ કરવામાં આવે છે કે, વિષય નિષ્ણાંતશ્રી દ્વારા ગણિતશાસ્ત્ર સેમેસ્ટર ૧ અને ૨ નો નવો સુધારેલો અભ્યાસક્રમ ગણિતશાસ્ત્ર વિષયની અભ્યાસ સમિતિ, વિજ્ઞાન વિદ્યાશાખા, એકેડેમિક કાઉન્સિલ તથા બોર્ડ ઓફ મેનેજમેન્ટની બહાલીની અપેક્ષાએ મંજૂરી આપવા માન.કુલપતિ સાહેબને લલામણ કરેલ જે માન.કુલપતિશ્રીએ મંજૂર કરેલ છે. જેથી સંબંધિત તમામે તે મુજબ તેની ચુસ્તપણે અમલવારી કરવી.

(મુસદ્દો કુલસચિવશ્રીએ મંજૂર કરેલ છે.)

સહી/-

(ડૉ.આર.જી.પરમાર)

કુલસચિવ

બિડાણ:- ઉક્ત અભ્યાસક્રમ (સોફ્ટ કોપી)

રવાના કર્યું



એકેડેમિક ઓફીસર

પ્રતિ,

(૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની ગણિતશાસ્ત્ર વિષય ચલાવતી સ્નાતક કક્ષાની સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓ તરફ

નકલ જાણ અર્થે રવાના:-

૧. માન.કુલપતિશ્રી/કુલસચિવશ્રીના અંગત સચિવ

નકલ રવાના (યોગ્ય કાર્યવાહી અર્થે):-

૧. પરીક્ષા વિભાગ

૨. પી.જી.ટી.આર.વિભાગ

૩. જોડાણ વિભાગ



SAURASHTRA UNIVERSITY



FACULTY OF SCIENCE

Course Structure and Syllabus for Science FYUGP

B.Sc. Honours/Honours with Research in Mathematics

Based on

UGC's guidelines NEP-2020 "Curriculum and Credit Framework for Undergraduate Programmes- CCFUP" and

Education Department, Government of Gujarat's
Uniform Credit Structure for all HEIs of Gujarat State and
Implementation of the Common Curriculum and Credit Framework under the National
Education Policy-2020

(No: KCG/admin/2023-24/0607/kh.1 Sachivalaya, Gandhinagar dated 11/07/2023) and

Standard Operating Procedure for Implementation of NEP-2020 for the State of
Gujarat- HEIs of Gujarat

(No: KCG/admin/2023-24/865/ dated 26/07/2023) and

Additional content to be added to SOP published by KCG

(No: KCG/NEP-2020/2023-24/893/ dated 28/07/2023)

General Guidelines for Implementation of **Four Year Under Graduate Programmes**
for Saurashtra University (16 pages) published in August 2023

(E-mail from Academic Section Saurashtra University dated Oct 11, 2023)

Effective From June-2023 & onwards

(Submitted on 05-12-2023)



Preface

Timely revision of the curriculum to encompass new knowledge and information is a prime criterion of IQAC and a prime need for the institute educational systems affiliated with Universities. Under the NEP - 2020 and UGC guidelines, a student must be offered the latest courses of varied requirement of technology with societal, environmental, and economic implications. The curriculum should offer multiple entry-exits and a choice of vast subjects to choose from to a student to facilitate his learning abilities, aptitude, and inclination.

Mathematics is a foundation subject for Physical & Chemical Sciences, Life Sciences, Statistics, Computer Science, Engineering, Commerce, Management, Agriculture, Environmental Science, Genetic engineering and hence holds the central position in the curriculum of these subjects. Looking at the rapid inventions and technological developments in the field of Mathematics and keeping in view the recommendations of UGC and NEP-2020, this syllabus has been formulated by the combined and coordinated efforts of all the faculty members of Mathematics Departments of all the Colleges affiliated to Saurashtra University.

The composition of a curriculum for a particular subject requires the following criteria to be considered:

1. Guidelines and Model curriculum provided by the UGC, State Government, and the University.
2. Regional needs and Present National and International trends in the subject.
3. Geographical parameters of the University and its demographic property.
4. Relationship with other related subjects and resources of educational needs.
5. Financial and statutory provisions of the State government.

The content of a syllabus should be such that it maintains continuity with the course content of higher secondary classes and post-graduate courses. Keeping this in mind, the current curriculum is made; and is an effort to impart fundamental knowledge of the subject needed at this level. The curriculum is designed as per the guidelines of UGC and NEP-2020 and reflects the courses' total credit, teaching hours, and question paper style. The syllabus units are well-defined, and the scope of each is given in detail. A list of reference books is provided at the end of each course. Mathematics being a logical and application based subject, sufficient emphasis is given to problem solving skills.

The following objectives have been considered while formulating the curriculum:

1. To provide an updated, feasible, and modern syllabus to the students, emphasizing knowledge and skill to build up their valuable college education and employment oriented carrier.
2. To frame the syllabus in accordance with the semester system, UGC – NEP 2020 guidelines and in consultation with all stakeholders.
3. To offer the students an array of Core, Interdisciplinary, Multidisciplinary, Skill enhancement, Ability enhancement and Value-added courses to select from and to facilitate their academic, intellectual and social grooming.

The Board of Studies for Mathematics expresses heartfelt gratitude to the Dean, Faculty of Science, Saurashtra University, for valuable guidelines and the Academic Section for much-needed cooperation. The Board wishes all the students a very bright future.

(Prof. Vinaychandra N. Vagahsia & Dr. Milankumar K. Kansagara & Dr. Ankur N. Kansagara)
Subject Expert, Board of Studies, Mathematics
Saurashtra University, Rajkot (Gujarat)
Date: 05th December 2023.



Graduate Attributes:

Graduates should be able to demonstrate the acquisition of the following:

Academic Excellence: Comprehensive knowledge and coherent understanding of Mathematics and other interdisciplinary areas of study.

Practical, Professional and Procedural Knowledge:required for carrying out professional or highly skilled work/tasks related to Mathematics, including knowledge required for undertaking self-employment initiatives and knowledge and mind-set required for entrepreneurship, improved product development, or a new mode of organization.

Critical and Analytical Reasoning/Thinking and Effective Communications: Analysis and evaluation of information to form a judgment about a subject or idea and ability to communicate the same in a structured form.

Research-Related Skills: the ability to understand basic research ethics and skills in Practicing /doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.

Leadership Qualities and Teamwork Abilities:The graduates should be able to demonstrate the capability for mapping out the tasks of a team and setting direction and inspiring vision, and building a team that can help achieve the goals.

Global Citizenship: Mutual understanding with others from diverse cultures, perspectives, and backgrounds by embracing and practicing constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, and scientific temper.

Life Long Learning: Ready to imbibe new knowledge, values, and skills with an open mind and willing to adopt change for constructive development.



Programme Outcomes (PO):

By the end of the program, the following programme outcomes are aimed to be achieved.

PO 1	Disciplinary Knowledge: Bachelor degree in Mathematics is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas.
PO 2	Communication Skills: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modelling and solving of real life problems.
PO 3	Critical thinking and analytical reasoning: The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems.
PO 4	Problem Solving: The Mathematical knowledge gained by the students through this programme develop an ability to analyse the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development
PO 5	Research related skills: The completing this programme develops the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics.
PO 6	Information/digital Literacy: The completion of this programme will enable the learner to use appropriate software to solve system of algebraic equations and differential equations.
PO 7	Self – directed learning: The student completing this program will develop an ability to work independently and to make an in-depth study of various notions of Mathematics.
PO 8	Moral and ethical awareness/reasoning: The student completing this program will develop an ability to identify unethical behaviour such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in general.
PO 9	Lifelong learning: This programme provides self-directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real world problems.
PO 10	Advanced Studies and Research: Ability to pursue advanced studies and research in pure and applied Mathematical sciences.



Programme Specific Outcomes (PSO):

By the end of the program, the following programme specific outcomes are aimed to be achieved.

PSO 1	Student should be able to think in a critical manner and develop problem solving skills.
PSO 2	Students should be able to recall basic facts about mathematics and display knowledge of conventions such as notations,terminology etc.
PSO 3	Students are able to formulate and develop mathematical arguments in a logical manner.
PSO 4	It is to give in-depth knowledge of geometry, algebra, calculus, differential equations and several other branches of pureand applied mathematics. This also leads to study the related areas such as computer science and other allied subjects.
PSO 5	Students are motivated and prepared for research studies in mathematics and related fields.
PSO 6	Student should be able to apply their skills and knowledge in various fields of studies including, science, engineering,commerce and management etc.



B.Sc. Honours/ Honours with Research in Mathematics
(NCrF Level- 4.5 First Year – Certificate in Mathematics)

Semester II

SN	Course Category As per GoG- NEP- SOP - July 2023& additional content 28/7/23	Course Title	Credit			Hrs./ Wk.		Evaluation - Weightage CCE: SEE = 50:50					
			T	P	Tot al	T	P	CCE Marks		SEE Marks		Total Marks	
								T	P	T	P		
1	Major (Core) -3 (Mathematics)	Mathematics-3: Calculus-II & Mathematics-3P: Applications of Partial Derivatives (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100	
2	Major (Core)-4 (Mathematics)	Mathematics-4: Differential Equations & Mathematics-4P: Rectification, Volume and Surface area of revolution (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100	
3	Minor(Elective)*-2	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.2) Any One from Basket (As per the expertise and resources available in the college) (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100	
4	Multi/Inter - Disciplinary Course -2 (MDC/IDC-2) (Elective)** Categories: Natural & Physical Science/ Chemistry, Statistics/ Comp.Appl./Lib.,Info.an d Media Sci./Comm. and Mgt./Huma., and Social Sci./ Sanskrit etc...	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.3) Any One from Basket (As per the expertise and resources available in the college) (4- Credit Course including Theory & Practical	3	1	4	3	2	25	25	50	-	100	



		components)										
5	Ability Enhancement Course -2 (AEC-2)	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.4) English Language	2	-	2	2	-	25	-	25	-	50
6	Skill Enhancement Course-2 (SEC-2)	(As per GoG- NEP- SOP July 2023 & additional content 28/7/23 – Clause 3.3.5) Skill Based Practical Course: Scientific Writing using LaTeX & Scientific Writing using LaTeX Practical (2- Credit Course including Theory & Practical components)	1	1	2	1	2	-	25	25	-	50
7	Common Value Added Course-2 (C-VAC-2)*** NSS/NCC/ Sports & Fitness/ Ethics and Culture/ Culture and Communication/ Ethics and Values in Ancient Indian Traditions/ Human Values and Ethics/IPDC	(As per GoG- NEP- SOP July 2023& additional content 28/7/23 – Clause 3.3.6) Any One from Basket VAC based on IKS: NSS/NCC/Sports & Fitness/Human Values and Ethics	-	2	2	-	4	-	25	-	25	50
Total Credits and Marks (Semester-II)			14	08	22	14	16	125	150	225	50	550

* Any one course from the basket is to be selected as a Minor elective course as per the expertise and resources available in the college. The same course will be continued as a Minor in the semester-II as well.

** Any one course from the basket is to be selected as Multi/Inter disciplinary elective courses (MDC/IDC) as per the expertise and resources available in the college. The same MDC/IDC course will be continued in the semester-II as well.

*** **Common Value Added Elective Courses (C-VAC-1)** common to all is to be selected from University Basket for semester 1, as per the expertise and resources available in the college.



**Courses Offered by BoS in Mathematics to other
FYUGP- B.Sc. Program in Semester-II**

SN	Course Category As per GoG- NEP- SOP - July 2023 & additional content 28/7/23	Course Title	Credit			Hrs./ Wk.		Evaluation - Weightage CCE: SEE = 50:50				
			T	P	Total	T	P	CCE Marks		SEE Marks		Total Marks
								T	P	T	P	
1	Minor (Elective)-2 (Mathematics) (In addition to courses mentioned in SOP basket; Recommended for Statistics, Physical Science, Chemical Science, Life Science, Computer Science, etc...)	Mathematics-2: Calculus-II & Mathematics-2P: Applications of Partial Derivatives (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
2	Multi/Inter - Disciplinary Course -2 (MDC/IDC- 2) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical & Chemical Sciences, Statistics)	Mathematics-2: Basics of Mathematics -II & Mathematics-2P: Basics of Mathematics Practical-II (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100
3	Multi/Inter - Disciplinary Course -2 (MDC/IDC- 2) (Elective) (In addition to courses mentioned in SOP basket; Recommended for Physical & Chemical Sciences, Statistics)	Mathematics-2: Introductory Mathematics -II & Mathematics-2P: Introductory Mathematics Practical-II (4- Credit Course including Theory & Practical components)	3	1	4	3	2	25	25	50	-	100



Evaluation Scheme:(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Chapter-7: Evaluation Reforms)

The evaluation process should be formulated to make a systematic evaluation of students’ progress based on UGC guidelines. The evaluation must be designed with learner attributes in mind. These attributes have clear linkages to Programme Education Objectives and Outcomes. The evaluation consists of the following two components:

1. Continuous and Comprehensive Evaluation (CCE)- Formative
2. Semester End Evaluation (SEE)- Summative

CCE carries 50% of the total marks allotted to a subject and the other 50% being assigned to the SEE.

In each course, every credit carries 25 marks, of which 50% marks is assigned for CCE and rest 50% marks for SEE. The 50% marks assigned to the CCE is distributed between the continuous classroom evaluation and mid-term evaluation. The pattern may be as follows:

SN	Evaluation	T-3+P-1 = Total 4 credit subjects (Marks)	2 credit subjects (Marks)
1	CCE (50%)		
	Classroom & Mid-Term Evaluation	T-25+P-25	25
2	SEE (50%)	50	25
	Total	100	50

Continuous and Comprehensive Evaluation (CCE)

Subject–wise CCE will be undertaken by the concerned faculty member. The mode of evaluation will be decided by the faculty member concerned with the subject. Normally CCE consists of class participation, case analysis and presentation, assignment, tutorials, slip tests (announced/ surprised), quizzes, attendance etc. or any combination of these. The students are expected to submit their answer scripts/ reports of internal evaluation within the stipulated time. Failure to do so may result in the script not being valued. Another part of CCE consists of mid-term written evaluation, which is compulsory for all students. It can be done in a scheduled manner. The duration of the mid-term evaluation shall be one hour.

Semester End Evaluation (SEE)

The SEE carries 50% of the marks assigned to a course. SEE shall be of 2 hours for3/ 4 credit course and 2 hours in case of 1/2 credit courses. The controller of the examination will conduct these examinations. Paper setting and evaluation will be done by the external examiners to an extent of 50% of the evaluation process. This examination shall be conducted as per a schedule which shall be notified in advance.

The backlog exam will be conducted twice a year just after the result declared of the semester evaluation. Students shall have a second chance to clear their backlog and avoid the burden to carry forward the backlog with the next semester exam.



Appearance in all the evaluations is mandatory and no exemption can be granted except in the following cases:

1. In case of inability to attend the exam due to reasons considered genuine by the controller of examination in consultation with the Director/Board.
2. In case of medical emergency, a certificate from the registered medical practitioner must be produced before the commencement of exams. The evaluation board will then take final decision on the recommendation for exemption.

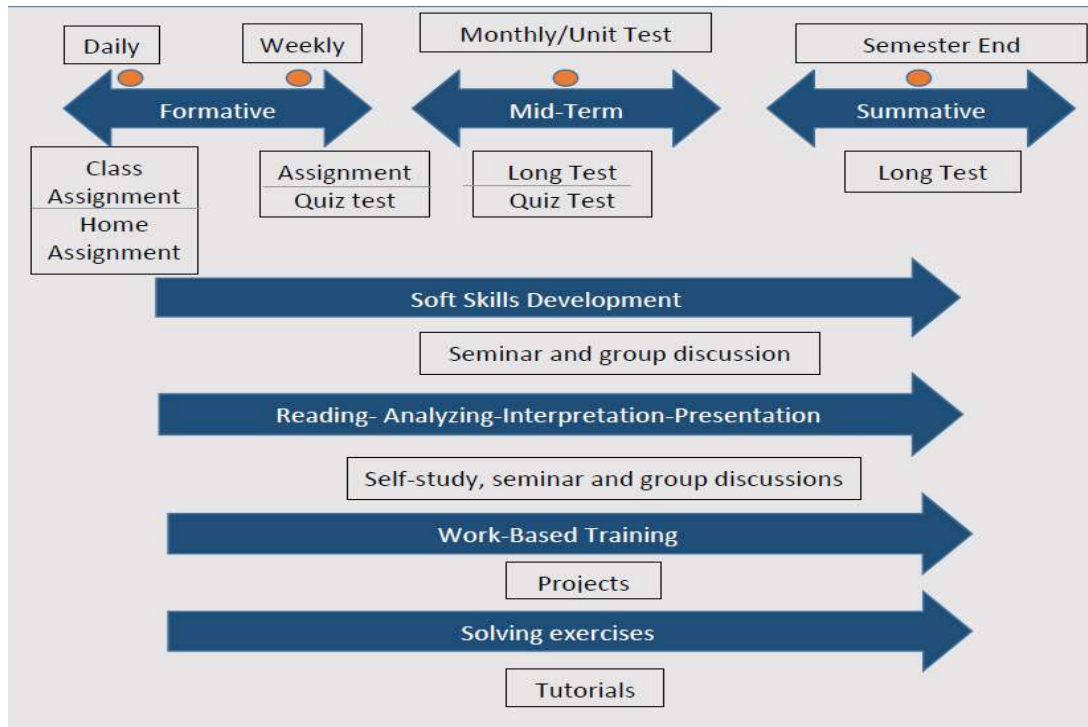
Eligibility Criteria to appear in SEE

To be able to appear for the SEE, a student must comply with the following conditions:

1. Should have at least 75% of attendance in all the courses put together.
2. Should have at least 70% of attendance in each course/subject.
3. Should not have any disciplinary proceedings pending against him/her.
4. Should have no pending due.

Continuum of Evaluation

Evaluation must be continuous which may include both formative and summative components in a timely manner for continuous feedback as follow:





Mode of Evaluation

A wide range of modes of evaluation for evaluating students is available for the teachers/ institutions to use. A suitable compendium of such a mode needs to be carefully chosen for a particular program depending on its nature, objectives, and available resources. The mode of evaluation can be as below:

Written Mode	Oral Mode	Practical Mode	Integrated Mode
Semester Exam Class Test Open book exam/test Open note exam/test Self-test/Online test Essay/Article writing Quizzes/Objective test Class assignment Home assignment Reports writing Research/Dissertation Class Studies	Viva/Oral exam Group Discussion Role Play Authentic Problem Solving Quiz Interview	Lab work Computer simulation/virtual labs Craft work Co-curricular work	Paper presentation/Seminar Field Assignment Poster Presentation

Written Mode		
Evaluation Type	Nature	Objective
Semester Exam	Traditionally essay type with objective/short answer questions to evaluate Lower Ordered Thinking (LOT) OBE skills.	For depth and planned preparation
Class test	Traditionally essay type	Fixed date forces students to learn
Open book test	Allowed choice of reference book	Measures what students can do with resources, less stress on memory
Open note test	To get used to the system	Encourage good note taking
Self-test	For subjective and objective items	Mastery learning occurs with proper feedback
Article/essay writing	Individual long written assignment	Individual expression and creativity
Quizzes/Objective test	Short duration structured test	Excellent validity as greater syllabus coverage
Class assignment	With defined time	Student's performance to make decision
Home assignment	With undefined time	Reinforce learning and facilitate mastery of specific skills
Reports Writing	On activities performed or event observed	Develop a key transferable skill
Research/Dissertation	Detailed research-based report	To judge creativity and research skills
Case Studies	Analyse a given case (real or fictional)	To assess thinking, value, and attitude



Oral Mode		
Evaluation Type	Nature	Objective
Viva/Oral exam	Individually or in small group	Practical experience towards job interview situation
Group discussion	Small group of 2-5 members work on a joint task	Encourage teamwork
Role Play	Small group of 2-5 members work on a joint task	Develop personality
Authenticate problem solving	Small group of 2-5 members work on a joint task	Communication of ideas
Quiz	Small group of 2-5 members work on a joint task	Assess memory power
Interview	Individually	Judge the personal confidence level

Practical Mode		
Evaluation Type	Nature	Objective
Lab work	Component of working with one's hand	Keep the students on the task
Computer simulation/virtual labs	Component of working with one's hand	To understand the practical exposure
Craft work	Component of working with one's hand	Encourage application of concepts learnt
Co-curricular work	Component of working with one's hand	For immediate feedback

Integrated Mode		
Evaluation Type	Nature	Objective
Paper presentation/Seminar	Group or individual work	Learn from others presentation
Field Assignment	Field visit with report	Develop observation and recording skills
Poster presentation	Group or individual work	Develop research, creativity, and discussion skills

Models of Evaluation

Based on the types of evaluation, various models of evaluation implementation are suggested for theory, practical, self-study and work-based learning. The focus of these models is to encourage the students to improve on skills and performance.

Evaluation Norms & Question Paper Pattern for Theory & Practical Courses: Please refer General Guidelines for Implementation of Four Year Under Graduate Programmes for Saurashtra University (16 pages) published in August 2023.

**Model for Theory Courses- Theory-3+Practical-1 = 4 Credit Course****CCE-50% (50 Marks) & SEE-50% (50 Marks)**

Exam Pattern	Marks
Class Test (Average of TWO tests)	T-25+P-25
Quiz (Average of TWO quizzes)	
Home Assignment	
Active Learning- PBL/CSBL/Seminar/Flipped Class Room etc..OBE tools.	
Class Assignment	
Attendance	
Continuous and Comprehensive Evaluation	
Semester-End Evaluation	T-50

Model for Practical Courses-1 Credit Course**CCE-100% (25 Marks)**

Exam Pattern	Marks
Lab work assessment	10
Viva voce/Lab quiz	10
Attendance	05
Continuous and Comprehensive Evaluation	25

Model for Skill Enhancement Course - Skill based Practical Course**2 Credit (1-Theory+1-Practical=2) Course****CCE-50% (25 Marks) SEE-50% (25 Marks)**

Exam Pattern	Marks
Lab work assessment or Project based Assessment	10
Viva voce/Lab quiz	10
Attendance & Performance	05
Continuous and Comprehensive Evaluation	25
Semester-End Evaluation	25



Theory Question Paper Pattern
Semester End Examination (SEE)
Major/Minor/MDC/IDC –4Credit Course (Theory)

Instructions:

- All Units/ Module carry equal weightage of 10 Marks each.
- There must be One Question from each Unit/ Module.
- Time duration: 2 Hours.
- Marks: 50.

The Theory Question Paper Skeleton is as follows.

Question 1 (Unit/Module 1)		Marks
A		(10/7/6/5)
B		(0/3/4/5)
OR		
A		(10/7/6/5)
B		(0/3/4/5)
Question 2 (Unit/Module 1)		Marks
A		(10/7/6/5)
B		(0/3/4/5)
OR		
A		(10/7/6/5)
B		(0/3/4/5)
Question 3 (Unit/Module 1)		Marks
A		(10/7/6/5)
B		(0/3/4/5)
OR		
A		(10/7/6/5)
B		(0/3/4/5)
Question 4 (Unit/Module 1)		Marks
A		(10/7/6/5)
B		(0/3/4/5)
OR		
A		(10/7/6/5)
B		(0/3/4/5)
Question 5 (Unit/Module 1)		Marks
A		(10/7/6/5)
B		(0/3/4/5)
OR		
A		(10/7/6/5)
B		(0/3/4/5)



Practical Question Paper Pattern
Semester End Examination (SEE)
Major/Minor/MDC/IDC - 4 Credit Course (Practical/Performance)

Instructions:

- Certified journal is must and minimum requirement to appearing for semester end practical examination.
- Should have at least 75% attendance in practical sessions during the semester.
- Time duration: **2 Hours**.

One Practical/Performance of 25 Marks (Viva – 10 Marks & Practical – 15 Marks)

Exam Pattern	Marks
Attempt any 3 out of 5 problems. (*Each problem carry 05 Marks; Each problem may be split into sub-problem(s)/question(s), if required.)	15
Viva voce	10
CCE	25



B.Sc. Honours/ Honours with Research in Mathematics

(NCrF Level- 4.5 First Year – Certificate in Mathematics)

Semester II

Course Category	Major (Core)-3
Title of the Course	Mathematics-3: Calculus-II
Course Credit	03
Teaching Hours per Semester	45
Total Marks	CCE-25 + SEE-50

Course Objectives

- 1) Upon completing this course, students will be introduced to the generalization of theory from a single variable to two variables.
- 2) Students will observe analogies and differences in concepts between single-variable and multivariable calculus.
- 3) The course will cover the necessary considerations for dealing with neighborhoods, limits, continuity, and differentiability of functions with two variables.
- 4) Students will learn the application of Euler's Theorem to evaluate standard expressions involving partial derivatives or higher-order partial derivatives.
- 5) Students will be able to express a function in terms of an infinite series and approximate its value at a point, considering relative and percentage errors.
- 6) Students will acquire various techniques to find maxima or minima of functions with two variables.
- 7) The course aims to equip students with the necessary analytical and technical skills used in analysis.

Course Outcomes– Cos

Upon completion of the course, students will be able to:

- 1) Understand the concept of the neighborhood of a point, limit at a point, and continuity at a point for a function with two variables.
- 2) Compute first-order and higher-order partial derivatives using both definitions and working rules.
- 3) Grasp the importance and difference in the order of variables in the evaluation of partial derivatives for a function.
- 4) Apply various chain rules to calculate partial derivatives.
- 5) Prove and apply Euler's Theorem for homogeneous functions.
- 6) Find the Taylor series expansion of a function with two variables.
- 7) Determine the approximate value of a function, considering relative and percentage errors.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	Yes	Minor		Yes	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દ્વિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Unit No.	Topics	Hours	Marks
1	Functions of two or more variables, Explicit and Implicit functions, The δ –Neighbourhood and deleted δ –Neighbourhood of a point (a, b) , Definition of the limit of a function, Examples to find limit using definition, Repeated Limits, Examples of Non-existence of the limits, Algebra of limits (Without Proof).	9	10
2	Definition of the continuity of a function at point (a, b) . Examples to check continuity at a point (a, b) , Algebra of continuity (Without Proof), Definition of partial derivative, Notations for partial derivative and higher order partial derivative, Examples to find partial derivatives using definition, Geometrical meaning of partial derivative.	9	10
3	Working rules to find partial derivatives and higher order partial derivatives, Examples to find higher order and mixed partial derivatives, The differential of f at (x, y) , Change of order of partial derivative, Young's Theorem (Without Proof), Schwarz's Theorem (Without Proof), Differentiation of composite functions (Chain rules), Examples based on chain rules.	9	10
4	Homogeneous function, Euler's Theorem on Homogeneous function and its consequences, Problems based on Euler's Theorem and its consequences.	9	10
5	Taylor's Theorem for two variables, Taylor's series expansion for a function of two variables, Approximate value of $f(x, y)$, Errors in $f(x, y)$ (Relative error, Absolute Error and Percentage error).	9	10



Reference Books:

- 1) Mathematical Analysis, S. C. Malik, Savita Arora, New Age International Publishers, Fourth Edition, 2015.
- 2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish Goyal Laxmi Publications (P) Ltd.



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Semester II

Course Category	Major (Core)-3 Practical
Title of the Course	Mathematics-3P: Applications of Partial Derivatives
Course Credit	01
Teaching Hours per Semester	30
Total Marks	CCE-25

Course Objectives

- 1) Understand and apply the process of finding the Jacobian for polar coordinates, cylindrical coordinates, and spherical coordinates. Study the properties of the Jacobian and solve problems based on its application. Determine the Jacobian and inverse Jacobian for given relations.
- 2) Explore the concepts of extreme values, stationary points, saddle points, etc., and apply working rules to find maxima and minima for functions with two variables. Find extreme values for given functions involving two variables. Apply the concepts learned to determine extreme values for word problems or real-life scenarios involving two variables.
- 3) Learn Lagrange's Method of Undetermined Multipliers (LMUM). Apply LMUM to find extreme values for given functions subject to some constraints. Solve word problems or real-life scenarios involving two variables using LMUM.

Course Outcomes - COs

Upon completion of all practical exercises, students will be proficient in:

- 1) Calculating the Jacobian of a given set of relations.
- 2) Applying the concepts and techniques of partial derivatives to identify maxima and minima of functions with two variables.
- 3) Utilizing Lagrange's Method of Undetermined Coefficients to determine extreme values of functions with two variables.
- 4) Solving real-life physical problems by applying the theory of partial derivatives.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાયેછે?				Yes	
3	Major	Yes	Minor		Yes	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Pr.No.	Practical
1	To find Jacobian of polar coordinates, cylindrical coordinates spherical coordinates.
2	To study properties of Jacobian and problems based on it.
3	To find Jacobian and inverse Jacobian of given relations.
4	To study the concept of extreme values, stationary point, saddle point, etc. and working rules to find maxima and minima for functions of two variables.
5	To find extreme values of given function of two variables. (Consider at least four problems of various types.)
6	To find extreme values of word problems or real life world problems involving two variables.
7	To learn Lagrange's Method of Undetermined Multipliers (LMUM).
8	To find extreme values of given function subject to some function by LMUM. (Consider at least four problems of various types.)
9	To solve word problems or real life world problems by LMUM. (Consider at least four problems of various types.)
10	To solve word problems or real life world problems by LMUM. (Consider at least four problems of various types.)

Reference Books:

- 1) Mathematical Analysis, S. C. Malik, SavitaArora, New Age International Publishers, Fourth Edition, 2015.
- 2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish GoyalLaxmiPublications(P) Ltd.



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Semester II

Course Category	Major (Core) -4
Title of the Course	Mathematics-4: Differential Equations
Course Credit	03
Teaching Hours per Semester	45
Total Marks	CCE-25 + SEE-50

Course Objectives

- 1) Understand order, degree, and formation of differential equations.
- 2) Explore methods such as variable separable, homogeneous, linear, and Bernoulli's equations for solving first-order first-degree differential equations.
- 3) Understand exact differential equations, including conditions for exactness, and learn methods to reduce equations to exact form using integrating factors.
- 4) Investigate HOLDE with constant coefficients, understand the differential operator, auxiliary equation, and fundamental results, explore rules for finding complementary functions and particular integrals, and learn the method of variation of parameters.
- 5) Explore different types of equations solvable for specific variables, and understand both Clairaut's differential equation and Lagrange's form.
- 6) Explore and solve examples of Cauchy's homogeneous linear differential equation, and similarly, investigate and solve examples of Legendre's differential equation.

Course Outcomes - COs

Students are able to

- 1) Recall and define and comprehend differential equations, explore their order, degree, and formation, and develop problem-solving skills.
- 2) Explain the conditions for exactness in differential equations and demonstrate comprehension of exact equations.
- 3) Apply methods to transform non-exact equations into exact ones and Utilize problem-solving skills to solve differential equations.
- 4) Examine higher-order linear differential equations with constant coefficients and Analyze the differential operator, auxiliary equation, and solving rules for HOLDE.
- 5) Investigate and evaluate the method of variation of parameters.
- 6) Evaluate and solve examples of higher-order linear differential equations and Comprehend Clairaut's differential equation and Lagrange's form.
- 7) Formulate solutions for Cauchy's and Legendre's differential equations and Develop problem-solving strategies for specific types of differential equations.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	Yes	Minor		No	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દ્વિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Unit No.	Topics	Hours	Marks
1	Definition of a Differential Equation, Orientation of order and degree of the Differential Equation, Formation of Differential Equation, Solution of Differential Equation, Methods to solve First Order First Degree Differential Equation Variable Separable Differential Equation, Homogeneous Differential Equation, Linear Differential Equation, Bernoulli's Differential Equation.	9	10
2	Exact Differential Equation, Necessary and Sufficient condition for Exactness of Differential Equation, Equations reducible to Exact Equation by multiplying integrating factor (I.F.) : I.F. by Inspection, I.F. for Homogeneous Equation, I.F. for an Equation of the form $f_1(xy)ydx + f_2(xy)x dy = 0$, $M(x,y)dx + N(x,y)dy = 0$, $x^a y^b (mydx + nxdy) + x^c y^d (pydx + qxdy) = 0$.	9	10
3	Differential Equation of the first order and higher degrees, Equations solvable for p , Equations solvable for y , Equations solvable for x , Clairaut's Differential Equation, Lagrange's form of a Differential Equation.	9	10
4	Higher Order Linear Differential Equation (HOLDE), HOLDE with Constant Coefficients, The Differential Operator D , Auxiliary Equation (A.E.), Complementary Function (C.F.), Particular Integral (P.I.), Fundamental results on solutions of HOLDE, Rules for finding C.F., The inverse operator $\frac{1}{f(D)}$, Rules for finding P.I. (when X is e^{ax} or $a^x (a > 0)$ or $\sin(ax + b)$ or $\cos(ax + b)$ or x^n (i.e. a	9	10



	polynomial) or $e^{ax}V(x)$, Method of variation of parameters, Examples of solving higher-order linear Differential Equations with constant coefficients.		
5	Cauchy's Homogeneous Linear Differential Equation, Examples of solving Cauchy's Homogeneous Linear Differential Equation, Legendre's Differential Equation, Examples of solving Legendre's Differential Equation.	9	10

Reference Books:

- 1) A Textbook of Engineering Mathematics, N. P. Bali, Manish GoyalLaxmiPublications(P) Ltd.
- 2) Elementary Differential Equations and Boundary Value Problems (11th ed.) by W. E. Boyce & R. C. DiPrima. Wiley, 2016.
- 3) Advanced Engineering Mathematics (10th ed.) by E. Kreyszig. Wiley, 2011.
- 4) Higher Engineering Mathematics (44th ed.) by B. S. Grewal. Khanna Publishers, 2017.
- 5) Introduction to Ordinary Differential Equations by S. K. Gupta & A. Kumar. PHI Learning, 2014.



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Semester II

Course Category	Major (Core)-4 Practical
Title of the Course	Mathematics-4P:Rectification, Volume and Surface area of revolution.
Course Credit	01
Teaching Hours per Semester	30
Total Marks	CCE-25

Course Objectives

Upon completion of the course, students will:

- 1) Develop a comprehensive understanding of the rectification process for Cartesian curves, Parametric curves, and Polar curves, including the derivation of the corresponding formulas.
- 2) Gain practical skills in applying the rectification process to various segments of given curves, encompassing Cartesian, Parametric, and Polar representations.
- 3) Acquire the ability to calculate the volume of revolution for curves represented in Cartesian, Parametric, and Polar forms, demonstrating proficiency in applying these concepts to real-world scenarios.
- 4) Develop competence in determining the surface area of revolution for curves represented in Cartesian, Parametric, and Polar forms, showcasing the application of mathematical principles in solving problems related to volumes and surface areas.

Course Outcomes - COs

Upon completion of the course, students will achieve the following:

- 1) Derive the formula for the rectification of Cartesian curves, Parametric curves, and Polar curves.
- 2) Apply the rectification process to a segment of given Cartesian, Parametric, and Polar curves.
- 3) Determine the volume of revolution for given Cartesian, Parametric, and Polar curves.
- 4) Calculate the surface area of revolution for given Cartesian, Parametric, and Polar curves.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહી?			Yes		
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાયેછે?			Yes		
3	Major	Yes	Minor	No		
	Skill Enhancement Courses	No	Ability Enhancement Courses	No		
	Value Added Courses	No	Exit/ Vocational Courses	No		
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?			Yes		
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?			Yes		
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?			No		
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?			No		

Pr. No.	Practical
1	Derivation of the formula for rectification of the Cartesian curve, Parametric curve, Polar curve.
2	To rectify a piece of given Cartesian curves.
3	To rectify a piece of given Parametric curves.
4	To rectify a piece of given Polar curves.
5	To find volume of revolution of given Cartesian curves.
6	To find volume of revolution of given Parametric curves.
7	To find volume of revolution of given Polar curves.
8	To find surface area of revolution of given Cartesian curves.
9	To find surface area revolution of given Parametric curves.
10	To find surface area revolution of given Polar curves.

Reference Books:

- 1) Advanced Calculus by Shanti Narayan, S. Chand & Company Ltd., 2009.
- 2) Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers, 2017.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish Goyal Laxmi Publications(P) Ltd.
- 4) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.



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Semester II

Course Category	Minor(Core)-2
Title of the Course	Mathematics-2: Calculus-II
Course Credit	03
Teaching Hours per Semester	45
Total Marks	CCE-25 + SEE-50

Course Objectives

- 1) Upon completing this course, students will be introduced to the generalization of theory from a single variable to two variables.
- 2) Students will observe analogies and differences in concepts between single-variable and multivariable calculus.
- 3) The course will cover the necessary considerations for dealing with neighborhoods, limits, continuity, and differentiability of functions with two variables.
- 4) Students will learn the application of Euler's Theorem to evaluate standard expressions involving partial derivatives or higher-order partial derivatives.
- 5) Students will be able to express a function in terms of an infinite series and approximate its value at a point, considering relative and percentage errors.
- 6) Students will acquire various techniques to find maxima or minima of functions with two variables.
- 7) The course aims to equip students with the necessary analytical and technical skills used in analysis.

Course Outcomes - COs

Upon completion of the course, students will be able to:

- 1) Understand the concept of the neighborhood of a point, limit at a point, and continuity at a point for a function with two variables.
- 2) Compute first-order and higher-order partial derivatives using both definitions and working rules.
- 3) Grasp the importance and difference in the order of variables in the evaluation of partial derivatives for a function.
- 4) Apply various chain rules to calculate partial derivatives.
- 5) Prove and apply Euler's Theorem for homogeneous functions.
- 6) Find the Taylor series expansion of a function with two variables.
- 7) Determine the approximate value of a function, considering relative and percentage errors.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	Yes	Minor		Yes	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દ્વિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Unit No.	Topics	Hours	Marks
1	Functions of two or more variables, Explicit and Implicit functions, The δ –Neighbourhood and deleted δ –Neighbourhood of a point (a, b) , Definition of the limit of a function, Examples to find limit using definition, Repeated Limits, Examples of Non-existence of the limits, Algebra of limits (Without Proof).	9	10
2	Definition of the continuity of a function at point (a, b) . Examples to check continuity at a point (a, b) , Algebra of continuity (Without Proof), Definition of partial derivative, Notations for partial derivative and higher order partial derivative, Examples to find partial derivatives using definition, Geometrical meaning of partial derivative.	9	10
3	Working rules to find partial derivatives and higher order partial derivatives, Examples to find higher order and mixed partial derivatives, The differential of f at (x, y) , Change of order of partial derivative, Young's Theorem (Without Proof), Schwarz's Theorem (Without Proof), Differentiation of composite functions (Chain rules), Examples based on chain rules.	9	10
4	Homogeneous function, Euler's Theorem on Homogeneous function and its consequences, Problems based on Euler's Theorem and its consequences.	9	10
5	Taylor's Theorem for two variables, Taylor's series expansion for a function of two variables, Approximate value of $f(x, y)$, Errors in $f(x, y)$ (Relative error, Absolute Error and Percentage error).	9	10



Reference Books:

- 1) Mathematical Analysis, S. C. Malik, SavitaArora, New Age International Publishers, Fourth Edition, 2015.
- 2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish GoyalLaxmiPublications(P) Ltd.



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Semester II

Course Category	Minor (Core)-2 Practical
Title of the Course	Mathematics-2P: Applications of Partial Derivatives
Course Credit	01
Teaching Hours per Semester	30
Total Marks	CCE-25

Course Objectives

- 4) Understand and apply the process of finding the Jacobian for polar coordinates, cylindrical coordinates, and spherical coordinates. Study the properties of the Jacobian and solve problems based on its application. Determine the Jacobian and inverse Jacobian for given relations.
- 5) Explore the concepts of extreme values, stationary points, saddle points, etc., and apply working rules to find maxima and minima for functions with two variables. Find extreme values for given functions involving two variables. Apply the concepts learned to determine extreme values for word problems or real-life scenarios involving two variables.
- 6) Learn Lagrange's Method of Undetermined Multipliers (LMUM). Apply LMUM to find extreme values for given functions subject to some constraints. Solve word problems or real-life scenarios involving two variables using LMUM.

Course Outcomes - COs

Upon completion of all practical exercises, students will be proficient in:

- 5) Calculating the Jacobian of a given set of relations.
- 6) Applying the concepts and techniques of partial derivatives to identify maxima and minima of functions with two variables.
- 7) Utilizing Lagrange's Method of Undetermined Coefficients to determine extreme values of functions with two variables.
- 8) Solving real-life physical problems by applying the theory of partial derivatives.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહી?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાયેછે?				Yes	
3	Major	Yes	Minor		Yes	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Pr.No.	Practical
1	To find Jacobian of polar coordinates, cylindrical coordinates spherical coordinates.
2	To study properties of Jacobian and problems based on it.
3	To find Jacobian and inverse Jacobian of given relations.
4	To study the concept of extreme values, stationary point, saddle point, etc. and working rules to find maxima and minima for functions of two variables.
5	To find extreme values of given function of two variables. (Consider at least four problems of various types.)
6	To find extreme values of word problems or real life world problems involving two variables.
7	To learn Lagrange's Method of Undetermined Multipliers (LMUM).
8	To find extreme values of given function subject to some function by LMUM. (Consider at least four problems of various types.)
9	To solve word problems or real life world problems by LMUM. (Consider at least four problems of various types.)
10	To solve word problems or real life world problems by LMUM. (Consider at least four problems of various types.)

Reference Books:

- 1) Mathematical Analysis, S. C. Malik, SavitaArora, New Age International Publishers, Fourth Edition, 2015.
- 2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish GoyalLaxmi Publications(P) Ltd.



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Semester II

***This course is recommended for Physical & Chemical Sciences, Statistics.**

Course Category	Multi/Inter-Disciplinary Course-2 (MDC/IDC-2) (Elective)
Title of the Course	Mathematics: Basics of Mathematics-II
Course Credit	03
Teaching Hours per Semester	45
Total Marks	CCE-25 + SEE-50

Course Objectives

- 1) Upon completing this course, students will be introduced to how to find partial derivatives and higher-ordered partial derivatives of multivariable functions using working rules.
- 2) Students will learn how to handle vectors and will understand the geometry of terms like Gradient, Divergence, and Curl along with their applications.
- 3) Students will learn the Fourier series expansion of a periodic function and the associated mathematical manipulations for it.
- 4) Students will learn various methods to find the Laplace transform and inverse Laplace transform of a function and its application to solving differential equations.
- 5) The course aims to equip students with the necessary technical skills used in the application of Mathematics in their respective subjects.

Course Outcomes - COs

- 1) Students are able to compute first-order and higher-order partial derivatives using working rules.
- 2) Students are able to compute various types of vector products and can evaluate gradient, divergence, and curl.
- 3) Students are able to classify periodic and non-periodic functions and can find the period of a given function in the case of periodic functions.
- 4) Students are able to find the Fourier series of a given periodic piecewise continuous function.
- 5) Students are knowledgeable about various techniques to find the Laplace transform of a given function and can solve a differential equation using it.
- 6) Students are knowledgeable about some important mathematical tools used in the subjects of Physics and Chemistry.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	No	Minor		No	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	Yes	Interdisciplinary	Yes
5	દ્વિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Unit No.	Topics	Hours	Marks
1	Partial differentiation using working rules only (Don't explain by limit approach), Partial derivatives of first order, Partial derivative of composite functions (Chain rule), Higher order partial derivatives, Total derivative, Derivative of implicit functions.	9	10
2	Vectors in R^2 and R^3 , Unit vector, Product of two vectors, Product of three vectors, Scalar function and Vector function, Differentiation of vector function with respect to scalar variable, Geometric interpretation of $\frac{d\vec{r}}{dt}$, Gradient, Divergence, Curl and its properties.	9	10
3	Period of a function, Periodic function, Fourier series for a piecewise continuous function in an interval of length 2π , Fourier series for a piecewise continuous function in interval of any arbitrary length.	9	10
4	Definition of Laplace transform, Laplace transform of standard functions, Change of scale, First shifting Theorem, Second shifting Theorem, Multiplication by t , Division by t , Laplace transform of Derivative.	9	10
5	Inverse Laplace transform of standard functions, Inverse Laplace transform by Partial fraction, Derivative of $F(s)$, and Convolution Theorem (Without Proof), Solution of differential equations using Laplace transform.	9	10



Reference Books:

- 1) Mathematical Analysis, S. C. Malik, SavitaArora, New Age International Publishers, Fourth Edition, 2015.
- 2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish GoyalLaxmiPublications(P) Ltd.
- 4) The Laplace Transform Theory and Applications, Joel L. Schiff, Springer.



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(NCrF Level- 4.5 First Year – Certificate in Mathematics)

Semester II

***This course is recommended for Physical & Chemical Sciences, Statistics.**

Course Category	Multi/Inter -Disciplinary Course-2Practical (MDC/IDC-2) (Elective)
Title of the Course	Mathematics-2P: Basics of Mathematics Practical-II
Course Credit	01
Teaching Hours per Semester	30
Total Marks	CCE-25

Course Objectives

- 1) Develop the ability to compute the Jacobian of coordinate systems, including polar coordinates, cylindrical coordinates, and spherical coordinates.
- 2) Explore and analyze the properties of the Jacobian matrix and its application in problem-solving.
- 3) Acquire the skills to find the Jacobian and inverse Jacobian of given relations.
- 4) Understand the concepts of extreme values, stationary points, saddle points, etc., and apply working rules to find maxima and minima for functions of two variables.
- 5) Study the geometric interpretation of the gradient, divergence, and curl, and solve problems based on their concepts.
- 6) Develop the ability to find the directional derivative of a scalar function at a given point.

Course Outcomes– Cos

After completing all the practicals, students will be able to:

- 1) Compute the Jacobian of a given set of relations in polar coordinates, cylindrical coordinates, and spherical coordinates.
- 2) Study and analyze properties of Jacobian and solve problems based on its application.
- 3) Determine the Jacobian and inverse Jacobian of given relations.
- 4) Understand the concepts of extreme values, stationary points, saddle points, etc. Apply working rules to find maxima and minima for functions of two variables.
- 5) Solve real-life world problems that involve finding extreme values, considering two variables, and compute the directional derivative of a scalar function at a given point.
- 6) Study the geometry of the gradient, divergence, and solve problems based on their concepts.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	No	Minor		No	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	Yes	Interdisciplinary	Yes
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

PN	Practical
1	To find Jacobian of polar coordinates, cylindrical coordinates spherical coordinates.
2	To study properties of Jacobian and problems based on it.
3	To find Jacobian and inverse Jacobian of given relations.
4	To study the concept of extreme values, stationary point, saddle point, etc. and working rules to find maxima and minima for functions of two variables.
5	To find extreme values of given function of two variables. (Consider at least four problems of various types.)
6	To find extreme values of word problems or real life world problems involving two variables.
7	To study the geometry of gradient and problems based on it.
8	To find directional derivative of a scalar function at a given point.
9	To study the geometry of divergence and problems based on it.
10	To study the geometry of curl and problems based on it.

Reference Books:

- 1) Mathematical Analysis, S. C. Malik, SavitaArora, New Age International Publishers, Fourth Edition, 2015.
- 2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
- 3) A Textbook of Engineering Mathematics, N. P. Bali, Manish GoyalLaxmiPublications(P) Ltd.
- 4) The Laplace Transform Theory and Applications, Joel L. Schiff, Springer.



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Semester II

***This course is recommended for Life Sciences.**

Course Category	Multi/Inter-Disciplinary Course-2 (MDC/IDC-2) (Elective)
Title of the Course	Mathematics: Introductory Mathematics-II
Course Credit	03
Teaching Hours per Semester	45
Total Marks	CCE-25 + SEE-50

Course Objectives

- 1) Upon completing this course, students will be introduced to the concepts of permutation and combination, followed by probability.
 - 2) Students will learn the concept of testing hypotheses.
 - 3) Students will learn how to deal with the theory of probability, understand how to find conditional probability, and apply Bayes' Theorem to evaluate inverse probability.
 - 4) The course will help students check the authenticity of data received from various sources in terms of applications of hypothesis testing.
 - 5) Students will learn various student t-tests, F-tests, and χ^2 -tests for hypothesis testing.
- The course aims to equip students with the necessary mathematical and statistical technical skills used in the application of their respective subjects.

Course Outcomes - COs

Students will be able to:

- 1) Apply the Fundamental Principle of Counting to enumerate all possible ways of various phenomena.
- 2) Count all possible combinations of selections in procedures involving the selection of items.
- 3) Find the probability of events associated with a random experiment.
- 4) Understand rules and techniques to work with the theory of probability and compute conditional probability. Apply Bayes' Theorem to find conditional probability.
- 5) Recognize the applications of hypothesis testing.
- 6) Apply t-tests, F-tests, and χ^2 -tests on data in their respective fields.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	No	Minor	No		
	Skill Enhancement Courses	No	Ability Enhancement Courses	No		
	Value Added Courses	No	Exit/ Vocational Courses	No		
4	Holistic Education	Yes	Multidisciplinary	Yes	Interdisciplinary	Yes
5	દ્વિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Unit No.	Topics	Hours	Marks
1	Definition of factorial and its computation, Fundamental Principal of Counting, Permutation, Formula to find permutations in various cases (All distinct Objects, Some objects repeated), Circular permutations, Word problems based on permutations, Combination, Basic properties of combination, Word problems based on permutations.	9	10
2	Random excrement, Sample space, Event, Sure event, Impossible event, Elementary event, Compound event, Complementary event, Algebra of events, Mutually exclusive events, Exhaustive events, Classical definition of probability with examples, Theorems on probability (Without Proof), Word problems to find probability, Conditional probability, Basic properties of conditional probability (without proof), Multiplication rule of probability (Without Proof), Independent events, Theorem of total probability (Without proof), Bayes' Theorem(Without Proof), Examples based on it.	9	10
3	Test of Hypothesis, Some Related Terms and Concepts like Parameters, Statistic, Hypothesis, Statistical Hypothesis, Sampling Distribution, Standard Error of a Statistic, Null Hypothesis, Alternative Hypothesis, Testing of Hypothesis, Types of Errors in Test of Hypothesis, Level of Significance, Critical region, One Tailed test and Two Tailed test, Degree of Freedom.	9	10
4	Student's t-test, Conditions for applying t-tests, One sample t-test or t-test for one mean, t-test concerning difference between two means, Paired sample t-test, t-test for testing	9	10



	the significance of correlation coefficient, Unpaired sample t-test, Fisher's F-test for equality of two variances or Variance Ratio Test,		
5	Chi-Square test, Definition of statistic χ^2 , Conditions for the application of χ^2 -test, Applications of χ^2 -test, Examples of χ^2 -test, Contingency Table, Procedure to make 2×2 Contingency Table. Examples based on 2×2 Contingency Table.	9	10

Reference Books:

- 1) S.C. Gupta and V. K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
- 2) G u p t a S. C. & Kapoor V. K, Fundamental of Applied Statistics, SultanChand & Sons, New Delhi.



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Semester II

***This course is recommended for Life Sciences.**

Course Category	Multi/Inter-Disciplinary Course-2Practical (MDC/IDC-2) (Elective)
Title of the Course	Mathematics-2P: Introductory Mathematics Practical-II
Course Credit	01
Teaching Hours per Semester	30
Total Marks	CCE-25

Course Objectives

- 1) Develop an understanding of basic functions and their applications in the field of biology.
- 2) Learn the concept of derivatives as changes in variables and how to find derivatives of standard functions.
- 3) Master the algebra of derivatives and demonstrate proficiency in evaluating derivatives for given functions.
- 4) Explore integration as the inverse process of differentiation and acquire skills in finding integrals of standard functions.
- 5) Understand the algebra of integration and elementary techniques of integration.
- 6) Study the application of derivatives to analyze rates of change and solve real-world problems.
- 7) Explore methods for solving variable separable first-order differential equations, including their real-world applications.

Course Outcomes - COs

- 1) Apply basic functions, particularly those relevant to the field of biology.
- 2) Grasp the concept of derivatives as changes in variables and acquire the ability to find derivatives of standard functions.
- 3) Master the algebra of derivatives and demonstrate proficiency in evaluating derivatives for given functions.
- 4) Explore integration as the inverse process of differentiation and acquire skills in finding integrals of standard functions.
- 5) Understand the algebra of integration and elementary techniques of integration.
- 6) Study the application of derivatives to analyze rates of change and solve real-world problems.
- 7) Investigate methods for solving variable separable first-order differential equations, along with their real-world applications.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહી?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાયેછે?				Yes	
3	Major	No	Minor		No	
	Skill Enhancement Courses	No	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	Yes	Interdisciplinary	Yes
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

PN	Practical
1	To study basic functions and functions occurs in field of biology.
2	To learn concept of derivative as a change in variable and to learn derivative of standard functions.
3	To learn algebra of derivative and to evaluate derivative of a given function.
4	To study integration as an inverse process of derivative and to find integration of standard functions.
5	To learn algebra of integration and to learn elementary techniques of integration.
6	To study rate of change using derivative.
7	To study method to solve variable separable first order differential equation and its examples.
8	To study method to solve first orders linear differential equation and its examples.
9	To study real word applications of variable separable first order differential equation.
10	To study real word applications of first order linear differential equation.

Reference Books:

- 1) S.C. Gupta and V. K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
- 2) Gupta S. C. & Kapoor V. K, Fundamental of Applied Statistics, SultanChand & Sons, New Delhi.



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Semester II

Course Category	Skill Enhancement Course-2 (SEC-2)
Title of the Course	Skill Based Practical Course: Scientific Writing using LaTeX
Course Credit	01
Teaching Hours per Semester	15
Total Marks	SEE-25

Course Objectives

- 1) Students will learn LaTeX, a globally accepted editing software.
- 2) Students will acquire the basics of technical writing.
- 3) Students will effectively communicate their ideas through technical reports, journal papers, etc., utilizing the technical writing tool LaTeX.
- 4) Students will develop expertise in drafting technical documents, an indispensable skill for all professionals, enabling them to effectively share their knowledge of technical subjects across various domains of society. This competency enhances their professional careers.
- 5) Students will understand the importance of this software for publishing research articles, papers, project reports, and books.

Course Outcomes– Cos

- 1) Students will demonstrate the ability to install MikTeX (compiler) on their own computer/laptop.
- 2) Students will download and install a LaTeX editor such as WinEdt, Texmaker, or TeXstudio on their own computer.
- 3) Students will create and view a document using LaTeX.
- 4) Students will format text, include borders, page numbers, and incorporate text in header/footer.
- 5) Students will input mathematical text and symbols, including equations and matrices.
- 6) Students will input tables and design rows and columns according to their needs
- 7) Students will input figures and resize them as per their requirements.
- 8) Students will input the title of the document, author information, section, and subsection details.
- 9) Students will prepare different files for each chapter and include them to create a complete document.
- 10) Students will include a table of contents, index, and references in their documents.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?				Yes	
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાવેછે?				Yes	
3	Major	No	Minor		No	
	Skill Enhancement Courses	Yes	Ability Enhancement Courses		No	
	Value Added Courses	No	Exit/ Vocational Courses		No	
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દ્વિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?				Yes	
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?				Yes	
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?				No	
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?				No	

Unit No.	Topics
1	Set up and Installation, Document class, \usepackage, output file (dvi, pdf), Preparing a document, Typing text, Compile and view document, Types of document, Writing text in bold, italic, underline, SMALLCAPS, Spacing using \indent, \quad, \hspace, \vspace, Aligning text (Left, Center, Right, Justify), Toogle text, Bullets and numbering, Line spacing, Two column format, Input header and footer, Different styles of header and footer, Page border, \pagestyle.
2	Input mathematical text, symbols, use of \multicols command, \ldots, \cdots, Input Equations using \begin{equation}...\end{equation}, \begin{eqnarray}...\end{eqnarray}, Labels to equations, Input matrix using \begin{matrix}...\end{matrix}, Use of \begin{array}...\end{array}.
3	Input table, formatting rows and columns of table, Insert figure, Scaling the figure, Assign caption to table and figure using \caption command. Input title using \title, \author, \maketitle commands, Include chapters, section, subsection, table of contents, indexing, references, Presentation using Beamer.



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Semester II

Course Category	Skill Enhancement Course-2 (SEC-2)- Practical
Title of the Course	Scientific Writing using LaTeX Practical
Course Credit	01
Teaching Hours per Semester	30
Total Marks	CCE-25

Course Objectives

- 1) Install LaTeX software and configure it on personal systems successfully.
- 2) Create LaTeX documents and apply diverse text formatting styles using appropriate commands.
- 3) Manipulate spacing and align text effectively using LaTeX commands and environments.
- 4) Organize content efficiently using enumerate and itemize environments in LaTeX.
- 5) Write accurate mathematical notations, insert matrices, and tables, and handle mathematical expressions proficiently within LaTeX documents.
- 6) Learn the basics of creating presentations using the Beamer class.
- 7) Create presentations, including title slides, using the Beamer class effectively.

Course Outcomes - COs

- 1) Gain proficiency in LaTeX software installation and document creation.
- 2) Master text formatting techniques, including bold, italics, underline, and small capitals.
- 3) Develop skills in spacing management and text alignment within LaTeX documents.
- 4) Acquire expertise in organizing content using enumerate and itemize environments.
- 5) Attain proficiency in writing various mathematical notations, inserting matrices, tables, and handling mathematical expressions effectively.
- 6) Master the creation of mathematical equations and expressions using LaTeX.
- 7) Acquire skills in inserting images and managing their placement within LaTeX documents.
- 8) Understand the fundamentals of creating presentations using the Beamer class.



1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિતથયેલછેકેનહિ?			Yes		
2	Value added Courses Imparting Transferable and Life Skillsનાગુણોધરાયેછે?			Yes		
3	Major	No	Minor	No		
	Skill Enhancement Courses	Yes	Ability Enhancement Courses	No		
	Value Added Courses	No	Exit/ Vocational Courses	No		
4	Holistic Education	Yes	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગમાટેવિષયઅંતર્ગતઆનુસાંગિકજોગવાઈકરાયેલછે ?			Yes		
6	New India Literacy Programme (NILP) મુજબનોવિષયછે?			Yes		
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?			No		
8	ઈન્ડીયનનોલેજસીસ્ટમ (IKS) પરઆધારિતવિષયછે ?			No		

PN	Practical
1	To learn installation of LaTeX.
2	To prepare first document in LaTeX and learn how to write text using <code>\textbf{}</code> , <code>\textit{}</code> , <code>\underline{}</code> , and <code>\textsc{}</code> .
3	To learn spacing using commands such as <code>\indent</code> , <code>\quad</code> , <code>\hspace</code> , <code>\vspace</code> , and text alignment using environments like <code>\begin{flushleft}...\end{flushleft}</code> , <code>\begin{flushright}...\end{flushright}</code> , and <code>\begin{justify}...\end{justify}</code> in LaTeX.
4	To learn the enumerate and itemize environments.
5	To learn how to write various mathematical notations.
6	To learn how to insert matrices, tables, and information about them in LaTeX.
7	To learn how to write mathematical equations and expressions using various mathematical environments such as <code>\$\$</code> , <code>\$\$\$</code> , <code>equation</code> , <code>array</code> , <code>eqnarray</code> and the <code>alignat</code> environment.
8	To learn how to insert how to insert an image in LaTeX document.
9	To learn the basics of preparing presentations using the Beamer class, including creating a title slide.
10	To learn how to prepare presentations using the Beamer class (content addition and various effects).



Reference Books:

- 1) LaTeX 2e: An Unofficial Reference Manual, Karl Berry, Stephen Gilmore and Torsten Martinsen.
- 2) LaTeX Beginner's Guide: Create visually appealing texts, articles, and books for business and science using LaTeX
- 3) The Not So Short Introduction to LaTeX, by Hubert Partel, Irene Hyna and Elisabeth Schlegl, Tobias Oetiker, 1999.
- 4) Digital platform: <https://www.latex-project.org>.



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EXIT COURSES:

Suggested MOOCs: SWAYAM-NPTEL.

Semester II

Course Category	EXIT COURSE
Title of the Course	Any course related to concerned subject from any MOOC –Platform
Course Credit	04
Teaching Hours per Semester	As per the guidelines of Saurashtra University and convenience of students.
Total Marks	As per guidelines of the Saurashtra University.

**** Students have to earn credits through the certificate provided by the MOOC platform upon completing the course according to the guidelines of Saurashtra University. ****