નં.એકે/વિજ્ઞાન/ ૮૪૩૫૮ /૨૦૨૩

તા. ૨૩ /૦૮/૨૦૨૩

ગણિતશાસ્ત્ર

પરિપત્ર:-

સૌરાષ્ટ્ર યુનિવર્સિટીની વિજ્ઞાન વિદ્યાશાખા હેઠળની સ્નાતક કક્ષાના B.Sc.(ગણિતશાસ્ત્ર)ના અભ્યાસક્રમ ચલાવતી સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓને આથી જાણ કરવામાં આવે છે કે, NEP-2020 અંતર્ગતના રાજય સરકારશ્રીના તા.૧૧/૦૭/૨૦૨૩ના ઠરાવ ત્યારબાદ તા.૨૭/૦૭/૨૦૨૩ના રોજ પ્રકાશિત થયેલ સ્ટાન્ડર્ડ ઓપરેટિંગ પ્રોસિજર(SOP) તેમજ ત્યારબાદ તેને આનુસંગિક તા.૨૮/૦૭/૨૦૨૩ના રોજ આવેલ સુધારા મુજબના અભ્યાસક્રમો વિષયનિષ્ણાંતશ્રી(ગણિતશાસ્ત્ર અભ્યાસ સમિતિના સભ્યશ્રી), ગણિતશાસ્ત્ર વિષયની અભ્યાસ સમિતિ દ્વારા રજૂ કરાયેલ B.Sc.(ગણિતશાસ્ત્ર) સેમેસ્ટર-૦૧ના અભ્યાસક્રમો આગામી શૈક્ષણિક સત્ર જૂન-૨૦૨૩થી અમલમાં આવે તે રીતે ગણિતશાસ્ત્ર વિષયની અભ્યાસ સમિતિ, વિજ્ઞાન વિદ્યાશાખા, એકેડેમિક કાઉન્સિલ તથા સિન્ડિકેટની બહાલીની અપેક્ષાએ મંજુર કરવા માન.કુલપતિશ્રીને ભલામણ કરેલ, જે માન.કુલપતિશ્રીએ મંજુર કરેલ છે. જેથી સંબંધિત તમામે તે મુજબ તેની ચુસ્તપણે અમલવારી કરવી.

(મુસદ્દો કુલસચિવશ્રીએ મંજુર કરેલ છે.)

સહી/-

(ડૉ. એચ.પી.રૂપારેલીઆ)

કુલસચિવ

બિડાણ:- ઉક્ત અભ્યાસક્રમ (સોફ્ટ કોપી)

રવાના કર્યું

૨૨/૮/૨૩

એકેડેમિક ઓફીસર

પ્રતિ,

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

(૨) વિજ્ઞાન વિદ્યાશાખા હેઠળની ગણિતશાસ્ત્ર વિષયની અભ્યાસ સમિતિના સર્વે સભ્યશ્રીઓ

નકલ જાણ અર્થે રવાના:-

૧. માન.કુલપતિશ્રી/કુલસચિવશ્રીના અંગત સચિવ

નકલ રવાના (યોગ્ય કાર્યવાહી અર્થે):-

૧. ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા   ૨. પરીક્ષા વિભાગ   ૩. પી.જિ.ટી.આર.વિભાગ   ૪. 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)

Effective From June – 2023 & onwards

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:14th August 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 pure and 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 I

SN	Course Category As per GoG- NEP-SOP - July 2023& additional content 28/7/23	Course Title	Credit		SEE Duration Hrs.	Evaluation - Weightage CCE: SEE = 50:50		
			T	P		CCE Marks	SEE Marks	Total Marks
1	**Major (Core) -1** (Mathematics)	Mathematics-1: Calculus-I	3	-	$2\frac{1}{2}$	75	75	**150** To be converted for 75
2	**Major(Core)-1 Practical** (Mathematics)	Mathematics-1P: Graphs and Properties of Functions Practical	-	1	2	25	25	**50** To be converted for 25
3	**Major (Core) -2** (Mathematics)	Mathematics-2: Matrix Algebra	3	-	$2\frac{1}{2}$	75	75	**150** To be converted for 75
4	**Major (Core) -2 Practical** (Mathematics)	Mathematics-2P: Tracing of Curves Practical	-	1	2	25	25	**50** To be converted for 25
5	**Minor(Elective)*-1**	(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)	3	-	$2\frac{1}{2}$	75	75	**150** To be converted for 75
6	**Minor (Elective) Practical*-1**	**Practical** of the Course selected as **Minor (Elective)-1**	-	1	2	25	25	**50** To be converted for 25
7	**Multi/Inter - Disciplinary Course -1** (MDC/IDC-1) **(Elective)****	(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)	3		$2\frac{1}{2}$	75	75	**150** To be converted for 75
8	**Multi/Inter - Disciplinary Course-1 Practical**** (MDC/IDC Practical-1) **(Elective)**	**Practical** of the Course selected as **MDC/IDC(Elective) -1**	-	1	2	25	25	**50** To be converted for 25
9	**Ability Enhancement Course -1** (AEC-1)	(As per GoG- NEP-SOP July 2023 & additional content 28/7/23 – Clause 3.3.4) **English Language:**	2	-	2	50	50	**100** To be converted for 50

10	**Skill Enhancement Course-1** (SEC-1)	(As per GoG- NEP-SOP July 2023 & additional content 28/7/23 – Clause 3.3.5) **Skill Based Practical Course: Interpretative Mathematics**	-	2	2	50	50	**100** To be converted for 50
		Development of Functional English						
11	**Common Value Added Course-1** (C-VAC-1)*** 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) VAC based on **IKS:** NSS/NCC/Sports & Fitness/Human Values and Ethics	-	2	2	50	50	**100** To be converted for 50
Total Credits and Marks (Semester-I)			14	8	NA	550	550	**1100** To be converted for 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-I

SN	Course Category As per GoG- NEP-SOP - July 2023& additional content 28/7/23	Course Title	Credit		SEE Duration Hrs.	Evaluation - Weightage CCE: SEE = 50:50		
			T	**P**		**CCE** Marks	**SEE** Marks	**Total** Marks
1	**Minor (Elective)-1** (Mathematics) (In addition to courses mentioned in SOP basket; Recommended for Statistics, Physical Science, Chemical Science, Life Science, Computer Science, etc...)	Mathematics-1: Calculus-I	**3**	-	$2\frac{1}{2}$	**75**	**75**	**150** To be converted for 75
2	**Minor (Elective) Practical-1** (Mathematics) (In addition to courses mentioned in SOP basket; Recommended for Statistics, Physical Science, Chemical Science, Life Science, Computer Science, etc...)	Mathematics-1P: Graphs and Properties of Functions Practical	-	**1**	**2**	**25**	**25**	**50** To be converted for 25
3	**Multi/Inter - Disciplinary Course -1** (MDC/IDC-1) **(Elective)** (In addition to courses mentioned in SOP basket; Recommended for Physical & Chemical Sciences, Statistics)	Mathematics: Basics of Mathematics -I	**3**	-	$2\frac{1}{2}$	**75**	**75**	**150** To be converted for 75
4	**Multi/Inter - Disciplinary Course-1 Practical** (MDC/IDC Practical-1) **(Elective)** (In addition to courses mentioned in SOP basket; Recommended for Physical & Chemical Sciences, Statistics)	Mathematics-1P: Basics of Mathematics Practical-I	-	**1**	**2**	**25**	**25**	**50** To be converted for 25
5	**Multi/Inter - Disciplinary Course -1** (MDC/IDC-1) **(Elective)** (In addition to courses	Mathematics: Introductory Mathematics -I	**3**	-	$2\frac{1}{2}$	**75**	**75**	**150** To be converted for 75

	mentioned in SOP basket; Recommended for Life Sciences, Statistics)							
6	**Multi/Inter - Disciplinary Course-1 Practical** (MDC/IDC Practical-1) **(Elective)** (In addition to courses mentioned in SOP basket; Recommended for Life Sciences, Statistics)	Mathematics-1P: Introductory Mathematics Practical-I	-	1	2	25	25	**50** To be converted for 25

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	4 credit subjects (Marks)	2 credit subjects (Marks)
1	CCE (50%)		
	Classroom & Mid-Term Evaluation	50	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 ½ hours for 4 credit course and 2 hours in case of 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:
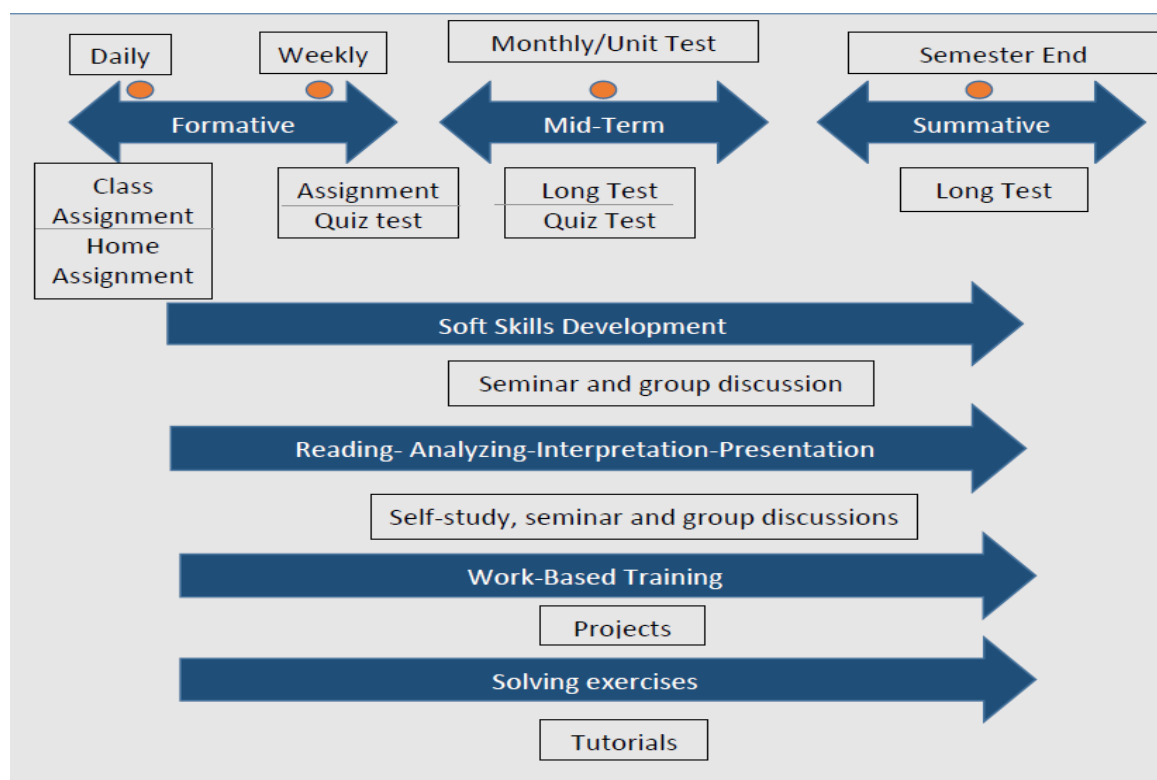
Mode of Evaluation

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.

Model for Theory Courses- 3 Credit Course	
CCE-50% (75) & SEE-50% (75)	
Exam Pattern	**Marks**
Class Test (Average of **TWO** tests)	15
Quiz (Average of **TWO** quizzes)	15
Home Assignment	15
Active Learning- PBL/CSBL/Seminar/Flipped Class Room etc..OBE tools.	10
Class Assignment	10
Attendance	10
Continuous and Comprehensive Evaluation	**75**
Semester-End Evaluation	**75**

*Similarly Model for Theory 4 Credit Courses be formulated and can be implemented after discussion and approval.

Model for Practical Courses- 1 Credit Course	
CCE-50% (25) & SEE-50% (25)	
Exam Pattern	**Marks**
Lab work assessment	10
Viva voce/Lab quiz	10
Attendance	05
Continuous and Comprehensive Evaluation	**25**
Semester-End Evaluation	**25**

*Similarly Model for Practical 2-Credit Courses be formulated and can be implemented after discussion and approval.

Model for Project/Self-study Courses- 4 Credit Course	
CCE-50% (100) & SEE-50% (100)	
Exam Pattern	**Marks**
Project Evaluation (Best 4 out of 5)	80
Participation in discussion	10
Attendance	10
Continuous and Comprehensive Evaluation	**100**
Semester-End Evaluation	**100**

*Model for Project/Self-study Courses will be implemented from semester-6 after discussion and approval.

Model for Work Experience Courses – 4 Credit Course	
CCE-50% (100) & SEE-50% (100)	
Exam Pattern	**Marks**
Project Evaluation (Best 4 out of 5)	80
Participation in discussion	10
Attendance	10
Continuous and Comprehensive Evaluation	**100**
Semester-End Evaluation	**100**

*Model for Work Experience Courses will be implemented from semester-6 after discussion and approval.

Model for Skill Enhancement Course - Skill Based Practical Course **-2 Credit Course**	
CCE-50% (50) & SEE-50% (50)	
Exam Pattern	**Marks**
Lab work assessment or Project based Assessment	20
Viva voce/Lab quiz	20
Attendance & Performance	10
Continuous and Comprehensive Evaluation	**50**
Semester-End Evaluation	**50**

Component	Marks	SEE Duration Hrs.	Evaluation - Weightage CCE: SEE = 50:50			
			CCE Marks	**SEE Marks**	**Total Marks**	**Total Marks to be Converted for**
Theory	75	$2\frac{1}{2}$	75	75	150	75
Practical	25	2	25	25	50	25
Total	100	NA	100	100	200	100

*Similarly Model for Theory 4 Credits Courses and Practical 2 Credit Courses be formulated and can be implemented after discussion and approval.

Theory Question Paper Pattern
Semester End Examination (SEE)
(Major/Minor/MDC/IDC - 3 Credit Course)

Instructions:
- All Units/ Module carry equal weightage of 15 Marks each.
- There must be One Question from each Unit/ Module.
- Each Subtopic/ Chapter must be given due weightage in the Question paper.
- Time duration: 2½ Hours.

The Theory Question Paper Skeleton is as follows.

Question 1 (Unit/Module 1)		Marks
A	Answer all the Three.	03
B	Answer Any Two out of Three.	06
C	Answer Any One out of Two.	06
	Total Marks Question 1	**15**
Question 2 (Unit/Module 2)		Marks
A	Answer all the Three.	03
B	Answer Any Two out of Three.	06
C	Answer Any One out of Two.	06
	Total Marks Question 2	**15**
Question 3 (Unit/Module 3)		Marks
A	Answer all the Three.	03
B	Answer Any Two out of Three.	06
C	Answer Any One out of Two.	06
	Total Marks Question 3	**15**
Question 4 (Unit/Module 4)		Marks
A	Answer all the Three.	03
B	Answer Any Two out of Three.	06
C	Answer Any One out of Two.	06
	Total Marks Question 4	**15**
Question 5 (Unit/Module 5)		Marks
A	Answer all the Three.	03
B	Answer Any Two out of Three.	06
C	Answer Any One out of Two.	06
	Total Marks Question 5	**15**

Practical Question Paper Pattern
Semester End Examination (SEE)
(Major/Minor/MDC/IDC - 1 Credit Practical Course)

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.

Exam Pattern	Marks
Attempt any 5 out of 7 problems. (*Each problem carry 04 Marks; Each problem may be split into sub-problem(s)/question(s), if required.)	20
Viva voce	05
Semester-End Evaluation	**25**

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

Semester I

Course Category	**Major (Core)-1**
Title of the Course	**Mathematics-1: Calculus-I**
Course Credit	**03**
Teaching Hours per Semester	**45**
Total Marks	**75**

Course Objectives

1) A primary objective of a course in Calculus is to provide a bridge to the students from high-school or lower-division Mathematics courses to upper-division Mathematics.
2) Students will be challenged to grow in mathematical maturity and to develop and strengthen problem-solving skills.
3) Students will learn higher order derivatives of a function.
4) Students will learn evaluation of some special types of integrals using reduction formulae.
5) Students will learn Mean value Theorems, expansions of functions and behavior of functions in limiting situation.
6) The course will helps to the students for problem solving in Mathematics and also to understand other higher level concepts in Mathematics.

Course Outcomes - COs

Students are able to
1) find the relation between roots and coefficients of a polynomial.
2) apply De Moivre's Theorem and could simplify some special types of complex expressions.
3) find higher order derivatives and could use it as a tool in other concepts.
4) use reduction formulae to evaluate some special types of integrals.
5) understand and could apply Mean Value Theorems.
6) find Taylor's series expansion of functions at given point.
7) evaluate indeterminate forms of limits.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?		Yes	
2	Value added Courses Imparting Transferable and Life Skills નાગુણોધરાવે છે?		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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?	Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?	Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?	No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?	No

Unit No.	Topics	Hours	Marks
1	Relation between Roots and Coefficients of polynomial and problems based on it, Descartes' rule of sign. De Moivre's Theorem and its applications, n^{th} roots of complex number, Results and Properties of nth roots of unity, Expansions of $\sin n\theta, \cos n\theta, \tan n\theta$ in powers of $\sin \theta, \cos \theta$.	9	15
2	Successive Differentiation, Standard Forms, Problems of successive differentiation based on standard forms, Leibnitz's Rule and its Applications.	9	15
3	Derivation of reduction formulae of $\int \sin^n x \, dx, \int \cos^n x \, dx , \int \sin^m x \cos^n x \, dx, \int \tan^n x \, dx$ $\int_0^{\frac{\pi}{2}} \sin^n x \, dx , \int_0^{\frac{\pi}{2}} \cos^n x \, dx, \int_0^{\frac{\pi}{2}} \sin^m x \cos^n x \, dx , \int_0^{\frac{\pi}{4}} \tan^n x \, dx$ Problems based on reduction formulae.	9	15
4	Roll's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Geometric representation of Mean Value Theorems, Problems based on Mean Value Theorems.	9	15
5	Taylor's Theorem, Maclaurin's Theorem, Taylor's and Maclaurin's series expansions of functions. Application to evaluate approximate value of a function. Indeterminate Forms $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty, \infty - \infty, 0^0, \infty^0, 1^\infty$ L'Hospital's rule (Without proof) for various indeterminate forms.	9	15

Reference Books:

1) Differential Calculus, Shanti Narayan and P. K. Mital, S. Chand & Co. Ltd
2) Integral Calculus, Shanti Narayan and P. K. Mital, S. Chand & Co. Ltd

3) A Textbook of Engineering Mathematics, N. P. Bali, Manish Goyal Laxmi Publications(P) Ltd.
4) Mathematical Analysis, S. C. Malik, Savita Arora, New Age International Publishers, Fourth Edition, 2015.
5) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
6) A basic Course in Real Analysis, Ajit kumar, S. Kumaresan, CRC Press.

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

Semester I

Course Category	**Major (Core)-1 Practical**
Title of the Course	**Mathematics-1P: Graphs and Properties of Functions Practical**
Course Credit	**01**
Teaching Hours per Semester	**30**
Total Marks	**25**

Course Objectives

1) Students define and graph trigonometric, inverse trigonometric, hyperbolic, exponential and logarithmic functions.
2) Students learn the domain, restricted domain and range of a given function.
3) Students learn basic properties and characteristics of a given function.
4) Students start to use graphing a function as a tool in problem solving.

Course Outcomes - COs

Students will be able to
1) draw the graph of trigonometric, inverse trigonometric, hyperbolic, exponential and logarithmic functions.
2) identify the domain and range of a given function.
3) know some properties and characteristics of a functions like one-one, onto, periodicity, inevitability, even-odd, etc…
4) imagine a rough sketch of graph of a function.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?			Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણોધરાવે છે?			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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?			Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?			Yes

7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?	No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?	No

Guideline for Practical:

The graphs in the entire practical (Pr. No. 1 to 10) are to be performed and visualised by the instructor using GeoGebra to explain properties of the graph and students will draw (manually) and note down its properties in journal.

Instructor will demonstrate similar kinds of relevant graphs (Other than mentioned in the list of practical) in GeoGebra and discuss its properties for more detailed knowledge and practice. It is advisable to keep record of demonstration of extra graphs but it is optional.

In the practical examination the questions should be formed from the graphs drawn by student in respective journal and graphs demonstrated by the instructor.

Pr.No.	Practical
1	To study the graphs of $y = \sin ax$ and $y = \cos ax$ and its properties.
2	To study the graphs of $y = \tan ax$ and $y = \cot ax$ and its properties.
3	To study the graphs of $y = cosec\ ax$ and $y = \sec ax$ and its properties.
4	To study the graphs of $y = \sin^{-1} x$ and $y = \cos^{-1} x$ and its properties.
5	To study the graphs of $y = \tan^{-1} x$ and $y = \cot^{-1} x$ and its properties.
6	To study the graphs of $y = cosec^{-1} x$ and $y = \sec^{-1} x$ and its properties.
7	To study the graphs of $y = e^{ax}$ and $y = a^x$ $(a > 0, a \neq 1)$ and its properties.
8	To study the graphs of $y = \log_{10} x$ and $y = \ln x$ and its properties.
9	To study the graphs of $y = \sinh x$, $y = \cosh x$ and $y = \tanh x$ and its properties.
10	To study the graphs of $y = cosech\ x$, $y = sech\ x$ and $y = \coth x$ and its properties.

Reference Books:

1) Play with Graphs by Amit M. Agarwal, Arihant Publications.
2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.

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Semester I

Course Category	**Major (Core) -2**
Title of the Course	**Mathematics-2: Matrix Algebra**
Course Credit	**03**
Teaching Hours per Semester	**45**
Total Marks	**75**

Course Objectives

1) An objective of this course is to teach the concepts related to matrix theory and its applications in various aspects.
2) Students will learn Row Echelon Form (REF) and Reduced Row Echelon Form (RREF), Normal form, and rank of a matrix.
3) Students will learn applications of matrices to solve a linear system of equations.
4) Students will learn Eigenvalues and Eigenvectors.
5) Students will learn Cayley-Hamilton Theorem and its applications.

Course Outcomes - COs

Students are able to
1) classify the types of matrices and know its properties.
2) identify the singularity of a matrix and could take care of singularity during working with matrices.
3) find the rank of matrix by various ways and know the properties of rank.
4) solve system of linear equations using matrix algebra and also could classify the nature of the solution of system of linear equations by rank.
5) understand and apply the Cayley-Hamilton Theorem.
6) find eigen values and corresponding eigen vectors of a matrix and also know the properties of eigenvalues and eigenvectors.
7) take mathematical care whenever they deal with matrices in other concepts of Mathematics.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?			Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?			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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?					Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?					No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?					No

Unit No.	Topics	Hours	Marks
1	Reorientation of Matrix and Determinant, Types of Matrices, Results and Properties based on types of matrices. Singularity of Matrices, Results and properties of singularity of matrices and adjoint of matrix.	9	15
2	Row Echelon Form (REF) of a matrix, Reduced Row Echelon Form (RREF) of a matrix, Rank of a matrix by determinant, Rank of a matrix by RRF or RREF, Rank of matrix by Normal Form, Results and Properties of rank of a matrix.	9	15
3	Homogeneous System of Linear Equations, Non-Homogeneous System of Linear Equations, Results on classification of solution(s) of homogeneous and non-homogeneous system of liner equations in terms of rank (without Proof), Consistency of system of equations, Solution of system of linear equations by Gauss elimination method, Solution of system of linear equations by Gauss-Jordan elimination method, Problems based on solution of System of equations.	9	15
4	Characteristic Equation and Characteristic roots of a matrix, Cayley-Hamilton Theorem, Applications of Cayley-Hamilton Theorem.	9	15
5	Eigenvalues of a matrix, Results and properties of eigenvalues of a matrix, Eigen vectors of a matrix.	9	15

Reference Books:

1) A Textbook of Matrices, Shanti Narayan, P. K. Mittal, S. Chand & Co. Ltd.
2) Matrices, A. R. Vasishtha, A. K. Vasishtha, Krishna Prakashan Media(P) Ltd.
3) Linear Algebra A Geometric Approach, S. Kumaresan, PHI Learning Private Limited.
4) Linear Algebra, Vivek Sahai, Vikas Bist, Narosha Publishing House.
5) A Textbook of Engineering Mathematics, N. P. Bali, Manish Goyal Laxmi Publications(P) Ltd.
6) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.

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Semester I

Course Category	**Major (Core)-2 Practical**
Title of the Course	**Mathematics-2P: Tracing of Curves Practical**
Course Credit	**01**
Teaching Hours per Semester	**30**
Total Marks	**25**

Course Objectives

1) Students learn symmetry of Cartesian curves, parametric curves and polar curves about various axes.
2) Students learn to find intersection points of a given curve with axes.
3) Students learn to find asymptotes of a given curve parallel to axis.
4) Students could draw the graph of a given function using basic properties of graphing of a curve.

Course Outcomes - COs

Students will be able to
1) draw the graph of a curve given in either Cartesian, Parametric or Polar form.
2) identify like symmetry about axis and origin, point of intersection, tangent at origin.
3) find asymptote parallel to axis of a given Cartesian curve.
4) decide limitations of a given curve and also could predict the rough shape of a given curve.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?				Yes
2	Value added Courses Imparting Transferable and Life Skills નાગુણોધરાવે છે?				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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?				Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?				Yes

Pr. No.	**Objective of Practical**
1	**To learn procedure for tracing of Cartesian curves :** (A) Symmetry about the X-axis. (B) Symmetry about the Y-axis. (C) Symmetry about the origin. (D) Symmetry about the line $y = x$. (E) Intersection points with axis.
2	**To learn procedure for tracing of Cartesian curves :** (A) Origin and Tangents thereat. (B) Asymptotes parallel to the X-axis. (C) Asymptotes parallel to the Y-axis. (D) Limitations.
3	**Trace the curves :** (i) $y^2(2a - x) = x^3$, $(a > 0)$. (ii) $x^2 y = a^2(a - y)$, $(a > 0)$. **Extra Practice : Trace the following curves:** (iii) $x^2(2a - y) = y^3$, $(a > 0)$. (iv) $xy^2 = a^2(a - x)$, $(a > 0)$. (v) $y(x^2 + 4a^2) = 8a^3$, $(a > 0)$.
4	**Trace the curves :** (i) $x(x^2 + y^2) = a(x^2 - y^2)$, $(a > 0)$. (ii) $x^2 y + (y + a)^2(y + 2a) = 0$, $(a > 0)$. **Extra Practice : Trace the following curves:** (iii) $y(x^2 + y^2) = a(y^2 - x^2)$, $(a > 0)$. (iv) $xy^2 + (x + a)^2(x + 2a) = 0$, $(a > 0)$. (v) $y^2(a + x) = x^2(3a - x)$, $(a > 0)$. (vi) $y^2(a - x) = x^2(a + x)$, $(a > 0)$.
5	**Trace the curves :** (i) $a^2 y^2 = x^3(2a - x)$, $(a > 0)$ (ii) $y^2(a^2 + x^2) = x^2(a^2 - x^2)$, $(a > 0)$ **Extra Practice : Trace the following curves:** (iii) $a^2 x^2 = y^3(2a - y)$, $(a > 0)$ (iv) $ay^2 = x(x - a)^2$, $(a > 0)$ (v) $y^2(x^2 + y^2) = a^2(y^2 - x^2)$, $(a > 0)$ (vi) $a^2 y^2 = x^2(a^2 - x^2)$, $(a > 0)$
6	**To learn procedure for tracing of Parametric curves :** (A) Symmetry about X-axis. (B) Symmetry about Y-axis. (C) Symmetry in opposite quadrants. (D) Curve passing through origin.

	(E) Limitations of the curve. (F) Axis of Intersection. (G) Special points. (H) Region.
7	**Trace the curve :** (i) $x = a(t + \sin t); \ y = a(1 - \cos t), \ (a > 0).$ (ii) $x = a(t + \sin t); \ y = a(1 + \cos t), \ (a > 0).$ **Extra Practice : Trace the following curves:** (iii) $x = a(t - \sin t); \ y = a(1 - \cos t), \ (a > 0).$ (iv) $x = a(t - \sin t); \ y = a(1 + \cos t), \ (a > 0).$
8	**Trace the curve :** (i) $\left(\dfrac{x}{a}\right)^{2/3} + \left(\dfrac{y}{b}\right)^{2/3} = 1, (a, b > 0).$ (ii) $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}, (a > 0).$
9	**To learn procedure for tracing of Polar curves :** (A) Definition of polar coordinates. (B) Relation between polar and Cartesian coordinates. (C) Symmetry about the initial line (polar axis). (D) Symmetry about the line $\theta = \dfrac{\pi}{2}$ (Normal axis). (E) Symmetry about the pole. (F) Curve passing through pole. (G) Intersection with initial axis and Normal axis. (H) Value of ϕ. (I) Region.
10	**Trace the curve :** (i) $r = a(1 + \cos \theta), (a > 0).$ (Cardioid) (ii) $r = a(1 - \sin \theta), (a > 0).$ (Cardioid) (iii) $r^2 = a^2 \cos 2\theta, \ (a > 0).$ (Lemniscate) (iv) $r = a \sin 3\theta, (a > 0)$ (Rose curve) **Extra Practice : Trace the following curves:** (i) $r = a(1 - \cos \theta), \ (a > 0).$ (ii) $r = a(1 + \sin \theta), \ (a > 0).$ (iii) $r^2 = -a^2 \sin 2\theta \ (a > 0).$ (iv) $r^2 = -a^2 \cos 2\theta, \ (a > 0).$ (v) $r^2 = a \cos 2\theta, \ (a > 0).$ (vi) $r = a \sin 2\theta, (a > 0).$ (vii) $r = a \cos 3\theta, (a > 0)$

Reference Books:

1) A Textbook of Engineering Mathematics, N. P. Bali, Manish Goyal Laxmi Publications (P) Ltd.
2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.

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Semester I

Course Category	**Minor (Core) -1**
Title of the Course	**Mathematics-1: Calculus-I**
Course Credit	**03**
Teaching Hours per Semester	**45**
Total Marks	**75**

Course Objectives

1) A primary objective of a course in Calculus is to provide a bridge to the students from high-school or lower-division Mathematics courses to upper-division Mathematics.
2) Students will be challenged to grow in mathematical maturity and to develop and strengthen problem-solving skills.
3) Students will learn higher order derivatives of a function.
4) Students will learn evaluation of some special types of integrals using reduction formulae.
5) Students will learn Mean value Theorems, expansions of functions and behavior of functions in limiting situation.
6) The course will help the students for problem solving in Mathematics and also to understand other higher level concepts in Mathematics.

Course Outcomes - COs

Students are able to
1) find the relation between roots and coefficients of a polynomial.
2) apply De Moivre's Theorem and could simplify some special types of complex expressions.
3) find higher order derivatives and could use it as a tool in other concepts.
4) use reduction formulae to evaluate some special types of integrals.
5) understand and could apply Mean Value Theorems.
6) find Taylor's series expansion of functions at given point.
7) evaluate indeterminate forms of limits.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?		Yes	
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?		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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?					Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?					No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?					No

Unit No.	Topics	Hours	Marks
1	Relation between Roots and Coefficients of polynomial and problems based on it, Descartes' rule of sign. De'Moivre's Theorem and its applications, n^{th} roots of complex number, Results and Properties of nth roots of unity, Expansions of $\sin n\theta, \cos n\theta, \tan n\theta$ in powers of $\sin\theta, \cos\theta$.	9	15
2	Successive Differentiation, Standard Forms, Problems of successive differentiation based on standard forms, Leibnitz's Rule and its Applications.	9	15
3	Derivation of reduction formulae of $\int \sin^n x \, dx, \int \cos^n x \, dx, \int \sin^m x \cos^n x \, dx, \int \tan^n x \, dx$ $$\int_0^{\frac{\pi}{2}} \sin^n x \, dx, \int_0^{\frac{\pi}{2}} \cos^n x \, dx, \int_0^{\frac{\pi}{2}} \sin^m x \cos^n x \, dx, \int_0^{\frac{\pi}{4}} \tan^n x \, dx$$ Problems based on reduction formulae.	9	15
4	Roll's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Geometric representation of Mean Value Theorems, Problems based on Mean Value Theorems.	9	15
5	Taylor's Theorem, Maclaurin's Theorem, Taylor's and Maclaurin's series expansions of functions. Application to evaluate approximate value of a function. Indeterminate Forms $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty, \infty - \infty, 0^0, \infty^0, 1^\infty$ L'Hospital's rule (Without proof) for various indeterminate forms.	9	15

Reference Books:
1) Differential Calculus, Shanti Narayan and P. K. Mital, S. Chand & Co. Ltd
2) Integral Calculus, Shanti Narayan and P. K. Mital, S. Chand & Co. Ltd

3) A Textbook of Engineering Mathematics, N. P. Bali, Manish Goyal Laxmi Publications(P) Ltd.
4) Mathematical Analysis, S. C. Malik, Savita Arora, New Age International Publishers, Fourth Edition, 2015.
5) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
6) A basic Course in Real Analysis, Ajit kumar, S. Kumaresan, CRC Press.

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Semester I

Course Category	**Minor (Core)-1 Practical**
Title of the Course	**Mathematics-1P: Graphs and Properties of Functions Practical**
Course Credit	**01**
Teaching Hours per Semester	**30**
Total Marks	**25**

Course Objectives

1) Students define and graph trigonometric, inverse trigonometric, hyperbolic, exponential and logarithmic functions.
2) Students learn the domain, restricted domain and range of a given function.
3) Students learn basic properties and characteristics of a given function.
4) Students start to use graphing a function as a tool in problem solving.

Course Outcomes - COs

Students will be able to
1) draw the graph of trigonometric, inverse trigonometric, hyperbolic, exponential and logarithmic functions.
2) identify the domain and range of a given function.
3) know some properties and characteristics of a functions like one-one, onto, periodicity, inevitability, even-odd, etc…
4) imagine a rough sketch of graph of a function.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?			Yes
2	Value added Courses Imparting Transferable and Life Skills નાગુણોધરાવે છે?			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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?			Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?			Yes

7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?	No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?	No

Guideline for Practical:

The graphs in the entire practical (Pr. No. 1 to 10) are to be performed and visualised by the instructor using GeoGebra to explain properties of the graph and students will draw (manually) and note down its properties in journal.

Instructor will demonstrate similar kinds of relevant graphs (Other than mentioned in the list of practical) in GeoGebra and discuss its properties for more detailed knowledge and practice. It is advisable to keep record of demonstration of extra graphs but it is optional.

In the practical examination the questions should be formed from the graphs drawn by student in respective journal and graphs demonstrated by the instructor.

Pr.No.	Practical
1	To study the graphs of $y = \sin ax$ and $y = \cos ax$ and its properties.
2	To study the graphs of $y = \tan ax$ and $y = \cot ax$ and its properties.
3	To study the graphs of $y = cosec\ ax$ and $y = \sec ax$ and its properties.
4	To study the graphs of $y = \sin^{-1} x$ and $y = \cos^{-1} x$ and its properties.
5	To study the graphs of $y = \tan^{-1} x$ and $y = \cot^{-1} x$ and its properties.
6	To study the graphs of $y = cosec^{-1} x$ and $y = \sec^{-1} x$ and its properties.
7	To study the graphs of $y = e^{ax}$ and $y = a^x$ $(a > 0, a \neq 1)$ and its properties.
8	To study the graphs of $y = \log_{10} x$ and $y = \ln x$ and its properties.
9	To study the graphs of $y = \sinh x$, $y = \cosh x$ and $y = \tanh x$ and its properties.
10	To study the graphs of $y = \cosech x$, $y = \sech x$ and $y = \coth x$ and its properties.

Reference Books:

1) Play with Graphs by Amit M. Agarwal, Arihant Publications.
2) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.

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Semester I

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

Course Category	**Multi/Inter-Disciplinary Course-1 (MDC/IDC-1) (Elective)**
Title of the Course	**Mathematics: Basics of Mathematics-I**
Course Credit	**03**
Teaching Hours per Semester	**45**
Total Marks	**75**

Course Objectives

1) An objective of this course is to introduce the students to the fundamental concepts of Mathematics like functions, algebra of functions, graph of functions.
2) Students will learn determinant, matrix and its properties,.
3) Students will learn techniques to find solution and classify the nature of the solutions of system of linear equations.
4) Students will be oriented by the concept of limit, continuity, differentiation, integration and its applications.
5) Students will learn first order differential equation and second order differential equation and its applications in their respective subjects.

Course Outcomes - COs

Students are able to
1) expand determinant and understand the theory of matrices.
2) identify the singularity of a matrix could take care of singularity during working with matrices.
3) reduce a matrix in REF or RREF and could find rank using it.
4) solve system of linear equations and also could classify the nature of the solution of system of linear equations by rank.
5) find eigen values and corresponding eigen vectors of a matrix and also know properties of eigen value and eigen vectors.
6) solve first order differential equation and second order differential equation with constant coefficients.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?				Yes
2	Value added Courses Imparting Transferable and Life Skills નાગુણોધરાવે છે?				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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?				Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?				Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?				No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?				No

Unit No.	Topics	Hours	Marks
1	Determinant, Expansion of Determinants, Properties of Determinant (Without Proof), Matrices, Types of Matrices, Algebra of Matrices, Singularity of Matrix, Row Echelon Form, Reduced Row Echelon Form, Rank of a matrix by REF or RREF, Nature of solution of system of linear equations by rank (Only statements), Solution of System of Linear Equation using Matrices, Eigenvalues and Eigenvectors of a matrix, Basic properties of Eigenvalues.	9	15
2	Function, Domain and Range of some standard functions (Constant, Identity, Linear, Quadratic, Polynomial, Trigonometric, Exponential, Logarithmic), Algebra of functions, Composition of functions, Even and odd functions, At least three examples of functions of respective discipline.	9	15
3	Orientation of Limit, Continuity and Differentiability of a function (Don't Explain the concept of Limit and Continuity by ϵ-δ definition, Don't Explain the concept of Differentiation by limit), Derivative as a gradient, Increasing and decreasing functions using derivative, Concavity of a function (Concave upwards/Concave downwards), Integration as an inverse process of differentiation, Elementary techniques to evaluate integration.	9	15
4	Differential equation, Order and degree of a differential equation, Solution of first order differential equations (Variable separable, Homogeneous, Linear differential equation and Exact differential equation).	9	15

5	Second order differential equation with constant coefficients, Complementary function, Particular integral, General solution, Methods to find particular integral.	9	15

Reference Books:

1) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
2) A Textbook of Matrices, Shanti Narayan, P. K. Mittal, S. Chand & Co. Ltd.
3) Matrices, A. R. Vasishtha, A. K. Vasishtha, Krishna Prakashan Media(P) Ltd.
4) Linear Algebra A Geometric Approach, S. Kumaresan, PHI Learning Private Limited.
5) Linear Algebra, Vivek Sahai, Vikas Bist, Narosha Publishing House.
6) Advanced Engineering Mathematics, Erwin Kreyszing, Wiley Publications.

Semester I

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

Course Category	**Multi/Inter -Disciplinary Course-1 Practical (MDC/IDC-1) (Elective)**
Title of the Course	**Mathematics-1P: Basics of Mathematics Practical-I**
Course Credit	**01**
Teaching Hours per Semester	**30**
Total Marks	**25**

Course Objectives

1) Students learn to draw graphs of trigonometric functions and also know some properties of it.
2) Students could solve system of homogeneous and non-homogeneous system of linear equations.
3) Students could find Eigenvectors corresponding to Eigenvalue of a given matrix.
4) Students could solve some real world problems using first order differential equation and second order differential equation with constant coefficients.

Course Outcomes - COs

Students will be able to
1) draw graphs of trigonometric functions and also know some properties of it.
2) solve system of homogeneous and non-homogeneous linear equations.
3) find Eigenvectors corresponding to Eigenvalue of a matrix.
4) solve some real world problems using first order differential equation and second order differential equation with constant coefficients.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?		Yes
2	Value added Courses Imparting Transferable and Life Skills નાગુણોધરાવે છે?		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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?					Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?					No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?					No

PN	Practical
1	To study properties and graph of $y = \sin ax$ and $y = \cos ax$.
2	To study properties and graph of $y = \tan ax$ and $y = \cot ax$.
3	To study properties and graph of $y = \operatorname{cosec} ax$ and $y = \sec ax$.
4	To solve non-homogeneous system of linear equation by Gauss elimination or Gauss-Jordan method. (Include each case: No solution, Unique Solution, Infinitely many solutions)
5	To solve homogeneous system of linear equation by Gauss elimination or Gauss-Jordan method. (Include each case: Unique Solution, Infinitely many solutions)
6	To find slope and equations of tangent and normal at a given point of a given curve.
7	To find Eigen values and Eigen vectors of a given matrix. (Repeated Eigen vectors)
8	To find Eigen values and Eigen vectors of a given matrix. (Distinct Eigen vectors)
9	To study applications of first order differential equation to real life problems.
10	To study applications of second order differential equation to real life problems.

Reference Books:

1) Calculus, Thomas and Finney, Pearson Education, 9th or higher edition.
2) A Textbook of Matrices, Shanti Narayan, P. K. Mittal, S. Chand & Co. Ltd.
3) Matrices, A. R. Vasishtha, A. K. Vasishtha, Krishna Prakashan Media(P) Ltd.
4) Linear Algebra A Geometric Approach, S. Kumaresan, PHI Learning Private Limited.
5) Linear Algebra, Vivek Sahai, Vikas Bist, Narosha Publishing House.
6) Advanced Engineering Mathematics, Erwin Kreyszing, Wiley Publications.

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Semester I

*This course is recommended for Life Sciences.

Course Category	**Multi/Inter-Disciplinary Course-1 (MDC/IDC-1) (Elective)**
Title of the Course	**Mathematics: Introductory Mathematics-I**
Course Credit	**03**
Teaching Hours per Semester	**45**
Total Marks	**75**

Course Objectives

1) Students will learn to organize the data in tabular form.
2) Students will learn the concept of a frequency distribution for sample data, and be able to summarize the distribution by diagrams and statistics.
3) Students will learn various methods to find correlation.
4) Students will understand the theory of regression, and be able to make predictions and understand their limitations.

Course Outcomes - COs

Students are able to
1) classify the data.
2) create and interpret frequency tables.
3) display data graphically and interpret graphs, histogram, frequency polygon, bar chart, pie chart, etc.
4) recognize, describe, and calculate the measures of the center of data: mean, median, and mode.
5) recognize, describe, and calculate the measures of the spread of data: variance, standard deviation, and range.
6) find correlation of coefficient for both types of data qualitative and quantitative.
7) Find equation of regression line for the given data or data obtained from experiment.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?			Yes
2	Value added Courses Imparting Transferable and Life Skills નાગુણોધરાવે છે?			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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?	Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?	Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?	No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?	No

Unit No.	Topics	Hours	Marks
1	Data, Ungrouped Data, Grouped Data, Frequency Distribution, Graphical Representation of frequency distribution, Histogram or Bar Chart, Frequency Polygon, Frequency curve, Ogive or Cumulative Frequency Curve, Pie Chart, Good enough examples of each concept.	9	15
2	Measure of central Tendency, Mean, Weighted Mean, Median, Mode, Quartiles, Deciles, Percentiles, Geometric Mean and Harmonic Mean for Ungrouped Data, Frequency Distribution and Continuous Frequency Distribution, Good enough examples of each concept.	9	15
3	Measure of Dispersion, Range, Mean deviation, Mean deviation about mean, Mean deviation about median, Coefficient of Mean deviation, Standard deviation, Variance, Coefficient of variance, Good enough examples of each concept.	9	15
4	Correlation, Types of correlation, Coefficient of Correlation, Methods of Correlation: Scatter Diagram Method, Karl Pearson's Product Moment Method and Spearman's Rank Correlation Method, Good enough examples of each concept.	9	15
5	Regression, Regression Lines, Methods to obtain Regression Lines: The Scatter Diagram Method and The Method of Least Squares, Regression Equations, Formulae for Computations of Regression Coefficients, Examples of Regression Lines, Good enough examples of each concept.	9	15

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, Sultan Chand & Sons, New Delhi.

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Semester I

*This course is recommended for Life Sciences.

Course Category	**Multi/Inter-Disciplinary Course-1 Practical (MDC/IDC-1) (Elective)**
Title of the Course	**Mathematics-1P: Introductory Mathematics Practical-I**
Course Credit	**01**
Teaching Hours per Semester	**30**
Total Marks	**25**

Course Objectives

1) Students learn to represent the large data in graphical form.
2) Students learn to analyze the data with respect to measures of central tendency and measures of dispersions using Microsoft Excel.
3) Students could predict the trend between two sets of data using correlation coefficient using Microsoft Excel.
4) Students could find the equation of regression line using Microsoft Excel.

Course Outcomes - COs

Students will be able to
1) represent the large data in graphical form.
2) analyze the data with respect to measures of central tendency and measures of dispersions using Microsoft Excel.
3) predict the trend between two sets of data using correlation coefficient using Microsoft Excel.
4) find the equation of regression line using Microsoft Excel.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?			Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણોધરાવે છે?			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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?					Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?					No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?					No

The entire practical are to be performed in computer lab.
Suggested Software - Microsoft Excel.

PN	Practical
1	To draw and study the Histogram and Frequency Polygon of given data and analyse the data.
2	To draw and study the Frequency curve, Ogive or Cumulative Frequency Curve, Pie Chart of given data and analyse the data.
3	To find Mean, Weighted Mean, Median and Mode of given data and analyse the data.
4	To find Quartiles, Deciles, Percentiles, Geometric Mean and Harmonic Mean of given data and analyse the data.
5	To find Range, Mean deviation about mean, Mean deviation about median and Coefficient of Mean Deviation of given data and analyse the data.
6	To find Standard deviation, Variance and Coefficient of variance of given data and analyse the data.
7	To find correlation between two sets of data by Karl Pearson's Product Moment Method.
8	To find correlation between two sets of data by Spearman's Rank Correlation Method.
9	To obtain regression lines (x on y, y on x) of given data by least square method.
10	To find regression coefficients of regression lines of given data.

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, Sultan Chand & Sons, New Delhi.

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Semester I

Course Category	**Skill Enhancement Course-1 (SEC-1)**
Title of the Course	**Skill Based Practical Course: Interpretative Mathematics**
Course Credit	**02**
Teaching Hours per Semester	**60**
Total Marks	**50**

Course Objectives

1) Students will learn the Mathematical meaning of "and, or, for all, there, etc."
2) Students will learn Mathematical formulation of a problem.
3) The ultimate objective of this course is to make aware and conscious about writing Mathematics as well as reading Mathematics correctly.
4) Students will learn how to explore reference book and how to find required information from it.
5) Students could start to read reference books for detail study.

Course Outcomes - COs

Students are able to
1) understand difference between "and", "or", etc…
2) convert information in to Mathematical statements.
3) use various notations to express Mathematical ideas.
4) take care in Mathematical drafting.
5) write proof of basic results independently.
6) read reference books.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?				Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?				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	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?	Yes
6	New India Literacy Programme (NILP) મુજબનો વિષય છે?	Yes
7	Swayam પ્લેટફોર્મપરના MOOC વિષય પર આધારિત આ વિષય છે ?	No
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પરઆધારિત વિષય છે ?	No

Unit No.	Topics
1	Mathematical Statement, Mathematical understanding of "and", "or" , "for all", "there exists", "implies", "if and only if " etc.. with examples, Making of converse of a statement, Understanding and use of "Therefore", "Thus", "Hence", etc. in Mathematical arguments by suitable examples. Understanding of difference between similar Mathematical terminology like similarity and congruency of two triangles, determinant and matrix etc…AMS (American Mathematical Society) Notations.
2	Conversion of word statement into Mathematical statement with Mathematical notations, Alignments in Mathematical writing, Necessity of proof or counter example. Proof of simple results to understand care of Mathematical draft.
3	Difference among Definition, Postulate, Proposition, Lemma, Theorem, Corollary, Conjecture etc., How to apply Theorem or results to solve some problems by appropriate examples, How to excess library, How to find reference book, How to read reference book, How to find a concept or a topic or a term in reference book, etc. How to prepare presentations in Mathematics.

Model for Skill Enhancement Course - Skill based Practical Course **-2 Credit Course**	
CCE-50% (50) & SEE-50% (50)	
Exam Pattern	**Marks**
Lab work assessment or Project based Assessment	20
Viva voce/Lab quiz	20
Attendance & Performance	10
Continuous and Comprehensive Evaluation	**50**
Semester-End Evaluation	**50**

Semester-End Evaluation	
Exam Pattern	**Marks**
Problems/Task/Experiment/Explanation/Seminar/etc..	40
Viva voce	10
Total	**50**

Reference Books:

Student may use any standard UG Mathematics book as per his/her level of understanding.