

CURRICULUM & SYLLABUS



SRM
UNIVERSITY
DELHI-NCR, SONEPAT

Bachelor of Science (Hons.) Mathematics

OR

**Bachelor of Science (Hons.) Mathematics with
Research/ Academic Projects**

(4 Year Undergraduate Degree Program)

**Under UGC Framework - 2022 based on National Education
Policy – 2020**

(w.e.f. Academic Year 2025-26)

**DEPARTMENT OF MATHEMATICS
FACULTY OF SCIENCE AND HUMANITIES
SRM UNIVERSITY DELHI-NCR, SONEPAT
Rajiv Gandhi Education City, Sonapat Haryana-131029**

SRM UNIVERSITY DELHI-NCR, SONEPAT (HARYANA)

VISION

SRM University Haryana aims to emerge as a leading World Class Institution that creates and disseminates knowledge upholding the highest standards of instruction in Engineering & Technology, Science & Humanities, Commerce, Management, Hotel Management & Medicine & Health Science. Along with academic excellence, our curriculum imparts integrity and social sensitivity so that our graduates may best serve the Nation and the World.

MISSION

- To create a diverse community campus that inspires freedom and innovation.
- Strengthen Excellence in educational & skill development processes
- Continue to build productive international alliances
- Explore optimal development opportunities available to students and faculty
- Cultivate an exciting and rigorous research environment

DEPARTMENT OF MATHEMATICS

VISION

The broad vision of the Department is to carry out high quality research in the different areas of Mathematics, Statistics and Computing so that we can produce proficient graduates, engineers, and scientists to contribute significantly in the development of the society. Excellence, integrity, innovation, entrepreneurship, and leadership are priorities of the Department. The vision is to become a leading department of global excellence in research and education in all discipline of Mathematics.

MISSION

The Department supports the University's mission by empowering students to:

- Provide excellent knowledge of Mathematical Sciences as well as Statistics for suitable career and groom them for institutional, state, national and international recognition.
- Discover, mentor, and nurture mathematically inclined students, and provide them a supportive environment that fosters intellectual growth.
- Train the students for interdisciplinary applications and research.
- Train the students with Mathematical and Statistical tools for industries as well as research organizations
- Provide professional services based on our diverse mathematical and statistical expertise
- The scientific, technical, and educational community.
- Achieve excellence in the subject as well as overall development of the student to strive in a competitive society.

GRADUATE EMPLOYMENT ATTRIBUTES

EXIT-1: A student may take exit after completion of one year with 46 credits earned. S/He will get Certificate in the UG Mathematics.

EA-1: Graduates should possess a clear understanding of their chosen scientific field, including relevant concepts, theories, and methodologies.

EXIT-2: A student may take exit after completion of two years with 95 credits earned. S/He will get Diploma in the UG Mathematics.

EA-1: Graduates should possess a clear understanding of their chosen scientific field, including relevant concepts, theories, and methodologies.

EA-2: Equipping students with skills like critical thinking, problem-solving, and communication, which are highly valued in today's job market.

EXIT-3: A student may take exit after completion of three years with 145 credits earned. S/He will get Bachelor in the Mathematics.

EA-1: Graduates should possess a clear understanding of their chosen scientific field, including relevant concepts, theories, and methodologies.

EA-2: Equipping students with skills like critical thinking, problem-solving, and communication, which are highly valued in today's job market.

EA-3: Effective written and verbal communication skills, including the ability to convey complex scientific information clearly and concisely.

EXIT-4: On completion of Four years with 181 credits earned. S/He will get B.Sc. Mathematics. (Honours/Honours with Research).

EA-1: Graduates should possess a deep understanding of their chosen scientific field, including relevant concepts, theories, and methodologies.

EA-2: Equipping students with skills like critical thinking, problem-solving, and communication, which are highly valued in today's job market.

EA-3: Effective written and verbal communication skills, including the ability to convey complex scientific information clearly and concisely.

EA-4: They should be able to apply their knowledge to solve real-world problems, and analyse data.

EA-5: A strong foundation in research, including the ability to formulate research questions, design experiments, and interpret results.

PROGRAM EDUCATIONAL OBJECTIVES

PEO-1: The programme covers the full range of mathematics, from classical Calculus to modern Cryptography, Information Theory, and Statistical computation.

PEO-2: The course lays a structured foundation of Pure & Applied Mathematics.

PEO-3: An exceptionally broad range of topics covering: Linear Algebra, Metric spaces, Statistics, Linear Programming, Numerical Analysis, Mathematical Finance, Coding theory, Mechanics, and Bio- Mathematics cater to varied interests and ambitions.

PEO-4: Skill enhancement Courses enable the student acquire the skill relevant to the main subject.

PEO-5: The well-structured programme empowers the student with the skills and knowledge leading to enhanced career opportunities in industry, commerce, education, finance and research.

PROGRAM LEARNING OUTCOMES

PLO-1: Communicate mathematics effectively by written, computational and graphic means.

PLO-2: Create mathematical ideas from basic axioms.

PLO-3: Estimate the hypothesis, theories, techniques, and proofs provisionally.

PLO-4: Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis, and synthesis.

PLO-5: Identify applications of mathematics in other disciplines and in the real-world, leading to enhancement of career prospects in a plethora of fields and research.

MAPPING MATRIX BETWEEN PEOs & PLOs:

PEO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5
PEO1	✓				
PEO2		✓			
PEO3		✓	✓		
PEO4				✓	
PEO5					✓

**Four Year B.Sc. Mathematics Program Structure in alignment with NEP-
2020 (UGC guidelines) in the Department of Mathematics, SRMUH
w.e.f. Academic Year 2024-25**

S. No.	Broad Category of Courses	No. of Courses	Credits	%
1	Major Course (Discipline Specific Course DSC)	24	$24 \times 4 = 96$	53.03
2	Minor Stream Course (MSC)	7	$7 \times 4 = 28$	15.46
3	Multi-Disciplinary Course (MDC)	3	$3 \times 3 = 9$	4.97
4	Ability Enhancement course (AEC)	4	$4 \times 2 = 8$	4.41
5	Skill Enhancement Course (SEC)	10	$10 \times 1 = 10$	5.52
6	Value Added Course (VAC)	3	$3 \times 2 = 6$	3.31
7	Project / Dissertation	2	12	6.62
8	Live Projects / Vocational Courses/ Summer Internship	3	$3 \times 4 = 12$	6.62
Total		56	181	100

**Four Year B.Sc. Mathematics Program Credit Structure Semester-wise in alignment
with NEP-2020 (UGC guidelines) in the Department of Mathematics, SRMUH
w.e.f. Academic Year 2024-25**

Semester	Broad Category of Courses								Total Credits	Remarks
	Major	IDC/ MSC	MDC	AEC	SEC	VAC	RP/Dissertation	Live Projects/Vocational Courses/Summer Internship		
I	8	4	3	2	2	2	-	-	21	Certificate: 46 Credits
II	8	4	3	2	2	2	-	4	25	
III	12	4	3	2	2	-	-	-	23	Diploma: 95 Credits
IV	12	4	-	2	2	2	-	4	26	
V	16	4	-	-	2	-	-	-	22	Degree: 145 Credits
VI	16	8	-	-	-	-	-	4	28	
VII	12	6*	-	-	-	-	6#	-	18	Honours / Honours with Research: 181 Credits
VIII	12	6*	-	-	-	-	6#	-	18	
3 Years	72	28	9	8	10	6	0	12	145	
%	49.65	19.31	6.20	5.51	6.89	4.13	0.00	8.27	100.00	
4 Years	96	28	9	8	10	6	12	12	181	
%	53.03	15.46	4.97	4.41	5.52	3.31	6.62	6.62	100.00	
*Students pursuing Honours will do 1 MSC course of 4 Credits, 2 MSC courses of 2 credits and 1 minor project of 4 credits in lieu of a Research Project/Dissertation.										
#Students pursuing Honours with Research would complete 2 credits of Research Methodology, 4 credits of minor dissertation and 6 Credits of major Research/Dissertation.										

SEMESTER – I

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	23MABS101	Calculus	3	1	0	4	Major
2	23MABS102	Algebra I	3	1	0	4	Major
3	23MABS103	Object Oriented Programming using C++	3	0	0	3	MSC
4	23MABS103L	Object Oriented Programming using C++ Lab	0	0	2	1	MSC
5		MDC – I	3	0	0	3	MDC
6	23AEC101	Functional English – I	2	0	0	2	AEC
7	23SS151	Effective Communication Skills	0	0	2	1	SEC (Soft)
8	23TS101	Digital Literacy & IT Skills	0	0	2	1	SEC (Tech)
9	23VAC102	Indian Constitution & Polity	2	0	0	2	VAC
TOTAL			16	2	6	21	

L – Lectures, T- Tutorial, P- Practical

- **Major – Major Course**
- **MSC - Minor Stream Course**
- **MDC - Multidisciplinary Course**
- **AEC - Ability Enhancement Course**
- **SEC (Soft) - Skill Enhancement Course (Soft Skills)**
- **SEC (Tech) - Skill Enhancement Course (Technical Skills)**
- **VAC – Value Added Course**

SEMESTER – II

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	24MABS201	Algebra II	3	1	0	4	Major
2	24MABS202	Vector Calculus	3	1	0	4	Major
3	24MABS203	Python Programming	3	0	0	3	MSC
4	24MABS203L	Python Programming Lab	0	0	2	1	MSC
5		MDC – II	3	0	0	3	MDC
6	23AEC201	Functional English – II	2	0	0	2	AEC
7	23SS252	Teamwork & Interpersonal Skills	0	0	2	1	SEC (Soft)
8	23SS202	Advanced Excel Skills	0	0	2	1	SEC (Tech)
9	23VAC101	Environmental Protection & Sustainable Development	2	0	0	2	VAC
10	23SEC271	Live Projects/Vocational Courses/Summer Internship	-	-	-	4	SIP
TOTAL			16	2	6	25	

L – Lectures, T- Tutorial, P- Practical

On Exit, students shall be awarded UG Certificate (Mathematics) on securing the requisite 46 Credits on completion of II-Semester.

SEMESTER – III

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	23MABS301	Real Analysis	3	1	0	4	Major
2	24MABS302	Ordinary Differential Equations	3	1	0	4	Major
3	23MABS303	Theory of Equations	3	1	0	4	Major
4	24MABS304	Integral Transforms	3	1	0	4	MSC
5		MDC – III	3	0	0	3	MDC
6	23HIN101 I/ 23FLGR201 I/ 23FLFR201 I	Hindi – I / German – I / French – I	2	0	0	2	AEC
7	23SS353	Presentation Skills	0	0	2	1	SEC (Soft)
8	23SS303	Statistical Analysis with SPSS	0	0	2	1	SEC (Tech)
TOTAL			17	4	4	23	

L – Lectures, T- Tutorial, P- Practical

SEMESTER – IV

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	23MABS401	Multivariate Calculus	3	1	0	4	Major
2	23MABS402	Mechanics	3	1	0	4	Major
3	23MABS403	Partial Differential Equations	3	1	0	4	Major
4	24MABS404	Operations Research	3	1	0	4	MSC
5	23HIN101II / 23FLGR201 II / 23FLFR201 II	Hindi – II / German – II / French – II	2	0	0	2	AEC
6	23SS454	Professional Skills	0	0	2	1	SEC (Soft)
7	23SS404	R Language Programming	0	0	2	1	SEC (Tech)
8	23VAC103	Sports, Yoga & Fitness	0	0	4	2	VAC
9	23SEC471	Live Projects/Vocational Courses/Summer Internship	-	-	-	4	SIP
TOTAL			14	4	8	26	

L – Lectures, T- Tutorial, P- Practical, C- credits

On Exit, students shall be awarded UG Diploma (Mathematics) on securing the requisite 95 Credits on completion of IV-Semester.

SEMESTER – V

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	23MABS501	Number Theory	3	1	0	4	Major
2	23MABS502	Descriptive Statistics	3	0	0	3	Major
3	23MABS502L	Descriptive Statistics Lab	0	0	2	1	Major
4	24MABS503	Graph Theory and its Applications	3	1	0	4	Major
5	23MABS504	Metric Spaces	3	1	0	4	Major
6	23MABS505	Riemann Integration and Series of Functions	3	1	0	4	MSC
7	23AR555	Aptitude & Reasoning	0	0	2	1	SEC (Soft)
8	23SS505	Programming with MATLAB	0	0	2	1	SEC (Tech)
TOTAL			15	4	6	22	

L – Lectures, T- Tutorial, P- Practical

SEMESTER – VI

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	23MABS601	Topology	3	1	0	4	Major
2	23MABS602	Numerical Methods	3	0	0	3	Major
3	23MABS602L	Programming of Numerical Methods using MATALB	0	0	2	1	Major
4	24MABS603	Discrete Mathematics	3	1	0	4	Major
5	23MABS604	Complex Analysis	3	1	0	4	Major
6	24MABS605	Fuzzy Set Theory	3	1	0	4	MSC
7	23MABS606	Differential Geometry	3	1	0	4	MSC
8	23SEC671	Live Projects/Vocational Courses/Summer Internship	-	-	-	4	SIP
TOTAL			18	5	2	28	

L – Lectures, T- Tutorial, P- Practical

On Exit, students shall be awarded B.Sc. Degree (Mathematics) on securing the requisite 145 Credits on completion of VI-Semester.

SEMESTER – VII

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	24MABS701	Probability and Probability Distributions	3	0	0	3	Major
2	24MABS701L	Probability and Probability Distributions Lab	0	0	2	1	Major
3	23MABS702	Measure Theory and Integration	3	1	0	4	Major
4	24MABS703A/ 24MABS703B	Optimization Techniques /Solid Mechanics	3	1	0	4	Major
5	23MABS704	Cryptography	2	0	0	2	MSC for Honours*
6	24MABS705	Data Structure	3	0	0	3	MSC for Honours*
7	24MABS705L	Data Structure Lab	0	0	2	1	MSC for Honours*
8	23RMBS710	Research Methodology	2	0	0	2	MSC for RP**
9	23MABS777	Minor Project / Minor Dissertation	-	-	-	4	Research Project/Dissertation for RP**
TOTAL			16	2	2	18	

L – Lectures, T- Tutorial, P- Practical

*** Students pursuing Honours will do 1 Course of 4 Credits and 1 course of 2 credits in lieu of Research Project in 7th Semester.**

**** Students pursuing Honours with Research will do Research Methodology of 2 Credit and Research Project/Dissertation of 4 Credits.**

SEMESTER – VIII

S.No.	Course Code	Course Title	L	T	P	Credits	Course Category
1	23MABS801	Functional Analysis	3	1	0	4	Major
2	23MABS802	Special Functions	3	1	0	4	Major
3	24MABS803A/ 24MABS803B	Fluid Dynamics/ Combinatorial Mathematics	3	1	0	4	Major
4	23MABS804	Classical Mechanics	2	0	0	2	MSC for Honours*
5		Minor Project / Minor Dissertation	0	0	0	4	For students pursuing Honours*
6	23MABS871	Major Project / Major Dissertation #	-	-	-	6	Research Project/Dissertation for RP #
TOTAL			14	4	0	18	

L – Lectures, T- Tutorial, P- Practical

<p>* Students pursuing Honours will do 1 course of 2 Credit and Minor Project of 4 credits in lieu of research project in 8th Semester</p>

<p># Students pursuing Honours with research would complete 6 Credits of Research/Dissertation in the 8th Semester.</p>
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On Exit, students shall be awarded B.Sc. (Mathematics) (Honours) or (Honours with Research) after securing the requisite 181 Credits on completion of VIII – Semester.

**List of Major Courses offered to
Four Year B.Sc. Mathematics program in the Department of Mathematics
w.e.f. Academic Year 2024-25**

S. No.	Semester	Course Code	Course Title	L	T	P	Credits
1	I	23MABS101	Calculus	3	1	0	4
2		23MABS102	Algebra – I	3	1	0	4
3	II	24MABS201	Algebra – II	3	1	0	4
4		24MABS202	Vector Calculus	3	1	0	4
5	III	23MABS301	Real Analysis	3	1	0	4
6		24MABS302	Ordinary Differential Equations	3	1	0	4
7		23MABS303	Theory of Equations	3	1	0	4
8	IV	23MABS401	Multivariate Calculus	3	1	0	4
9		23MABS402	Mechanics	3	1	0	4
10		23MABS403	Partial Differential Equations	3	1	0	4
11	V	23MABS501	Number Theory	3	1	0	4
12		23MABS502	Descriptive Statistics	3	0	0	3
		23MABS502L	Descriptive Statistics Lab	0	0	2	1
13		24MABS503	Graph Theory and its Applications	3	1	0	4
14		23MABS504	Metric Spaces	3	1	0	4
15	VI	23MABS601	Topology	3	1	0	4
16		23MABS602	Numerical Methods	3	0	0	3
		23MABS602L	Programming of Numerical Methods using MATALB	0	0	2	1
17		24MABS603	Discrete Mathematics	3	1	0	4
18		23MABS604	Complex Analysis	3	1	0	4
19	VII	24MABS701	Probability and Probability Distributions	3	0	0	3
		24MABS701L	Probability and Probability Distributions Lab	0	0	2	1
20		23MABS702	Measure Theory and Integration	3	1	0	4

21		24MABS703A/ 24MABS703B	Optimization Techniques/ Solid Mechanics	3	1	0	4
22	VIII	23MABS801	Functional Analysis	3	1	0	4
23		23MABS802	Special Functions	3	1	0	4
24		24MABS803A/ 24MABS803B	Fluid Dynamics/ Combinatorial Mathematics	3	1	0	4

**List of Minor Stream Courses (MSC) offered to
Four Year B.Sc. Mathematics program in the Department of Mathematics
w.e.f. Academic Year 2024-25**

S. No.	Course code	Course title	L	T	P	Credits
1	23MABS103	Object Oriented Programming using C++	3	0	0	3
	23MABS103L	Object Oriented Programming using C++ Lab	0	0	2	1
2	24MABS203	Python Programming	3	0	0	3
	24MABS203L	Python Programming Lab	0	0	2	1
3	24MABS304	Integral Transforms	3	1	0	4
4	24MABS404	Operations Research	3	1	0	4
5	23MABS505	Riemann Integration and Series of Functions	3	1	0	4
6	24MABS605	Fuzzy Set Theory	3	1	0	4
7	23MABS606	Differential Geometry	3	1	0	4
8	23MABS704	Cryptography	2	0	0	2
9	24MABS705	Data Structure	3	0	0	3
	24MABS705L	Data Structure Lab	0	0	2	1
10	23MABS804	Classical Mechanics	2	0	0	2
11	23RMBS710	Research Methodology	2	0	0	2

**List of Multidisciplinary Courses (MDC) offered to
Four Year B.Sc. Mathematics program in the Department of Mathematics
w.e.f. Academic Year 2024-25**

Cat.	Code	Course Name	L	T	P	Credits
MDC I	23MDC201	Renewable Energy Sources	3	0	0	3
	23MDC202	Hybrid Electric Vehicle	3	0	0	3
	23MDC301	IPR in Business	3	0	0	3
	23MDC302	Library Information Sciences & Media Literacy	3	0	0	3
	23MDC401	Management Process & Organizational Behaviour	3	0	0	3
MDC II	23MDC203	Introduction to Bio-engineering	3	0	0	3
	23MDC204	Introduction to Robotics	3	0	0	3
	23MDC303	Psychology and Emotional Intelligence	3	0	0	3
	23MDC304	Indian Economy	3	0	0	3
	23MDC402	Creating an Entrepreneurial Mind	3	0	0	3
MDC III	23MDC205	Arduino Based Programming	3	0	0	3
	23MDC305	Electoral Literacy in India	3	0	0	3
	23MDC403	Personal Financial Planning	3	0	0	3
	23MDC404	Interior Design	3	0	0	3

**List of Ability Enhancement Courses (AEC) offered to
Four Year B.Sc. Mathematics program in the Department of Mathematics
w.e.f. academic Year 2024-25**

S. No.	Code	Course Name	L	T	P	Credits
1	23AEC101	Functional English – I	2	0	0	2
2	23AEC201	Functional English – II	2	0	0	2
3	23HIN101 I / 23FLGR201 I / 23FLFR201 I	Hindi – I / German – I / French – I	2	0	0	2
4	23HIN101II / 23FLGR201 II / 23FLFR201 II	Hindi – II / German – II / French – II	2	0	0	2

**List of Value-Added Courses (VAC) offered to
Four Year B.Sc. Mathematics program in the Department of Mathematics
w.e.f. Academic Year 2024-25**

S. No.	Code	Course Name	L	T	P	Credits
1	23VAC102	Indian Constitution & Polity	2	0	0	2
2	23VAC101	Environment Protection & Sustainable Development	2	0	0	2
3	23VAC103	Sports, Yoga & Fitness	0	0	4	2

**List of Skill Enhancement Courses (SEC) offered to
Four Year B.Sc. Mathematics program in the Department of Mathematics
w.e.f. Academic Year 2024-25**

Courses on Soft Skills

S. No.	Code	Course Name	L	T	P	Credits
1	23SS151	Effective Communication Skills	0	0	2	1
2	23SS252	Teamwork & Interpersonal Skills	0	0	2	1
3	23SS353	Presentation Skills	0	0	2	1
4	23SS454	Professional Skills	0	0	2	1
5	23AR555	Aptitude & Reasoning	0	0	2	1

Courses on Technical Skills

S. No.	Code	Course Name	L	T	P	Credits
1	23TS101	Digital Literacy & IT Skills	0	0	2	1
2	23SS202	Advanced Excel Skills	0	0	2	1
3	23SS303	Statistical Analysis with SPSS	0	0	2	1
4	23SS404	R Language Programming	0	0	2	1
5	23SS505	Programming with MATLAB	0	0	2	1

SEMESTER I

Year/Semester	1st Year/1st Semester	Course Category	Major Course
Course Code	23MABS101	Course Title	Calculus
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: XII (Mathematics)		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of calculus
2. To illustrate differential calculus
3. To impart integral calculus
4. To highlight the relationship of differential and integral calculus
5. To make students familiar with applications of differential and integral calculus

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the concepts of limit, continuity and differentiability, Rolle's Theorem and Mean value theorems.
2. Well-versed with the consequences of the intermediate value theorem for continuous functions.
3. Do successive differentiation and know about Leibnitz's theorem.
4. Interpret a function from an algebraic, numerical, graphical and verbal perspective and extract relevant information.
5. Equipped with area and volume of solid of revolution.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Limit continuity and Differentiability: limit of single variable function, indeterminate forms, continuity and discontinuity of single variable function, differentiability of single variable function, Rolle's Theorem, mean value theorems

Unit-II

Successive Differentiation: Successive differentiation, Leibnitz's theorem and applications, Taylor's theorem with Lagrange's and Cauchy's forms of Taylor's series, Maclaurin's series.

Unit-III

Application of Differentiation: curvature, asymptotes, singular points, Curve tracing - Cartesian form and polar form

Unit-IV

Integration: definite integral as limit of a sum, integration of hyperbolic and inverse hyperbolic functions, reduction formulae

Unit-V

Length and area under curve: Arc length of Cartesian curve, parametric curve, and polar curve, area bounded by Cartesian curve, by parametric curve, area by polar curve. Volume of solid of revolution for Cartesian curve, parametric curve, and for polar curves.

TEXT BOOKS/ REFERENCE BOOKS

1. S. Narayan and P.K. Mittal, Differential Calculus, S. Chand & Company, Revised Edition, 2018.
2. S. Narayan and P.K. Mittal, Integral Calculus, S. Chand & Company, Revised Edition, 2014.
3. B. George Thomas, Jr., Ross L. Finney, Late Jan. D. Weir Giordano, Thomas Calculus, Pearson, 10th Edition, 2005.
4. A. Frank and E Mendelson, Calculus, McGraw-Hill, 6th Edition, 2013.
5. Robert T Smith and R. Minton, Calculus: Early Transcendental Functions, 4th Edition, 2012.

Year/Semester	1st Year/1st Semester	Course Category	Major Course
Course Code	23MABS102	Course Title	Algebra I
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: XII (Mathematics)		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basic algebraic structures
2. To illustrate groups
3. To highlight the relationship of abstract algebra
4. To impart rings, and fields
5. To make students familiar with fundamental algebraic structures

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the concepts of groups, rings and fields.
2. Understand the notions of homomorphism and isomorphism in groups, rings, and fields.
3. Design of a quotient groups and rings.
4. Quote with polynomial rings.
5. Illustrate with unique factorization domain.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, Normal subgroups, Cosets, Left and right cosets, Index of a sub-group.

Unit-II

Coset decomposition, Lagrange's theorem and its consequences, Quotient Groups, cyclic groups. Permutations groups, Even and odd permutations, Alternating Groups.

Unit-III

Homomorphisms, Isomorphisms, Automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Cayley's theorem, Center of a group and derived group of a group.

Unit-IV

Introduction to rings, subrings, Characteristics of a ring, Ring homomorphisms, ideals (prime and Maximal) and Quotient rings.

Unit-V

Integral domains and fields, Field of quotients of an integral domain, Euclidean rings.

TEXT BOOKS/ REFERENCE BOOKS

1. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publication House, India, 2006.
2. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd., New Delhi, 1983.
4. I.S. Luthar and I.B.S. Passi, Algebra, Naorsa Publishing House, Vol.-II, 2013.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2nd Edition, 1975.

Year/Semester	1st Year/1st Semester	Course Category	Minor Stream Course
Course Code	23MABS103	Course Title	Object Oriented Programming Language with C++
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: C Programming Language		L T P : 3 0 0	Credits: 3

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of Object – Oriented Approach,
2. To illustrate difference Classes and Objects
3. To impart of Inheritance and Polymorphism
4. To highlight the relationship of Generic function.
5. To make students familiar with files and exception handling.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the basics of the concept of Object – Oriented Approach.
2. Choose encapsulation, information hiding, abstract data types, Object & classes, attributes, methods.
3. Write inheritance, Class hierarchy, derivation – public, private & protected, Aggregation.
4. Interpret function, function name overloading, overriding inheritance methods, Runtime polymorphism.
5. Streams and files, Namespaces, Exception handling.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Introducing Object – Oriented Approach, Abstraction, Encapsulation, Inheritance, Polymorphism, Review of C, Difference between C and C++, new, delete, operators.

Unit-II

Classes and Objects: Encapsulation, information hiding, abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default parameter value, object types.

Unit-III

Inheritance and Polymorphism: Inheritance, Class hierarchy, derivation – public, private & protected, Aggregation, composition vs classification hierarchies, Polymorphism, Categorization of polymorphism techniques, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric Polymorphism.

Unit-IV

Generic function: Template function, function name overloading, overriding inheritance methods, Runtime polymorphism, Multiple Inheritance.

Unit-V

Files and Exception Handling: Streams and files, Namespaces, Exception handling, Generic Classes.

TEXT BOOKS/ REFERENCE BOOKS

1. N.S. Kutti and P.Y. Padhye, Data Structures in C++, Prentice Hall of India Pvt., Ltd., New Delhi 2001.
2. Liberty and Keogh, C++: An introduction to programming, Prentice Hall of India Pvt., Ltd., New Delhi 2002.
3. B. Stroustrup, The C++ Programming Language, Addison Wesley by publication, New York 1994.
4. Jean – Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Tata McGraw Hill 1998.
5. E. Balagurusamy, Object oriented Programming with C++, Tata McGraw Hill, New Delhi, 1996.

Year/Semester	1st Year/1st Semester	Course Category	Minor Stream Course
Course Code	23MABS103L	Course Title	Object Oriented Programming Language with C++ Lab
Continuous Evaluation: 60		End Semester Examination:40	
Prerequisite: C Programing		L T P : 0 0 2	Credits: 1

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of Object – Oriented Approach,
2. To illustrate difference Classes and Objects
3. To impart of Inheritance and Polymorphism
4. To highlight the relationship of Generic function.
5. To make students familiar with files and exception handling.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the basics of the concept of Object – Oriented Approach.
2. Choose encapsulation, information hiding, abstract data types, Object & classes, attributes, methods.
3. Write inheritance, Class hierarchy, derivation – public, private & protected, Aggregation.
4. Interpret function, function name overloading, overriding inheritance methods, Runtime polymorphism.
5. Streams and files, Namespaces, Exception handling.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

LIST OF PROGRAMS

1. Write a program to print number entered by user.
2. Write a Program to add two numbers.
3. Write a Program to find quotient and remainder.
4. Write a Program to swap two numbers.
5. Write a Program for Local and Global Variables.
6. Write a Program for check whether number is even or odd.
7. Write a Program to find largest number among three numbers.
8. Write a Program to Calculate Sum of Natural Numbers.
9. Write a Program for Increment and Decrement Operators.
10. Write a Program for special Operators.
11. Write a program to Display Fibonacci Series.
12. Write a Program to display the different types of patterns using nested for loop.
13. Write a Program to print biggest number from n numbers.
14. Write a Program to reading and printing a single dimensional array of elements.
15. Write a Program to passing an array element to a function.
16. Write a Program to Reading and Printing a string.

SEMESTER II

Year/Semester	1st Year/2nd Semester	Course Category	Major Course
Course Code	24MABS201	Course Title	Algebra II
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: XII (Mathematics)		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of vector spaces
2. To illustrate linear transformations
3. To solve linear transformations
4. To contrast the relationship of linear algebra and Matrices
5. To make students familiar with applications of linear algebra

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the concepts of vector space.
2. Understand the notions of linear transformation.
3. Determine basis and dimension of a vector space.
4. Well-versed with characteristic polynomials.
5. Equipped with characteristic roots of a square matrix.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Types of Matrices -Symmetric, Skew symmetric, Hermitian, Skew Hermitian, Orthogonal, Unitary and Normal matrices Elementary Properties of Matrices, Inverse of Matrices, Rank of Matrix, System of Linear Equations, Characteristic Equation, properties of Eigenvalues and Eigenvectors, Cayley – Hamilton Theorem, Diagonalization.

Unit-II

Vectors in two-dimensional space and n-dimensional space, Vectors addition and scalar multiplication of Vectors, Vector Spaces Definition and Examples General properties of vector spaces, internal and external composition, Vector subspaces, Algebra of subspaces, Union and Intersection, Linear sum of subspaces, Direct Sum.

Unit-III

Linear combination of Vectors, Linear independence, and Linear dependence of Vectors. Finite dimensional Vector spaces, Basis, Dimension of Vector Spaces.

Unit-IV

Linear transformations, linear operators, Properties of Linear Transformation, Algebra of Linear transformation, and composition of two linear transformations.

Unit-V

Null space and range of linear Transformation, Fundamental theorem of vector space homomorphism, Rank and Nullity Theorem, Matrix of linear transformation.

TEXT BOOKS/ REFERENCE BOOKS

1. S. H. Friedberg, Arnold J. Insel, E. S. Lawrence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
2. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
3. K. Hoffman, R. A. Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
4. G. Strang and R. Kunze, Linear Algebra, Pearson, 5th Edition, 2016.
5. J.N. Sharma and A.R. Vasishtha, Linear Algebra, Krishna Prakashan Mandir, Meerut, 1st Edition, 2015.

Year/Semester	1st Year/2nd Semester	Course Category	Major Course
Course Code	24MABS202	Course Title	Vector Calculus
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: XII (Mathematics)		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To introduce the methods of vector analysis
2. To illustrate vector differentiation
3. To impart vector integration
4. To highlight the relationship of vector differentiation and vector integration
5. To make students familiar with fundamental tool in many theories of applied mathematics

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the concepts of scalar and vector products and find the vector equations of lines and planes.
2. Understand the notions the parametric equations of curves and surfaces.
3. Construction of gradient, divergence and curl of a vector field and prove identities.
4. Well-versed with irrotational and solenoidal vector fields.
5. Equipped with various integral theorems.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Vector addition and scalar multiplication, Scalar and vector products, Scalar and vector point's functions, Scalar and vector fields, Differentiation of vector valued functions.

Unit-II

Gradient, Divergence & Curl and their geometrical interpretations. Vector identities, Directional derivatives.

Unit-III

Line integrals, Surface integrals. Green's, Gauss and Stoke's theorems with their applications.

Unit-IV

Curvilinear Coordinate system, coordinate free vector derivatives, Vector derivatives in curvilinear coordinates, Spherical, polar and cylindrical coordinates.

Unit-V

Equations of lines and planes, Curves and surfaces; parametric and non-parametric equations of curves and surfaces, Geometry of curves, Normal and tangent plane to a surface.

TEXT BOOKS/REFERENCE BOOKS

1. S. Narayanan and T. K. Manickavachagam Pillai, Trigonometry, S. Viswanathan Printers & Publishers, (Reprint), 2012.
2. M. Spiegel, S. Lipschutz, D. Spellman, Vector Analysis, McGraw Hill Education, 2017.
3. J. Marsden and A. Tromba, Vector Calculus, W. H. Freeman & Co Ltd; 5th edition, 2003.
4. R. Courant and F. John, Introduction to Calculus and Analysis, Volume II, Springer First Edition, 2004.
5. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2015

Year/Semester	1st Year/2nd Semester	Course Category	Minor Stream Course
Course Code	24MABS203	Course Title	Python Programming
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: C Programming Language		L T P : 3 0 0	Credits: 3

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To study the basic taxonomy, terminology and components of the python programming.
2. To study about the control flow and different type of functions in python programming language.
3. To study the different data types and their usage in python programming language.
4. To study different modules and libraries associated with python programming.
5. To study the visualization and plotting functions provided by python programming language.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate the usage of basic programs of python programming.
2. Implementation of loops, control flow and different functions.
3. Classify the different data types and their application in different scenarios.
4. Develop advanced programs in python programming using the libraries. .
5. Use various visualization tools to develop graphs for data analysis.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit– I

Introduction: The Python Programming Language, History, features, Installing Python, Running Python program, Debugging : Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging, Formal and Natural Languages, The Difference Between Brackets, Braces, and Parentheses

Unit – II

Variables and Expressions: Values and Types, Variables, Variable Names and Keywords, Type conversion, Operators and Operands, Expressions, Interactive Mode and Script Mode, Order of Operations, Conditional Statements: if, if-else, nested if –else, Looping: for, while, nested loops, Control statements: Terminating loops, skipping specific conditions

Unit – III

Functions: Function Calls, Type Conversion Functions, Math Functions, Composition, Adding New Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters Are Local, Stack Diagrams, Fruitful Functions and Void Functions, Why Functions? Importing with from, Return Values, Incremental Development, Composition, Boolean Functions, More Recursion, Leap of Faith, Checking Types, Strings: A String Is a Sequence, Traversal with a for Loop, String Slices, Strings Are Immutable, Searching, Looping and Counting, String Methods, The in Operator, String Comparison, String Operations.

Unit – IV

Lists: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List, Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods
Tuples and Dictionaries: Tuples, Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in Tuple

Unit – V

Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods, Files: Text Files, The File Object Attributes, Directories, Exceptions: Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions

TEXT BOOKS/ REFERENCE BOOKS

1. R Nageswara Rao, Core Python Programming, Dream Tech Press, 2017.
2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
3. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. W J Chun, Core Python Programming, Prentice Hall, 2007.
5. John V Guttag, Introduction to computation and programming, MIT Press, 2013.

Year/Semester	1st Year/2nd Semester	Course Category	Minor Stream Course
Course Code	24MABS203L	Course Title	Python Programming Lab
Continuous Evaluation: 60		End Semester Examination:40	
Prerequisite: C Programming Language		L T P : 0 0 2	Credits: 1

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To understand the basic concepts of Python.
2. Familiarize with the programing using linked lists, Sequential lists.
3. Explore the basic concepts of algorithms
4. Highlight the different modules and libraries associated with python programming.
5. To impart the basic concepts of operations on stack and Stack application.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate the usage of basic programs of python programming.
2. Implementation of loops, control flow and different functions.
3. Classify the different data types and their application in different scenarios.
4. Develop advanced programs in python programming using the libraries.
5. Use various visualization tools to develop graphs for data analysis.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

List of Programs

1. Create a program that asks the user to enter their name and their age. Print out a message

- addressed to them that tells them the year that they will turn 100 years old.
2. Enter the number from the user and depending on whether the number is even or odd, print out an appropriate message to the user.
 3. Write a program to generate the Fibonacci series.
 4. Write a function that reverses the user defined value.
 5. Write a function to check the input value is Armstrong and also write the function for Palindrome.
 6. Write a recursive function to print the factorial for a given number.
 7. Write a function that takes a character (i.e. a string of length 1) and returns True if it is a vowel, False otherwise.
 8. Write a program that takes two lists and returns True if they have at least one common member.
 9. Write a Python program to print a specified list after removing the 0th, 2nd, 4th and 5th elements.
 10. Write a Python script to sort (ascending and descending) a dictionary by value.
 11. Write a Python program to sum all the items in a dictionary.
 12. Write a Python program to read an entire text file.

SEMESTER III

Year/Semester	2nd Year/3rd Semester	Course Category	Major Course
Course Code	23MABS301	Course Title	Real Analysis
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite: Algebra		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To understand the basic properties of real line.
2. To describe and derive the topology of real numbers.
3. To impart the concept of convergence and divergence of Sequences of real numbers.
4. To develop student's understanding about infinite series and its convergence test.
5. To highlight the notion of arbitrary series.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe and apply the basic properties of real line.
2. Well-versed with the topology of real numbers.
3. Apply the concept of convergence of Sequences of real numbers.
4. Apply the concept of convergence test of series.
5. Be equipped with the notion of arbitrary series.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Real Number System, Algebraic and order properties of real, Absolute value of a real number; Boundedness of the set of real numbers; least upper bound, greatest lower bound of a set, Supremum and infimum of a nonempty subset of \mathbb{R} .

Unit-II

The completeness property of \mathbb{R} , Archimedean property, Density of rational numbers in \mathbb{R} ; Definition and types of intervals, Nested intervals property; Neighborhood of a point in \mathbb{R} , Open and closed sets in \mathbb{R} , interior points, isolated points, limit points, open sets, closed set, interior of a set, Closure of a set and their properties.

Unit-III

Real Sequences and their convergence, Theorem on limits of sequence, Bounded and Monotonic sequences, Cauchy's sequence, Cauchy general principle of convergence, Subsequences, Sub sequential limits.

Unit-IV

Convergence and divergence of Infinite Series, Comparison Tests, D-Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test, Logarithmic test, de Morgan and Bertrand's test, Gauss Test, Cauchy's integral test, Cauchy's condensation test. Alternating series, Leibnitz's test, absolute and conditional convergence of an alternating series.

Unit-V

Abel's lemma, Abel's test, Dirichlet's test, Insertion and removal of parenthesis, re-arrangement of terms in a series, Cauchy product of series (definitions and examples only), Convergence and absolute convergence of infinite products.

TEXT BOOKS/ REFERENCE BOOKS

1. S. C. Malik, Savita Arora, Mathematical analysis, New Age International, 2017.
2. G. R. Bartle and D. R. Sherbert, Introduction to Real Analysis, Wiley India Edition, Delhi, 4th Ed., 2015.
3. Denlinger, Charles G.M., Elements of Real Analysis, Jones & Bartlett (Student edition), First Indian Edition, 2015.
4. G.G. Bilodeau, P.R. Thie and G. E. Keough, An Introduction to Analysis (2nd ed.) Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.
5. W. Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 2017.

Year/Semester	2nd Year/3rd Semester	Course Category	Major Course
Course Code	24MABS302	Course Title	Ordinary Differential Equations
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Calculus		L T P: 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of differential equations.
2. To create competency to solve differential equations.
3. To illustrate about ordinary differential equations of different orders and degree.
4. To develop students' understanding about various methods for solving differential equations.
5. To make students familiar with applications of differential equations calculus.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Distinguish between linear, nonlinear, partial, and ordinary differential equations.
2. Recognize and solve a homogeneous differential equation and the exact differential equation.
3. Recognize and solve a linear differential equation by use of an integrating factor.
4. Well-versed with basic application problems described by second order linear differential equations with constant coefficients.
5. Equipped with simultaneous equations.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Geometrical meaning of a differential equation, order and degree of differential equation, primitives, solutions of differential equations, Singular solutions, Exact differential equations, integrating factors, First order higher degree equations solvable for x , y , p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. Picard's theorem, Existence and uniqueness theorem of first order ODE

Unit-II

Orthogonal trajectories in Cartesian and polar coordinates, Self-orthogonal family of curves, linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations, Equations reducible to homogeneous.

Unit-III

Linear differential equations of second order, one part of CF is known, Reduction to normal form, Solution by Changing the dependent variable/ the independent variable, Solution by operators of non-homogeneous linear differential equations.

Unit-IV

Method of variations of parameters, Method of undetermined coefficients, Reduction of order of a differential equation.

Unit-V

Ordinary simultaneous differential equations, Simultaneous equation of the form $dx/P = dy/Q = dz/R$, Total differential equations. Condition for $Pdx + Qdy + Rdz = 0$ to be exact, General method of solving $Pdx + Qdy + Rdz = 0$ by taking one variable constant, Method of auxiliary equations.

TEXT BOOKS/ REFERENCE BOOKS

1. M.D. Raisinghania, Advanced Differential Equations, S Chand Publishing, 2018
2. S. L. Ross, Ordinary Differential Equations, Wiley Publisher, 2007
3. D.A. Murray, Introductory Course in Differential Equations. Orient Longman (India), 11th Edition, 2017.
4. E.A. Coddington, An Introduction to Ordinary Differential Equations. New York. 4th Edition, 2011.
5. G.F. Simmons, Differential Equations: with applications and Historical Notes, McGraw Hill, 1972.

Year/Semester	2nd Year/3rd Semester	Course Category	Major Course
Course Code	23MABS303	Course Title	Theory of Equations
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite: XII (Mathematics)		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss general formation of graphs
2. To highlight general properties of equations
3. To illustrate relation between roots of equations
4. To discuss about transformation of equations
5. To provide solution of different equations

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Make and understand of graphs of different functions.
2. Grasp significance of properties of equations in their solution.
3. Understand relations between roots of equations and its applications
4. Interpret the results using transformation of equations.
5. Equipped with solution of different equations

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Introduction of graphs, Types of Graphs, Properties of Graph, Transformations and Curvature, Asymptotes and Singular Points

Unit-II

Polynomials, General properties of equations, Descartes' rule of signs positive and negative roots, Remainder and factor theorem, Fundamental theorem of algebra, Synthetic Division of polynomial by linear expression and by a quadratic expression, imaginary roots, integral and rational roots.

Unit-III

Relation between the roots and the coefficients of equations, Symmetric functions of the roots, order and weight of symmetric function, symmetric functions of roots expressed in terms of the coefficient Newton's theorem on the sums of powers of roots, Newton's Fundamental Theorem of symmetric Functions,

Unit-IV

Transformation of Equations, Reciprocal of Equations, formation of equation whose roots are symmetric functions

Unit-V

Solution of cubic equations, Cardan's method, solution of Biquadratic equations, Ferrari's method Separation of the roots of equations, Strum's theorem, Applications of Strum's theorem.

TEXT BOOKS/ REFERENCE BOOKS

1. C. C. Macduffee, Theory of Equations, Dover Publications Inc. 2002
2. W. S. Burnside and A.W. Panton, the Theory of Equations, Nabu Press, 2011
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2015
4. J.V. Uspensky, Theory of Equations, McGraw-Hill, 1958.
5. M.L. Khanna, Theory of Equations, Jai Prakash Nath, Meerut, 1956.

Year/Semester	2nd Year/3rd Semester	Course Category	Minor Stream Course
Course Code	24MABS304	Course Title	Integral Transforms
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Ordinary Differential Equations		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. This course aims to make the students familiar with Laplace-Integral transform
2. This course intends to render the students basic properties of Laplace transform
3. To develop the knowledge of Fourier series
4. To develop students understanding about Fourier transform technique and applications
5. To make students familiar with Fourier Transforms and relation with Laplace and Fourier Transforms

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Get an understanding about Laplace-Integral transform.
2. Fluent with the application with Laplace-Integral transform.
3. Study about Dirichlet's conditions, Parseval's identity.
4. Well-versed with solving differential Equations using Fourier Transforms.
5. Get an understanding about relation between Fourier Transforms and Fourier series.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Laplace Transforms – Existence theorem, Linearity of the Laplace transforms, Laplace Transform of elementary functions, Shifting theorems, Laplace transforms of derivatives and integral.

Unit-II

Inverse Laplace transforms-by partial fraction, long division, Heaviside, Convolution theorem, Inverse Laplace transforms of derivatives and integrals, Simple applications for solving ODE(IVP and BVP).

Unit-III

Introduction, Dirichlet's conditions and general Fourier series, Odd and even functions, half range Expansions and Parseval's identity, Harmonic Analysis.

Unit-IV

Fourier transforms: Linearity property, Fourier Transform of elementary functions, Shifting, Modulation, Convolution Theorem, and Fourier Transform of Derivatives, Fourier Integral Theorem.

Unit -V

Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms, solution of differential Equations using Fourier Transforms.

TEXT BOOKS/ REFERENCE BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2020.
2. E. Kreyszing: Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 10th Edition 2015.
3. A.R. Forsyth: A Treatise on Differential Equations, CBS, 1st Edition, 2005.
4. W.W. Bell: Special Functions for Scientists & Engineers Dover Publications 2013.
5. Murray R. Spiegel: Laplace transform, Schaum's Series, McGraw Hill Education, 2005.

SEMESTER IV

Year/Semester	2nd Year/4th Semester	Course Category	Major Course
Course Code	23MABS401	Course Title	Multivariate Calculus
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Calculus		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of calculus for several variables.
2. To illustrate single variable differential.
3. To highlight the relationship of functions of two or more independent variables.
4. To make students familiar with basic concept of Integral calculus.
5. To create competency about differential and integral calculus.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Well-versed with basics of multivariable calculus.
2. Develop students' understanding about the conceptual variations when advancing in calculus from one variable to multivariable discussions.
3. Construct line integral, double and triple integral formulations.
4. Apply the multi variable calculus tools in physics, economics, optimization, and understanding the architecture of curves.
5. Equipped with surfaces in plane and space.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Functions of several variables, limit and continuity of functions of two variables, Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability, Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

Unit-II

Extreme of functions of two variables, method of Lagrange multipliers, constrained optimization problems.

Unit-III

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates.

Unit-IV

Triple integrals, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, cylindrical and spherical coordinates, Change of variables in double integrals and triple integrals.

Unit-V

Curves in three dimensional spaces: Curves in three dimensional spaces, Tangent vector, Normal plane and osculating plane, Normal plane at a point and fundamental planes, Orthonormal triad of unit vectors.

TEXT BOOKS/ REFERENCE BOOKS

1. S. C. Malik, Savita Arora, Mathematical analysis, New Age International, 2017.
2. S. Narayan, Differential Calculus, Shyam Lal Charitable Trust, New Delhi, 2001
3. R. Wrede, M. Spiegel, Schaum's Outline of Advanced Calculus, Tata McGraw Hill Company, New Delhi, 2010.
4. G.V. Thomas and R.L. Finney, Calculus, Pearson Education, 9th Edition, 2006.
5. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling, Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.

Year/Semester	2nd Year/4th Semester	Course Category	Major Course
Course Code	23MABS402	Course Title	Mechanics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Vector Analysis		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To equip the students with the knowledge of velocity, harmonic motion.
2. To discuss basic of constrained motion.
3. To make students familiar with Kepler's law.
4. To impart Motion of a particle in three dimensions.
5. To create competency about forces in three dimensions.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Analyze and explain the components of Velocity and acceleration.
2. Know the concept of different Motion in resisting medium.
3. Classify the Motion on smooth and rough plane curves and Rocket motion.
4. Well-versed with Common catenary, Centre of gravity.
5. Equipped with forces in three dimensions.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Velocity and acceleration along radial and transverse directions, and along tangential and normal directions, Motion under other laws of forces.

Unit-II

Simple harmonic motion, Elastic strings. Motion in resisting medium.

Unit-III

Motion on smooth and rough plane curves, Central orbits and Kepler's law

Unit-IV

Common catenary, Centre of gravity, Stable and unstable equilibrium, Virtual work.

Unit-V

Motion of a particle in three dimensions. Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.

TEXT BOOKS/ REFERENCE BOOKS

1. N. Kumar, A Course in Mechanics, Narosa Publishing House, 2010.
2. S.L. Loney, an Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 2016.
3. J.L. Synge, B.A. Griffith, Principles of Mechanics, McGraw-Hill, 2nd Edition, 1959.
4. P. Duraipandian, L. Duraipandian and M. Jayapragasam, Mechanics, S. Chand & Company PVT, LTD, 2014.
5. S. Ramsey, Dynamics, Cambridge Library Collection- Mathematics, 2009

Year/Semester	2nd Year/4th Semester	Course Category	Major Course
Course Code	23MABS403	Course Title	Partial Differential Equations
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Ordinary Differential Equations		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basic of partial differential equations
2. To create competency for variety of methods to solve partial differential equations
3. To illustrate partial differential equations
4. To make students familiar with applications of partial differential equations to real life problems
5. To highlight a solid foundation further in higher mathematics, sciences, and engineering through mathematical modeling

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know about the concepts of partial differential equations.
2. Understand the notions to recognize when partial differential equations are appropriate for creating an appropriate model.
3. Construction of separation of variables, boundary value problems.
4. Well-versed with methods of solving higher-order linear differential equations.
5. Reduce a higher order equation to a system of first order simultaneous equations.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Introduction, classification, construction and geometrical interpretation of first order partial differential equations (PDE). Formation of PDE by elimination of arbitrary constants and by elimination of arbitrary functions.

Unit-II

General solution of first order PDE, canonical form of first order PDE, solution of first order PDE using separation of variables, Linear partial differential equation of order one.

Unit-III

Nonlinear partial differential equations of order one and its solutions, Charpit's method, Method of separation of variables for second order PDE, boundary value problems

Unit-IV

Homogeneous and Non – Homogeneous partial differential equations of second and higher order with constant coefficients.

Unit-V

One Dimensional wave equation, two-dimensional wave equation, One dimensional heat equation, two-dimensional heat equations. General solution of three-dimensional wave equations, General solution of three-dimensional Laplace equations. Problem based on telegraph or transmission line equation.

TEXT BOOKS/ REFERENCE BOOKS

1. M.D. Raisinghania, Advanced Differential Equations, 14th revised edition, 2011
2. K. S. Rao, Introduction to Partial Differential Equations, Prentice Hall India, 2006.
3. T. Amarnath, An Elementary Course in Partial Differential Equations, Narosa Publishing House, 2012
4. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
5. Lokenath Debnath, TynMyint-U, Linear Partial Differential Equation for Scientists and Engineers, Springer, 2008.

Year/Semester	2nd Year/4th Semester	Course Category	Minor Stream Course
Course Code	24MABS404	Course Title	Operations Research
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Linear Algebra		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To know about linear programming problems.
2. To study about simplex and Big –M methods.
3. To study about sensitivity analysis.
4. To know duality in linear programming problems.
5. Study about transportation and assignment problems.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Solve Linear Programming problems of real-life situations
2. Find the solutions of simplex methods and Big – M methods
3. Calculate the results for sensitivity analysis
4. Solve duality in programming problems
5. Find the solutions of different types of transportation and assignment problems

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit- I

Linear programming problems, Statement and formation of general linear programming problems, Graphical method, slack, and surplus variables, Standard and matrix forms of linear programming problem, Basic feasible solution.

Unit- II

Convex sets, Fundamental theorem of linear programming, Simplex method, artificial variables, Big- M method, two phase method.

Unit- III

Resolution of degeneracy, Revised simplex method, Sensitivity Analysis.

Unit- IV

Duality in linear programming problems, Dual simplex method, Primal-dual method.

Unit- V

Transportation problems: North West corner rule, least cost method, Vogel's approximation method, Modi method, unbalanced and degeneracy, Assignment problems: maximal assignment problem and travelling salesman problem.

TEXT BOOKS/ REFERENCE BOOKS

1. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, Tata McGraw Hill, Singapore, 10th Edition, 2015.
2. H. A. Taha, Operations Research, An Introduction, 9th Ed., Prentice-Hall India, 9th Edition, 2018.
3. P.K. Gupta , D.S. Hera , Operations Research, S. Chand & Company Pvt. Ltd., New Delhi, 7th Edition, 2014.
4. S.D. Sharma, Operations research: Theory, methods and applications, Kedar Nath, Ramnath Publications Meerut 2015.
5. V. Sundaresan, K.S.Ganapathy Subramanian and K.Ganesan, Resource Management, Techniques, AR Publications, Chennai, 2015.

SEMESTER V

Year/Semester	3rd Year/5th Semester	Course Category	Major Course
Course Code	23MABS501	Course Title	Number Theory
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite: Nil		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. The course provides a gentle introduction to the basics and applications of Number Theory.
2. To build a micro aptitude of understanding aesthetic aspect of mathematical instructions.
3. To Gear young minds to ponder upon number theory tricky problems.
4. To make the students familiar with simple number theoretic techniques.
5. To find applications of Legendre symbol.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Some of the problems related to The Division Algorithm.
2. About The Euclidean Algorithm.
3. About The Fermat Kraitchik Factorization Method.
4. About Congruence, Mobius Inversion Formula.
5. About Legendre Symbol with its properties.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit I

Divisibility Theory in the Integers: The Division Algorithm, The Greatest Common Divisor, Residue classes and reduced residue classes.

Unit II

The Euclidean Algorithm, The Diophantine Equation $ax + by = c$, The Fundamental Theorem of Arithmetic.

Unit III

Fermat's Theorem: Fermat Little Theorem and Pseudoprimes, Wilsons Theorem, the Fermat Kraitichik Factorization Method.

Unit IV

The Theory of Congruences: Basic Properties of Congruence, Binary and Decimal Representation of Integers, Linear Congruence, The Chinese Remainder Theorem.

Unit V

The Mobius Inversion Formula, The Legendre Symbol and Its Properties, Quadratic Reciprocity, The Equation $x^2 + y^2 = z^2$, Fermats Last Theorem.

TEXT BOOKS/ REFERENCE BOOKS

1. D. M. Burton, Elementary Number Theory, Mcgraw Hill Education, 7th Edition, 2017.
2. I. Niven, H. S. Zuckerman and H. L. Montgomery, an Introduction to the Theory of Numbers, Wiley, 5th Edition, 1991.
3. T. M. Apostol, Introduction to Analytic Number Theory, Springer, 1st Edition, 1976.
4. G. H. Hardy, An introduction to the theory of Numbers, Oxford University Press, Ely House, London, 2008.
5. I. Kenneth, M. Rosen, A Classical Introduction to Modern Number Theory, Springer, New York, 1990.

Year/Semester	3rd Year/5th Semester	Course Category	Major Course
Course Code	23MABS502	Course Title	Descriptive Statistics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To describe the of basics of statistics that are useful in various real-world projects
2. To summarize the diagrammatic and graphical representation of data
3. To provide a deep understanding of measures of central tendency, dispersion, and importance of moments
4. To discuss correlation and regression with their applications
5. To explain index numbers and its construction

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe of different data types and importance of statistics.
2. Present data with different graphs and tables.
3. Illustrate measures of central tendency, dispersion on and understand moments with their uses.
4. Identify difference between correlation and regression analysis.
5. Estimate Index numbers and their applications on different types of data sets.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Importance of statistics, concepts of statistical population and a sample – quantitative and qualitative data – Collection of primary and secondary data. Designing a questionnaire and a schedule. Classification and tabulation of data. Measurement scales –nominal, ordinal, interval and ratio.

Unit-II

Diagrammatic and Graphical representation of data. Construction of univariate and bivariate frequency distributions. Stem and leaf plot. Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.

Unit-III

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

Unit-IV

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Unit-V

Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers, conversion of fixed based to chain-based index numbers and vice-versa. Consumer price index numbers.

TEXT BOOKS/ REFERENCE BOOKS

1. A.M Goon, M.K Gupta and B. Dasgupta, Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata, 2002.
2. S.C. Gupta and V.K Kapoor, Fundamental of Mathematical Statistics, S. Chand & Sons, 2017
3. W. Daniel, "Biostatistics- A foundation for analysis in health sciences", John Wiley & Sons; 11th Edition, EMEA edition, 2019.
4. S. Lipschutz, J. Schiller, "Introduction to Probability and Statistics", Tata McGraw Hill, 2017.
5. R. E. Walpole, R.H. Myers, S.L. Myers, K. Ye, "Probability & Statistics for Engineers & Scientists", 9th Edition, Prentice Hall, 2017.

Year/Semester	3rd Year/5th Semester	Course Category	Major Course
Course Code	23MABS502L	Course Title	Descriptive Statistics Lab
Continuous Evaluation: 60		End Semester Examination:40	
Prerequisite: Nil		L T P : 0 0 2	Credits: 1

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To describe the of basics of statistics that are useful in various real-world projects.
2. To summarize the diagrammatic and graphical representation of data.
3. To provide a deep understanding of measures of central tendency, dispersion and importance of moments.
4. To discuss correlation and regression with their applications.
5. To explain index numbers and its construction.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe of different data types and importance of statistics.
2. Present data with different graphs and tables.
3. Illustrate measures of central tendency, dispersion on and understand moments with their uses.
4. Identify difference between correlation and regression analysis.
5. Estimate Index numbers and their applications on different types of data sets.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO					
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

LIST OF PROGRAMES

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, skewness and kurtosis.
6. Fitting of polynomials, exponential curves.
7. Karl Pearson correlation coefficient.
8. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between lines and estimated values of variables.
10. Partial and multiple correlations
11. Planes of regression and variances of residuals for given simple correlations
12. Calculate price and quantity index numbers using simple and weighted average of price relatives.
13. To calculate the Chain Base index numbers.
14. To calculate consumer price index number.

Year/Semester	3rd Year/5th Semester	Course Category	Major Course
Course Code	24MABS503	Course Title	Graph Theory and its Applications
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite:		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To classify graphs and its theoretic terminology and notations.
2. To apply theoretical knowledge acquired to solve realistic problems in real life.
3. To criticize the benefits of representing networks as probabilistic graphs vs. the traditional binary representation.
4. To demonstrate their knowledge of algorithms by solving concrete problems.
5. To design and compile graph theoretic algorithms and graph theory in Electrical networks

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the basic concepts of graph theory.
2. Illustrate the fundamental applications of Graph Theory in different walks of life.
3. Implement the graph theory in real life problems that can be modelled into graphs.
4. apply a variety of practical problems in electrical network analysis, in circuit layout, in data structures and in social sciences.
5. illustrate graph theoretic algorithms and graph theory in Electrical networks

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Introduction: Definitions: Directed and undirected graphs. Hand shaking property and its problems. Real life applications Applications- Konigsberg bridge problem, Utility problem and travelling salesman problem. Definitions: Walks, trail, paths, Circuits, Cycles, Sub graphs, Induced and Spanning subgraphs, connected graphs and Complement of a graph-Problems.

Unit-II

Euler graphs and Hamiltonian graphs, problems. Operations on graphs and Isomorphism of two graphs, problems Pre-order and Post-order Traversal. Prefix codes, optimal tree. Cut – sets. Cut – sets in a graph. Fundamental Circuits and Cut – sets, Network Flows. Max- flow Mincut Theorem (statement only) and problems.

Unit-III

Planar Graphs, Kuratowski's graphs. Different representation of planar graph. Detection of planar graphs. Euler's polyhedral formula. Geometrical Dual problems. Circuit matrix, Fundamental circuit matrix and rank of Circuit matrix. Cut – set matrix. Problems based on Network.

Unit-IV

Definition of Chromatic number. Chromatic Partitioning. Chromatic Polynomial. Finding Chromatic polynomial by Decomposition Theorem and by Multiplication Theorem. Dominating set. Minimal Dominating set. Domination number. Independent dominating set. Finding minimal dominating sets. Some applications of domination theory.

Unit-V

Graph Theoretic Algorithms and Graph theory in Electrical networks: Computer representation of a graph. Algorithm on spanning trees Graphs in switching and coding Theory. Contact networks, analysis of contact networks, synthesis of contact networks, Sequential switching networks. Electrical network analysis, Kirchoff's current and voltage networks, Loop currents and node voltages, LRC networks with independent sources.

TEXT BOOKS/ REFERENCE BOOKS

1. S.K. Sarkar, A Text book of Discrete Mathematics, S. Chand, 2017.
2. K. Rosen, Discrete Mathematics and its applications, Tata Mcgraw Hill, 2019
3. E. G. Goodaire and M.M. Parmenter, Discrete Mathematics with Graph Theory, Pearson Education Indian, 2015
4. N Deo: Graph Theory with applications to engineering and computer Science, Edition, Printice Hall of India Private Limited, 2009.
5. R. P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition , Pearson, 2006, ISBN: 9788177584240

Year/Semester	3rd Year/5th Semester	Course Category	Major Course
Course Code	23MABS504	Course Title	Metric Spaces
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Real Analysis		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To explain basics of metric space.
2. To illustrate open and closed balls.
3. To impart concept of neighborhood, interior.
4. To describe and classify closure, subspace, continuity.
5. To extend compactness, connectedness etc.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the basic concepts of metric spaces.
2. To correlate these concepts to their counterparts in real analysis.
3. Apply the abstractness of the concepts such as open balls, closed balls.
4. Construction of compactness, connectedness etc.
5. Describe compact spaces.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces.

Unit-II

Open and closed balls, neighborhood, open set, interior of a set, Limit point of a set, closed set, diameter of a set, Cantor's Theorem, Subspaces, dense sets, separable spaces.

Unit-III

Continuous mappings, sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mappings, Banach Fixed point Theorem.

Unit-IV

Connectedness, connected subsets of \mathbb{R} , connectedness, and continuous mappings.

Unit-V

Compactness, compactness and boundedness, continuous functions on compact spaces.

TEXT BOOKS/ REFERENCE BOOKS

1. S. Shirali, H. L. Vasudeva, Metric Spaces, Springer-Verlag London Limited 2006.
2. S. C. Malik, Savita Arora, Mathematical Analysis, New Age, January 2009.
3. S. Kumaresan, Topology of Metric Spaces, Narosa Publishing House, Second Edition 2011.
4. D. Gopal, A. Deshmukh, A. S. Ranadive and S. Yadav: An Introduction to Metric Spaces, CRC Press, 2020.
5. R. R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing, January 2020.

Year/Semester	3rd Year/5th Semester	Course Category	Minor Stream Course
Course Code	23MABS505	Course Title	Riemann Integration & Series of Functions
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Real Analysis and Calculus		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To understand the integration of bounded functions on a closed and bounded interval.
2. To describe and derive the different concepts of Improper integral.
3. To impart the concept of convergence of Beta and Gamma functions.
4. To interpret and apply sequence and series of real valued functions.
5. To discover the notion of Power Series.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe the integration of bounded functions on a closed and bounded interval.
2. explain different concepts of Improper integral.
3. Apply the concept of convergence of Beta and Gamma functions.
4. Interpret the concept of sequence and series of real valued functions
5. Compile the notion of Power Series

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Riemann Integration, Darboux's Theorem, The integral as a sum of limit of sums, Properties of Riemann integral, Continuity and differentiability of integrable functions, The Fundamental theorem of integral calculus, and Mean value theorems of integral calculus.

Unit-II

Improper integrals of Type-I, Type-II and mixed type, Convergence of Beta and Gamma functions, and their properties.

Unit-III

Point-wise and uniform convergence of sequence of functions, Theorem on the continuity of the limit function of a sequence of functions, Theorems on the interchange of the limit and derivative, and the interchange of the limit and integrability of a sequence of functions. Cauchy criterion, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence.

Unit-IV

Point-wise and uniform convergence of series of functions, Theorems on the continuity, derivability and integrability of the sum function of a series of functions. Cauchy criterion, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence.

Unit-V

Definition of a power series, Radius of convergence, Absolute convergence, Cauchy Hadamard Theorem, Uniform convergence, Differentiation and integration of power series, Abel's Theorem.

TEXT BOOKS/ REFERENCE BOOKS

1. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, Wiley India Edition, Delhi, 2015.
2. S. C. Malik, Savita Arora, Mathematical analysis, New Age International, 2017.
3. C. G. Denlinger, Elements of Real Analysis, Jones & Bartlett, First Indian Edition, 2015.
4. G.G. Bilodeau, P.K. Thie and G.E. Keough, An Introduction to Analysis, Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.
5. W. Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 2017.

SEMESTER VI

Year/Semester	3 rd Year/6 th Semester	Course Category	Major Course
Course Code	23MABS601	Course Title	Topology
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Real Analysis		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of set theory and topological space
2. To illustrate continuous mapping on the topological space
3. To highlight the concept of separable space
4. To impart knowledge of compact space and homeomorphism
5. To classify and compare with connectedness

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand basic set theory.
2. Apply the connected property of topological space.
3. Describe the compact topological space.
4. Analyze and apply the separation axiom of topological space.
5. Compile and construct connected and homeomorphism on topological space.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Definition and examples of topological space, Closed sets, Closure, Dense subset, Neighborhoods, interior, exterior, boundary and accumulation points, Derived sets, Bases and sub-bases. Subspaces, product spaces and relative topology.

Unit-II

Continuous functions, open maps, closed maps and homeomorphisms, Product topology, quotient topology, metric topology, Baire category theorem.

Unit-III

Continuous functions and homeomorphism. First and second countable space. Lindelöf spaces. Separable spaces. The separation axioms T_0 , T_1 , T_2 , $T_{3\frac{1}{2}}$, T_4 and their characterizations and basic properties.

Unit-IV

Connected and path connected spaces, connected sets in \mathbb{R} , components and path components, local connectedness, Connected spaces and their basic properties. Connectedness of the real line. Components. Locally connected spaces.

Unit-V

Compact spaces, compact sets in \mathbb{R} , Compactness in metric spaces. Basic properties of compactness. Compactness and finite intersection property. Sequential, countable, and B-W compactness. Local compactness. One-point compactification.

TEXT BOOKS/ REFERENCE BOOKS

1. K.D. Joshi, Introduction to general topology, New age Publications, 2010
2. J. R. Munkres, Topology, Pearson Education India, 2015.
3. G. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education, 2017.
4. J. L. Kelley, General Topology, Springer, 2018.
5. J. G. Hocking, G. S. Young, Topology, Dover Publications, 2012.

Year/Semester	3rd Year/6th Semester	Course Category	Major Course
Course Code	23MABS602	Course Title	Numerical Methods
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Basic Mathematical Computation		L T P : 3 0 0	Credits: 3

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basic of Numerical Analysis.
2. To illustrate about solutions of nonlinear equations in one variable.
3. To impart concept of interpolation and approximation.
4. To highlight direct methods for solving linear systems, numerical solution of ODE.
5. To classify the applications of numerical differentiation and integration.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the concepts of Numerical Analysis and demonstrate familiarity with different concepts.
2. Identify the suitable computational technique for a specific type of problem.
3. Describe and apply interpolation.
4. Implement numerical roots of equations by different methods.
5. Construct and compile computational method that is suitable for various problems.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Errors, Round off error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Efficient computations Bisection method, Secant method, Regula Falsi method, Newton Raphson method, Newton's method for solving nonlinear systems.

Unit-II

First and Higher order differences, Forward differences and backward differences and Central Differences, Differences of a polynomial, Properties of operators, Factorial polynomials, Shifting operator E, Relations between the operators, Finding the missing terms and effect of error in a difference tabular values.

Unit-III

Interpolation with equal intervals, Newton's forward and Newton's backward interpolation formulae, Interpolation with unequal intervals, Newton's divided difference, Lagrange's Interpolation formulae, Hermite Formula, Central Differences, Gauss forward and Gauss backward interpolation formulae, Sterling, Bessel Formula.

Unit-IV

Numerical Differentiation: Derivative of a function using interpolation formulae as studied in above interpolation methods, Numerical Integration, Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one- third and three-eighth rule.

Unit-V

Numerical solution of ordinary differential equations, Single step methods-Picard's method, Taylor's series method, Euler's method, Runge-Kutta Methods (II & IV orders).

TEXT BOOKS/ REFERENCE BOOKS

1. S.S. Shastri, Introductory methods of numerical methods, Prentice-Hall Ltd, 4th Edition 2004.
2. B.S. Grewal, Numerical Methods in engineering and science, Khanna Publishers, 2010.
3. S.R.K. Iyengar and R.K Jain, Numerical methods for Scientific and Engineering Computation, New Age Publishers, 1987.
4. R.M. Corless and N. Fillion, A graduate introduction to numerical methods, Springer International, 2013
5. M.K. Venkatraman, Numerical Methods in Science and Engineering, National publishing Company – Chennai, 5th Edition 1995.

Year/Semester	3rd Year/6th Semester	Course Category	Major Course
Course Code	23MABS602L	Course Title	Programming of Numerical Methods using MATLAB
Continuous Evaluation: 60		End Semester Examination:40	
Prerequisite: Basic Mathematical Computation		L T P : 0 0 2	Credits: 1

List of Programs

1. Write a program to solve a polynomial equation.
2. Write a program to find $C(n, r)$.
3. Write a program to write a tridiagonal matrix.
4. Write a program to solve the system of linear equations
(a) Using Gauss Elimination (b) using LU Decomposition.
5. Write a program in MATLAB to find the characteristic roots and the characteristic functions
6. Write a program on Bisection and False Position Method.
7. Write a program on polynomial interpolation.
8. Write a program on Taylor Series method.
9. Write a program on Runge-Kutta Methods
10. Write a program on Finite Difference Methods
11. Write a program on Trapezoidal and Simpson's rule.
12. Write a program on Lagrange's Interpolation.

Year/Semester	3rd Year/6th Semester	Course Category	Major Course
Course Code	24MABS603	Course Title	Discrete Mathematics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Algebra		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basic of logical mathematical reasoning.
2. To familiarize with the Boolean algebra.
3. To illustrate the basics operational property of set theory.
4. To describe the Counting Principles.
5. To construct the knowledge of recurrence relations and generating functions.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand mathematical logic.
2. Demonstrate the use of Boolean algebra.
3. Apply the operational property of set theory.
4. Analyze and apply applications of Counting Principles.
5. Construct and implement the recurrence relations and generating functions.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Mathematical logic, Propositions and Logical operators – Compound Propositions, Truth tables and propositions –Logical Equivalence –Conditional Propositions, Converse ,Contrapositive and Inverse, Bi conditional Statement, Tautologies and Contradiction, Mathematical Induction

Unit-II

Boolean algebra, Duality Principle, De-Morgan's Theorem, Boolean Functions, Simplification of Boolean Functions, Canonical Form, Karnaugh Map Method, Lattices –Properties of Lattices, Some Special Lattices, Product of lattices, Lattice Homomorphism.

Unit-III

Set, Subset, Operations on Sets, Algebra of sets, Functions, types of functions, Relations Types of relations, Equivalence Relation, Representation of relation, Matrices of relations, Posets–Partially Ordered Set, Hasse Diagram, well ordered Set, Closure of relations, Warshall's algorithm.

Unit-IV

Counting: Introduction, basic counting principles, factorial notations, Binomial coefficients, Permutations, Combinations, The Pigeonhole Principle, ordered and unordered partitions, Generation of permutations and combinations

Unit-V

Recurrence relations, Solution of a recurrence relation, Recurrence relations obtained from solutions, generating functions, Closed form expression for generating function, Solution of a recurrence relation using generating functions.

TEXT BOOKS/ REFERENCE BOOKS

1. C.L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill, 4th edition, 2017.
2. S. K. Sarkar, A Text book of Discrete Mathematics, S. Chand, 2017.
3. K. Rosen, Discrete Mathematics and its applications, Tata McGraw Hill, 2019
4. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 2009.
5. E. G. Goodaire and M.M. Parmenter, Discrete Mathematics with Graph Theory, Pearson Education Indian, 2015.

Year/Semester	3rd Year/6th Semester	Course Category	Major Course
Course Code	23MABS604	Course Title	Complex Analysis
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Calculus		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basic ideas of analysis.
2. To illustrate functions in complex variables.
3. To impart Analytic function, Contour integration.
4. To create competency Convergence of sequences and series.
5. To criticize Cauchy integral formula.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the significance of differentiability of complex functions.
2. Understand the notions of contour integrals.
3. explain Cauchy-Riemann equations.
4. interpret the Cauchy-Goursat theorem.
5. Compile Cauchy integral formula and Cauchy Residue theorem.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings, exponential function, Logarithmic function, trigonometric function, Limits involving the point at infinity, continuity, Differentiability.

Unit-II

Analytic functions, Cauchy- Riemann equations, sufficient conditions for differentiability. Harmonic function, harmonic conjugates, Milne's Thomson Method

Unit-III

Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, An extension of Cauchy integral formula, consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.

Unit-IV

Convergence of sequences and series, Power series, Radius of convergence of power series, Transformation: Mappings by elementary functions, Conformal Mapping, Mobius Transformations.

Unit-V

Taylor series, zero of analytic functions, Laurent series, singular points, Residue at pole, residue at infinity, Method of finding residue, Residue formula, Cauchy Residue theorem.

TEXT BOOKS/ REFERENCE BOOKS

1. J. Brown and R.V. Churchill, Complex Variables and Applications, McGraw-Hill Education, 2013.
2. H.S. Kasana, Complex Variables: Theory and applications, PHI Publisher, 2005.
3. B. Joseph and D. J. Newman, Complex analysis (Undergraduate Texts in Mathematics), Springer-Verlag New York Inc, 2010.
4. S. Ponnusamy Foundations of Complex Analysis, Narosa Publishing House, 2nd Edition, 2005
5. M. J. Ablowitz and A. S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press, NY, 2003.

Year/Semester	3rd Year/6th Semester	Course Category	Minor Stream Course
Course Code	24MABS605	Course Title	Fuzzy Set Theory
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Set Theory & Analysis		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basic of fuzzy set
2. To illustrates fuzzy logic and graph
3. To highlight the fuzzy linear programming
4. To impart the knowledge of fuzzy control theory
5. To construct and apply logical connectives for fuzzy logic

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Explain fuzzy sets and fuzzy logic.
2. Describe lattices and graphs.
3. Interpret the fuzzy numbers and arithmetic operations.
4. Compile Logical connectives and fuzzy graphs.
5. Construct and apply logical connectives for fuzzy logic.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Fuzzy Sets: Basic definitions, level sets, convex fuzzy sets, basic operations on fuzzy sets, Types of fuzzy sets, Cartesian products, and algebraic products bounded sum and difference.

Unit-II

Fuzzy Relations and Fuzzy Graphs: Fuzzy relations on fuzzy sets, composition of fuzzy relations, Fuzzy graphs. Fuzzy Analysis: Fuzzy functions and their extreme, integration of fuzzy functions, Fuzzy differentiation.

Unit-III

Fuzzy linear programming problems: Symmetric fuzzy linear programming problem, fuzzy linear Programming with crisp objective function, fuzzy graph.

Unit-IV

Systems and Fuzzy Control: Expert systems, uncertainty modeling in expert systems, fuzzy control, Process of fuzzy control. Fuzzy decisions, fuzzy linear programming problems, fuzzy transportation Problems.

Unit-V

An overview of classic logic, its connectives, tautologies, contradiction fuzzy logic, fuzzy quantities, Logical connectives for fuzzy logic, applications to control theory.

TEXT BOOKS/ REFERENCE BOOKS

1. S. Nanda and N. R. Das, Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi, 2010.
2. M. Ganesh, Introduction to Fuzzy Sets & Fuzzy Logic, Prentice Hall of India Pvt. Ltd., 2006.
3. H.J. Zimmerman, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., New Delhi, 4th Edition 2015.
4. J. Yen, R. Langari, Fuzzy Logic - Intelligence, Control and Information, Pearson Education, 1999.
5. K. H. Lee, First Course on Fuzzy Theory and Applications, Springer International Edition, 2005.

Year/Semester	3rd Year/6th Semester	Course Category	Minor Stream Course
Course Code	23MABS606	Course Title	Differential Geometry
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Real Analysis		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss the basics of curves.
2. To illustrate differential geometry of surfaces.
3. To impart the knowledge of curvature and Euler's theorem.
4. To derive intrinsic properties of plain curves and space curves.
5. To explain basic concepts of geodesic and Gauss-Bonnet theorem.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Know the concepts of space curves, plane curves, and Serret-Frenet formulae.
2. Learn about the relation between tangent, normal, and binormals, the first and second fundamental forms.
3. Describe the idea of various curvatures.
4. Interpret a developable associated with space curves and curves on surfaces.
5. Compile properties of the geodesic.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion, and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres, Existence of space curves.

Unit-II

Evolutes and involutes of curves. Theory of Surfaces: Parametric curves on surfaces, surfaces of revolution, helicoids, Direction coefficients, first and second Fundamental forms.

Unit-III

Principal and Gaussian curvatures. Lines of curvature, Euler's theorem, Rodrigue's formula Conjugate, and Asymptotic lines.

Unit-IV

Developable associated with space curves and curves on surfaces, Minimal surfaces.

Unit-V

Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature.

TEXT BOOKS/ REFERENCE BOOKS

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
2. A. Pressley, Elementary Differential Geometry, Springer International Edition, 2014.
3. O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
4. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003.
5. Q. Khan, Differential Geometry of Manifolds, PHI Publications, 2012

SEMESTER VII

Year/Semester	4th Year/7th Semester	Course Category	Major Course
Course Code	24MABS701	Course Title	Probability and Probability Distributions
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Knowledge of descriptive statistics		L T P : 3 0 0	Credits: 3

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To impart knowledge of basic probability theory.
2. To discuss about random variables and properties
3. To study two dimensional random variables.
4. To illustrate the mathematical expectation and its uses
5. To describe and compile probability distributions.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand of the concepts of basic probability and applications of Bayes theorem.
2. Interpret random variables and their properties.
3. Describe applications of two-dimensional random variables and central limit theorem.
4. Find moment generating function and cumulant generating function.
5. Discriminate with discrete and Continuous probability distributions with their properties.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit - I

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit- II

Random variables: discrete and continuous random variables, probability mass function, probability density function and cumulative density function, illustrations and properties of random variables, univariate transformations with illustrations.

Unit- III

Two dimensional random variables: discrete and continuous type, joint, marginal and conditional probability mass function, probability density function and cumulative density function., independence of variables, bivariate transformations with illustrations. Central limit theorem.

Unit- IV

Mathematical Expectation and Generating Functions: Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications. Conditional expectations.

Unit- V

Probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases.

TEXT BOOKS/ REFERENCE BOOKS

1. R.V. Hogg, E.A. Tanis and J.M. Rao, Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi, 2009.
2. I. Miller and M. Miller, J.E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia, 2006.
3. P.L. Myer, Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi, 1970.
4. 5. Goon A.M., Gupta M.K.: Das Gupta. B., Fundamentals of Statistics, Vol. I, World Press, Calcutta, 2005.
5. V. K. Rohatgi and A. K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Wiley Publisher, 2016.

Year/Semester	4th Year/7th Semester	Course Category	Major Course
Course Code	24MABS701L	Course Title	Probability and Probability Distributions Lab
Continuous Evaluation: 60		End Semester Examination:40	
Prerequisite: Knowledge of descriptive statistics		L T P : 0 0 2	Credits: 1

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To know about fitting of discrete probability distributions
2. To make students familiar with problems solution of Normal distribution.
3. To know about fitting of continuous distributions
4. To develop the practical knowledge on probability distributions
5. To perform various statistical techniques on real world projects

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Get an understanding of variance, covariance, conditional expectation with their related properties.
2. Equipped fitting of different probability distribution.
3. Apply probability distributions on different probability distributions.
4. Understand the real-life applications of Normal distribution.
5. Find Moment generating function, cumulant generating function and characteristic function.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

LIST OF EXPERIMENTS

1. Fitting of binomial distributions for n and $p = q = \frac{1}{2}$.
2. Fitting of binomial distributions for given n and p .
3. Fitting of binomial distributions after computing mean and variance.
4. Fitting of Poisson distributions for given value of λ .
5. Fitting of Poisson distributions after computing mean.
6. Fitting of negative binomial.
7. Fitting of suitable distribution.
8. Application problems based on binomial distribution.
9. Application problems based on Poisson distribution.
10. Application problems based on negative binomial distribution.
11. Problems based on area property of normal distribution.
12. To find the ordinate for a given area for normal distribution.
13. Application based problems using normal distribution.
14. Fitting of normal distribution when parameters are given.
15. Fitting of normal distribution when parameters are not given.

Year/Semester	4th Year/7th Semester	Course Category	Major Course
Course Code	23MABS702	Course Title	Measure Theory and Integration
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite:		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To define Measure theory and its basics to explain harmonic analysis, theory of partial differential equations and probability theory
2. To illustrate measure theory
3. To classify and interpret with measures, Lebesgue integration, differentiation and convergence
4. To discuss convergence in measure and dominated Convergence theorems
5. To calculate Riemann integrable simple functions

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe the shortcomings of Riemann integral and benefits of Lebesgue integral. Fluent with the fundamental concept of measure and Lebesgue measure.
2. Understand the use of the fundamental theorem of calculus.
3. Implement the basic concepts of measure and integration theory.
4. Compile convergence in measure and dominated Convergence theorems.
5. Use Riemann integrable simple functions

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Review of Riemann integral, integrable simple functions, Necessary and sufficient conditions of Riemann integral, Applications of Riemann integral.

Unit-II

Length of an open set, concept of measure, Lebesgue outer measure and measurable sets, example of non-measurable set, sigma algebra, outer and inner regularity of Lebesgue measure

Unit-III

Set function, abstract measure spaces, properties of measures, some examples of measures, measurable spaces

Unit-IV

Measurable functions, combinations of measurable functions, limits of measurable functions, Properties of measurable functions

Unit-V

Almost everywhere convergence, convergence in measure, Fatou's Lemma, Monotone and Dominated Convergence Theorems

TEXT BOOKS/ REFERENCE BOOKS

1. P. K Jain, V. P Gupta and P. Jain, Lebesgue Measure and Integration, New Academic Science, 2020
2. G. D Barra, Measure and Integration. New Age International (P) Ltd., New Delhi, 2006.
3. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
4. P. R. Halmos, Measure Theory, Springer-Verlag New York, 1974.
5. E. Hewitt and K. Stromberg, Real and Abstract Analysis, Springer, 1965.

Year/Semester	4th Year/7th Semester	Course Category	Major Course
Course Code	24MABS703A	Course Title	Optimization Techniques
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Operation Research		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To describe the game theory.
2. To summarize the replacement problem for individual and group replacement.
3. To provide a deep understanding of network analysis.
4. To discuss about the different inventory models.
5. To explain Markovian queueing models.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Define and formulate the problems of game theory.
2. Solve the problems based on sequencing and replacement problems.
3. Understand the concept of network analysis.
4. Conduct and interpret inventory models.
5. Develop mathematical skills to analyze and solve queueing models.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Game Theory: Optimal solution of two-person zero sum games mixed strategies, graphical solution of $(2 \times n)$ and $(n \times 2)$ games - solution of $(m \times n)$ games by linear programming.

Unit-II

Problem of sequencing – Processing ‘n’ jobs through two machines, three machines, processing two jobs through ‘m’ machines, Replacement model – Replacement of items that deteriorate, gradually, fail suddenly, group replacement policy analysis.

UNIT-III

Network analysis – PERT and CPM, Total slack, free slack, Probability of achieving completion date, Cost analysis.

Unit- IV

Inventory models – Deterministic models – Economic ordering quantity, Reorder level, optimum cost – Instantaneous and Non-instantaneous receipt of goods with or without shortages.

Unit- V

Introduction to Markovian queueing models – Single server model with finite and infinite system capacity – Characteristics of the model; Applications of queueing theory.

TEXT BOOKS/REFERENCE BOOKS

1. H. A. Taha, “Operations Research”, Prentice Hall of India., 5th Edition, 2012
2. P. K. Gupta, D. S. Hira, Operations Research, Sultan Chand Publication, Delhi, 2012.
3. K. Swarup, P.K. Gupta , and M. Mohan, Operations Research, Sultan Chand & Sons, 1994.
4. S.D. Sharma, Operations Research, Kedarnath Ramnath & Co., Meerut, 2013.
5. J.K. Sharma, Operations Research: Theory and Applications, Macmillan Publishers India Limited, 2011.

Year/Semester	4th Year/7th Semester	Course Category	Major Course
Course Code	24MABS703B	Course Title	Solid Mechanics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Operation Research		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To understand the theoretical concepts of Cartesian Tensor with particular emphasis on their elastic properties
2. To describe components of strain
3. To enhance the knowledge of strain quadric of Cauchy and stress quadric of Cauchy
4. To be familiar with various stress function
5. To illustrate Waves in various forms

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Define state of stress and strains, equilibrium and compatibility
2. Derive the governing equations and their solutions in plane stress state, plane strain state.
3. Explain strain quadric of Cauchy and stress quadric of Cauchy
4. Analyse various stress function
5. Identify and apply various Waves

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Cartesian Tensor: Coordinate transformation, Cartesian Tensor of different order, Sum or difference and product of two tensors. Contraction theorem, Quotient law, Symmetric & Skew symmetric tensors, Kronecker tensor, alternate tensor and relation between them, Scalar invariant of second order tensor, Eigen values & vectors of a symmetric second order tensor, Gradient, divergence & curl of a tensor field.

Unit-II

Analysis of Strain: Affine transformations. Infinitesimal affine deformation. Geometrical interpretation of the components of strain. Strain quadric of Cauchy. Principal strains and invariants. General infinitesimal deformation. Saint Venant's equations of Compatibility, Analysis of stress: Stress tensor. Equation of equilibrium. Transformation of co-ordinates. Stress quadric of Cauchy.

UNIT-III

Equations of elasticity: Generalized Hooke's law. Homogeneous isotropic media. Elastic moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's law. Beltrami-Michell compatibility equations.

Unit- IV

Two-dimensional problems. Plane stress. Generalized plane stress. Airy stress function. General solution of Biharmonic equation. Stresses and displacements in terms of complex potentials.

Unit- V

Waves: Propagation of waves in an isotropic elastic solid medium. Waves of dilation and distortion. Plane waves. Elastic surface waves such as Rayleigh and Love waves.

TEXT BOOKS/REFERENCE BOOKS

1. Shanti Narayan, A Text Book of Cartesian Tensors, S. Chand & Co., 1950.
2. I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata McGraw-Hill Private Ltd, 2nd Edition, 1956.
3. A.E.H. Love, A Treatise on Mathematical Theory of Elasticity, Dover Publications, New York, 4th Edition, 1944.
4. S. Timoshenko and J. N. Goodier, Theory of Elasticity, McGraw-Hill, New York, 3rd Edition, 1970.
5. W. Nowacki, Thermoelasticity, Pergamon Press, Warsaw, Poland, 1986.

Year/Semester	4th Year/7th Semester	Course Category	Minor Course
Course Code	23MABS704	Course Title	Cryptography
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: XII (Mathematics)		L T P : 2 0 0	Credits: 2

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To discuss basics of finite fields.
2. To illustrate factorization of polynomials over finite ring or fields.
3. To impart basics of classical cryptosystems and public key cryptosystems.

COURSE LEARNING OUTCOMES (CLO)

They syllabus has been prepare in accordance with National Education Policy (NEP). After completion of course, students would able to:

1. Know the concepts of ring, fields and factorizations of polynomials over ring and filed.
2. Well-versed with the consequences of the construction, factorizations of polynomials over finite fields,
3. Know the concept of basics of cryptography and key cryptosystems.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO1	CLO2	CLO3
CEO1	✓		
CEO2		✓	
CEO3			✓

COURSECONTENTS

Unit-I

Congruences, Quadratic congruence, Power residues, Higher power residues and reciprocity theorems, Algorithm to solve quadratic equations in Z_m

Unit-II

Finite fields, construction and examples, factorizations of polynomials over finite fields, algorithm to determine irreducible polynomials of degree n over Z_m .

Unit-III

Classical cryptosystems, DES-security and generalizations, Prime number generation, Public Key Cryptosystems of RSA, Rabin, etc. their security and cryptanalysis, Primality, factorization and quadratic sieve, efficiency of other factoring algorithms

TEXT BOOKS/REFERENCE BOOKS

1. I. Niven, H.S. Zuckerman and H.L. Montgomery, An Introduction to the Theory of Numbers, 5th Wiley Eastern, 2008
2. N. Koblitz, A Course in Number Theory and Cryptology, Graduate Texts in Mathematics, Springer Verlag, New York, 1987.
3. J. Katz and Y. Lindell, Introduction to Modern Cryptography, 2nd edition, CRC Press, New York, 2014
4. D. Bressoud, Factorization and Primality Testing, Undergraduate Texts in Mathematics, Springer , 1989
5. D.E. Burton, Elementary Number Theory, Tata McGraw-Hill Edu. Pvt. Ltd., 7th Edition, 2015.

Year/Semester	4th Year/7th Semester	Course Category	Minor Stream Course
Course Code	24MABS705	Course Title	Data Structures
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: C Programming Language		L T P : 3 0 0	Credits: 3

COURSE EDUCATIONAL OBJECTIVES (CEO)

6. To understand the basic concepts of Data Structures.
7. Be able to program using linked lists, Sequential lists.
8. To understand the basic concepts of terminology; Traversal of binary trees; Recursive algorithms for tree operations such as traversal, Binary Search Tree.
9. To impart the basic concepts of operations on stack and Stack application.
10. To understand concepts about searching and sorting techniques.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

6. To prepare data types – Arrays, Strings – Fixed and variable size – static and dynamic strings.
7. To explain class structures as fundamental, modular building blocks, to understand the role of inheritance, polymorphism, dynamic binding, and generic structures in building reusable code.
8. Student will able to analyze the statement of the problem, indexing with binary search trees; a better approach to tree indexes.
9. For the problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
10. For a given Search problem student will able to implement linear search, binary search.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit– I

Abstract data types – Arrays – Static, Dynamic and Generic arrays. Strings – Fixed and variable size – static and dynamic strings.

Unit – II

Introduction to linked lists; Sequential and linked lists, operations such as traversal, insertion, deletion searching, two way lists and Use of headers.

Unit – III

Introduction and terminology; Traversal of binary trees; Recursive algorithms for tree operations such as traversal, insertion, deletion; Binary Search Tree. B- TREES -The invention of B-Tree; Statement of the problem; Indexing with binary search trees; a better approach to tree indexes.

Unit – IV

Introduction and primitive operations on stack, Stack application, Infix, postfix, prefix expressions, Evaluation of postfix expression, Conversion between prefix, infix and postfix, introduction and primitive operation on queues, D- queues and priority queues.

Unit – V

Insertion sort, selection sort, merge sort, heap sort, searching Techniques: linear search, binary search and hashing.

TEXT BOOKS/ REFERENCE BOOKS

2. N.S. Kutti and P.Y. Padhye, Data Structures in C++, Prentice Hall of India Pvt., Ltd., New Delhi 2001.
3. Liberty and Keogh, C++: An introduction to programming, Prentice Hall of India Pvt., Ltd., New Delhi 2002.
4. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley by publication, New york 1994.
5. Jean – Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Tata McGraw Hill 1998.
6. E. Balagurusamy, Object oriented Programming with C++, Tata McGraw Hill, New Delhi, 1996.

Year/Semester	4th Year/7th Semester	Course Category	Minor Stream Course
Course Code	24MABS705L	Course Title	Data Structures Lab
Continuous Evaluation: 60		End Semester Examination:40	
Prerequisite: C Programming Language		L T P : 0 0 2	Credits: 1

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To understand the basic concepts of Data Structures.
2. Familiarize with the programming using linked lists, Sequential lists.
3. Explore the basic concepts of terminology; Traversal of binary trees; Recursive algorithms
4. Highlight the tree operations such as traversal, Binary Search Tree.
5. To impart the basic concepts of operations on stack and Stack application.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Prepare data types – Arrays, Strings – Fixed and variable size – static and dynamic strings.
2. Explain class structures as fundamental, modular building blocks
3. Understand the role of inheritance, polymorphism, dynamic binding, and generic structures in building reusable code.
4. Analyze the statement of the problem, indexing with binary search trees; a better approach to tree indexes.
5. Demonstrate the problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

List of Programs

1. Write a Programme to implement a stack using array.
2. Write a Programme to implement a stack using linked list.
3. Write a Programme to implement a queue using array.
4. Write a Programme to implement a queue using linked list.
5. Write a Programme to implement a circular queue using array.
6. Write a Programme to implement a simple linked list.
7. Write a Programme to implement a circular linked list.
8. Write a Programme to implement a doubly linked list.
9. Write a Programme to count a node in linked list.
10. Write a Programme to implement a reversed a linked list.
11. Write a Programme to implement a quick sort.
12. Write a Programme to implement a merge sort.

Year/Semester	4th Year/7th Semester	Course Category	Minor Stream Course
Course Code	23RMBS710	Course Title	Research Methodology
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite:		L T P: 2 0 0	Credits: 2

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To provide necessary background on research methodology to undergraduate students.
2. To give understanding of hypothesis testing.
3. To illustrate the different types of sampling techniques.
4. To explain the concept of data and data types and Know about the Formats of Reports, introduction, and different parts of a report.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe an idea about research methodology.
2. Understand the applications of sampling schemes and data types and data analysis.
3. Demonstrate and write a report for a particular type of research work.
4. Formulate the presentations method.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4
CEO 1	✓			
CEO 2		✓		
CEO 3			✓	
CEO 4				✓

COURSE CONTENTS

Unit-I

Meaning of research; objectives of research; basic steps of research; criteria of good research; types of research. Meaning of research problem; selection of research problem. Review of related literature- Meaning, necessity and sources.

Unit-II

Hypothesis- Meaning, function and types of hypotheses; Null/Alternative hypothesis, Variables- Meaning and types. Research design: Types of research design- exploratory, descriptive, diagnostic, and experimental.

Unit-III

Sampling- Meaning and types of sampling; Probability and Non-Probability. Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc. Statistics and its significance in research

Unit-IV

Research reports: Writing preliminaries, main body of research, references, and bibliography; Meaning and importance of workshop, seminar, conference, symposium etc. in research. Plagiarism- Concept and significance of plagiarism

Practical/Lab Work to be performed in Computer Lab

The practical will be taught using Excel software and/or using some statistical software like R /SPSS. Students are encouraged to use resources available on open sources.

TEXT BOOKS/ REFERENCE BOOKS

1. C.R. Kothari, Research Methodology: Methods and Techniques, 2nd Revised Ed. Reprint, New Age International Publishers, 2009.
2. G.L. Lilien and K. Philip, Marketing Decision Making; A Model Building Approach, Harper & Row, New York, 1983.
3. U.K. Srivastav, G.V. Shenoy and S.C. Sharma , Quantitative Techniques for Managerial Decision Making, Wiley Eastern, 1983.

SEMESTER VIII

Year/Semester	4th Year/8th Semester	Course Category	Major Course
Course Code	23MABS801	Course Title	Functional Analysis
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Linear algebra, Real analysis, and Metric Spaces		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To familiarize with distance and extension of distance as a norm.
2. To learn central concepts of functional analysis including the Hahn-Banach theorem, the open mapping and closed graph theorems and the uniform boundedness theorem.
3. To impart structural properties of spaces those are constructed with the help of suitable norms.
4. To highlight the relationship of differential and integral calculus.
5. To integrate and compile applications of linear operators, their adjoint operators and properties of bounded linear operators.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe distance and extension of distance as a norm.
2. Well-versed with central concepts of functional analysis including the Hahn-Banach theorem, the open mapping and closed graph theorems and the uniform boundedness theorem.
3. Apply structural properties of spaces those are constructed with the help of suitable norms
4. Interpret the relationship of differential and integral calculus
5. Classify and design the applications of linear operators, their adjoint operators and properties of bounded linear operators.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Normed Spaces, properties of normed spaces, examples of normed spaces, Finite dimensional normed spaces and subspaces, Quotient normed spaces, L^p -spaces, Banach Spaces, Equivalent norms.

Unit-II

Hahn Banach theorem for real/complex vector spaces and normed spaces. Bounded and continuous linear operators, Linear functional, Duals and transposes. reflexivity.

Unit-III

Inner product spaces, Hilbert spaces, properties of inner product spaces, orthogonal complements and Projection Theorem, Orthonormal sets.

Unit-IV

Approximation and optimization. Representation Theorems for Hilbert spaces, Weak convergence and weak boundedness.

Unit-V

Uniform boundedness Principle, Open Mapping Theorem (OMT), Closed Graph Theorem. Bounded inverse theorem, Spectrum of a bounded operator.

TEXT BOOKS/ REFERENCE BOOKS

1. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons (Asia) Pvt. Ltd., January 2007.
2. J.B. Conway, A Course in Functional Analysis, Second Edition Springer, September 7, 1990.
3. P.K. Jain and O.P. Ahuja, Functional Analysis, New Academic Science Ltd; 2nd edition, March -2010.
4. G.F. Simmons, Introduction to Topology and Analysis, McGraw Hill Education, 1 July 2017.
5. B.V Limaye, Functional Analysis, Second Edition, New Age International Publication, 2009.

Year/Semester	4th Year/8th Semester	Course Category	Major Course
Course Code	23MABS802	Course Title	Special Functions
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: ODE		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To explain the properties of special functions
2. To investigate and derive the properties of Beta-Gamma functions, inter-relations between such functions.
3. To illustrate special functions in differential equations.
4. To compile certain concepts of Bessel's function with its properties.
5. To summarize general concepts of Hermite polynomials and their properties.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe the applications and the usefulness of these special functions.
2. Demonstrate the Beta and Gamma functions and their properties.
3. Solve the Legendre equation and Legendre Polynomials.
4. Evaluate and compile the Bessel equations and Bessel functions.
5. Describe and integrate the Hermite equation and Hermite polynomial.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Hypergeometric Functions: Definition and special cases, convergence, analyticity, integral representation, differentiation, transformations, and summation theorems.

Unit-II

Chebyshev polynomials, orthogonal properties of Chebyshev polynomials, recurrence relations, generating functions for Chebyshev polynomials.

Unit-III

Definition, Solution of Bessel's equation, Bessel's function of the first kind of order n , Bessel's function of the second kind of order n , integration of Bessel's equation in series form, definition of $J_n(x)$ recurrence formulae for $J_n(x)$, generating function for $J_n(x)$, orthogonality of Bessel functions.

Unit-IV

Definition, Solution of Legendre's equation. Legendre polynomial of degree n , generating function of Legendre polynomials, definition of $P_n(x)$ and $Q_n(x)$, general solution of Legendre's Equation (derivations not required), Orthogonal properties of Legendre's polynomials, Recurrence formulas for Legendre's Polynomials.

Unit-V

Hermite Differential Equations, Solution of Hermite equation, Hermite polynomials, generating function for Hermite polynomials, other forms for Hermite Polynomials, Rodrigues formula for Hermite Polynomials, Orthogonal properties of Hermite Polynomials, Recurrence formulae for Hermite Polynomials.

TEXT BOOKS/ REFERENCE BOOKS

1. E. D. Rainville: Special Functions, Chelsea Publishing Co., Bronx, New York, Reprint, 1971.
2. M. D. Raisinghania, Ordinary and Partial Differential Equations, 20th Edition, S. Chand & Company Pvt. Ltd. New Delhi, 2020.
3. J. N. Sharma and R. K. Gupta, Differential equations with special functions, Krishna Prakashan, 20th Edition, 1992.
4. George F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw-Hill 3rd Edition, 2023.
5. Shepley L. Ross, Differential equations, 3rd Edition, John Willy & sons. New york, 2007.

Year/Semester	4th Year/8th Semester	Course Category	Major Course
Course Code	24MABS803A	Course Title	Fluid Dynamics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Mechanics		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To develop students understanding about the fluids and their characteristics
2. To make students familiar with Bernoullis equation and potential theorems
3. To develop student's understanding about two- dimensional flow in cylindrical polar coordinates
4. Familiar with two- dimensional motion, use of cylindrical polar co-ordinates
5. Familiar with Complex velocity potential

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Fluent with the basic principles of fluid dynamics.
2. Able to use Euler and Bernoulli's equations
3. Get an understanding the concept of rotational and irrotational flow, stream functions.
4. Able to analyse simple fluid flow problems.
5. Fluent with Complex velocity potential.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Kinematics, Velocity at a point of a fluid, Eulerian and Lagrangian methods, Streamlines, path lines and streak lines, Velocity potential, Irrotational and rotational motions, Vorticity and circulation, Equation of continuity, Boundary surfaces, Acceleration at a point of a fluid, Components of acceleration in cylindrical and spherical polar co-ordinates.

Unit-II

Pressure at a point of a moving fluid, Euler equation of motion, Equations of motion in cylindrical and spherical polar co-ordinates, Bernoulli equation, Impulsive motion, Kelvin circulation theorem, Vorticity equation, Energy equation for incompressible flow.

Unit-III

Kinetic energy of irrotational flow, Kelvin minimum energy theorem, Kinetic energy of infinite fluid, Uniqueness theorems. Axially symmetric flows, Liquid streaming past a fixed sphere, Motion of a sphere through a liquid at rest at infinity, Equation of motion of a sphere.

Unit-IV

Kinetic energy generated by impulsive motion, Motion of two concentric spheres. Three-dimensional sources, sinks and doublets, Images of sources, sinks and doublets in rigid impermeable infinite plane and in impermeable spherical surface Two-dimensional motion, Use of cylindrical polar coordinates, Stream function, Axisymmetric flow.

Unit-V

Stoke stream function, Stoke stream function of basic flows, Irrotational motion in two-dimensions, Complex velocity potential, Milne-Thomson circle theorem, Two-dimensional sources, sinks, doublets and their images, Blasius theorem.

TEXT BOOKS/ REFERENCE BOOKS

1. W. H. Besaint and A. S. Ramasey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi, 2006
2. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 18 April 2018.
3. O'Neill, M.E. and Chorlton, F., Ideal and Incompressible Fluid Dynamics, Ellis Horwood Limited, 1986.
4. R. K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, 1976.
5. G.K. Batchelor, An Introduction to Fluid Mechanics, Cambridge University Press, Feb 2000.

Year/Semester	4th Year/8th Semester	Course Category	Major Course
Course Code	24MABS803B	Course Title	Combinatorial Mathematics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Modern Algebra, Calculus		L T P : 3 1 0	Credits: 4

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To understand the basics of combinatorics and proofs.
2. To describe and derive the pigeonhole principle, double counting, parity arguments.
3. To execute Principle of Inclusion and Exclusion, Derangements, Inversion formulae and Systems of distinct representatives.
4. To enable students about Polya theory of counting and their immediate applications.
5. To define and apply the notion of Latin squares, Hadamard matrices, Combinatorial designs: t designs, BIBDs, Symmetric designs.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Describe and apply the basics of combinatorics and proofs.
2. Well-versed with the pigeonhole principle, double counting, parity arguments.
3. Apply Principle of Inclusion and Exclusion, Derangements, Inversion formulae and Systems of distinct representatives.
4. Apply the concept of Polya theory of counting and their immediate applications.
5. Integrate and estimate Latin squares, Hadamard matrices, combinatorial designs: t designs, BIBDs, Symmetric designs.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CEO 1	✓				
CEO 2		✓			
CEO 3			✓		
CEO 4				✓	
CEO 5					✓

COURSE CONTENTS

Unit-I

Introduction to combinatorics, Basic Counting Principles, Binomial Coefficients, Counting subsets, Set-partitions, Stirling numbers, Bijective proofs, mathematical induction, Combinatorial Proofs.

Unit-II

Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, pigeonhole principle, double counting, parity arguments.

Unit-III

Principle of Inclusion and Exclusion, Derangements, Inversion formulae. Integer partitions, Systems of distinct representatives.

Unit-IV

Polya theory of counting: Necklace problem and Burnside's lemma, Cyclic index of a permutation group, Polya's theorems and their immediate applications.

Unit-V

Latin squares, Hadamard matrices, combinatorial designs: t designs, BIBDs, Symmetric designs.

TEXT BOOKS/ REFERENCE BOOKS

1. J. H. Lint and R.M. Wilson, A Course in Combinatorics, Cambridge University Press (2nd Ed.), 2001.
2. S.S. Sane, Combinatorial Techniques, Hindustan Book Agency, 2013.
3. R.A. Brualdi, Introductory Combinatorics, Pearson Education Inc., (5th Ed.), 2009
4. M. Hall(Jr.),Combinatorial Theory, John Wiley & Sons (2nd Ed.), 1986.
5. P. J. Cameron, Combinatorics: Topics, Techniques, Algorithms, Cambridge University Press, 1995.

Year/Semester	4th Year/8th Semester	Course Category	Minor Stream course
Course Code	23MABS804	Course Title	Classical Mechanics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite:		L T P : 2 0 0	Credits: 2

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To examine derivation of Hamilton's principle from D. Alembert's principle.
2. To classify and compile classical mechanics approach to solve a mechanical problem.
3. To illustrate canonical transformation.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Apply the concept of D. Alembert's principle in solving problem related to Lagrangian of system.
2. Represent the equation of motion for mechanical systems using Hamiltonian formulations.
3. Apply the concept of transformation in changing the configuration space.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES AND COURSE LEARNING OUTCOMES

CEO	CLO	CLO 1	CLO 2	CLO 3
CEO 1		✓		
CEO 2			✓	
CEO 3				✓

COURSE CONTENTS

Unit-I

Generalized coordinates, Holonomic and non-holonomic systems, Scleronomic and rheonomic systems, Constraints, Generalized potential, Lagrange's equations of motion of the second kind, Energy equation for conservative field, Derivation of Lagrange's equations from D' Alembert's principle, Simple applications of the Lagrangian formulation.

Unit-II

Hamilton's variables, Hamiltonian, Hamilton canonical equations, Derivation of Hamilton's equations of motion by variational principle, Simple applications of Hamilton's equations of motion,

Unit-III

Cyclic coordinates and conservation theorems, Routh's equations of motion, The principle of least action, Derivation of Lagrange's equations from Hamilton's principle, Derivation of Hamilton's principle from D. Alembert's principle.

TEXT BOOKS/ REFERENCE BOOKS

1. H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House, New-Delhi, 2018.
2. A. S. Ramsey, Dynamics Part-II, The English Language Book Society and Cambridge University Press, 1972.
3. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, 1st edition Moscow, 1975
4. I. M. Gelfand and S.V. Fomin, Calculus of Variations, Dover Publications, 2012.
5. N. C. Rana and P. S. Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.

LIVE PROJECTS/ VOCATIONAL COURSES

Course Code:	Continuous Evaluation: 60 Marks
Credits: 4	End Semester Examination: 40 Marks
Duration: Continuous	Course Type: Skill Enhancement Course
Prerequisite: Nil	

LIVE PROJECT COURSE OBJECTIVES

- To provide qualitative enhancements to the UG students of FSH.
- Offered live projects serve to enhance student's employability attributes to make them job-ready.
- To provide experiential learning to students for an ability to work in a real-life work situation.
- To provide a learning ground for students to get an opportunity to apply what they have learned in classes to real-world scenarios. An opportunity to work in real constraints of resources, people factors and other organizational constraints. Classroom projects are primarily focused on singular concepts whereas live projects allow integrating knowledge across various functions.
- Live projects develop employment abilities in students and provide industry experience and insights.

LIVE PROJECT OUTCOMES

On completion of the live project(s), students will be

- Capable enough to exhibit strong foundation knowledge of domain area.
- Students can take a challenge and place better career development scenario in professional life.
- It gives a strong boost for experienced to take their career into next stage.
- Successfully completion of live projects shows a better stand and technical expertise in domain area.

ASSESSMENT DETAILS

Assessment of Live Project(s) & Industrial visit include the following:

- Formative & submissive assessment.
- During the final assessment students have to submit a hard copy of the project, the presentation has to be given by the students.
- Prototype or Working Model, in case of Live Project is taken up for it.
- Report on Project.
- Viva Voce.
- Final Presentation in front evaluation team.

PERIODIC MONITORING

DURATION→	Continuous Monitoring throughout the Project
EVALUATION PROCESS	<ol style="list-style-type: none">1. Student will prepare the report on the work done.2. Student will prepare the presentation on the learning outcomes.3. Student will give presentation about the learning achieved.

EVALUATION	<ul style="list-style-type: none">❖ Formative/Continuous Evaluation: 60 %❖ End Semester Evaluation: 40 %
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SIGNIFICANCE OF LIVE PROJECTS

Live projects play a significant role in providing real-time education to the students. During live projects, students are encouraged to identify the domain they want to work in and select the relevant project. They also get to meet working professionals or organizations and discuss with them about the project. In some institutions, live projects are considered as assignments and students get points for it. This is important as it helps the students during their placements.

SUMMER INTERNSHIP

Course Code:	Continuous Evaluation: 60 Marks
Credits: 4	End Semester Examination: 40 Marks
Duration: 3 / 4 Weeks	Course Type: Skill Enhancement Course
Prerequisite: Nil	

COURSE OBJECTIVES

- To have qualitative improvements in the UG students of FSH.
- To provide experiential learning to students to work in the real-life situation.
- Expose the student to professional role models or mentors who will provide the student with support in the early stages of the internship and provide an example of the behaviours expected in the intern's workplace.
- Assist the student's development of employer-valued skills such as teamwork, communications and attention to detail.

COURSE LEARNING OUTCOMES

On completion of course, students will be

- Able to demonstrate various aspects of theory as well as practical.
- Able to build and expand network of professional relationships and contacts.
- Develop a solid work ethic and professional demeanour, as well as a commitment to ethical conduct and social responsibility.
- At the end of the course, a student will be competent in their domain area.

PROJECT IDENTIFICATION

- The internships will be conducted after examination of the 4 semesters.
- The Internship will be of 4 credits.
- Projects will be undertaken by the students in collaboration with Student-Faculty, NGO, Government Departments and Industries.
- Projects will be identified keeping in mind application of knowledge & skills, relevance of project in terms of expectation of society.
- Allocation of the project to the students with active participation of students, faculty and concern authorities.

MONITORING OF THE PROJECTS

- Project should be supervised by faculty mentor and place where students is undertaking the project.
- Effective monitoring of project progress undertaken by the students through by digital technologies.
- Active involvement of industry & faculty supervisor.
- Weekly monitoring of the project through Faculty mentor & Industry person.
- All the project has to analyze in-depth and the outcome of the project should be identified

ASSESSMENT DETAILS

Assessment of SIP include the following:

- Formative & submissive assessment three times during the internship.
- During the final assessment students have to submit a hard copy of the project, the presentation has to be given by the students.
- Report on Project taken up.
- Viva Voce.
- Final Presentation in front of the industry experts and Faculty mentor.

PERIODIC MONITORING

Student will be monitored on periodic basis, both by the In-charge at the Industry and the Faculty In-charge. The Industry In-charge will submit the Mid-Term and End-Term Evaluation report. However, the faculty In-charge will take periodic presentation to keep a check on the progress.

DURATION→	3 to 4 Weeks (After 4thSemester End Term Examination)
EVALUATION PROCESS	4. Student will prepare the report on the work done. 5. Student will prepare the presentation on the learning outcomes. 6. Student will give presentation about the learning achieved.

EVALUATION	❖ Formative/Continuous Evaluation: 60 % ❖ End Semester Evaluation: 40 %
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EVALUATION PARAMETER FOR SUMMER INTERNSHIP PROJECT (SIP)

1. Evaluation Parameter for Formative Assessment (Summer Internship Project)

Continuous Assessment will perform by respective faculty & Industry coordinators within stipulated time period. Evaluation Parameter classified as follows:

S. No.	Basis of Evaluation Parameter with Time frame	Marks
1.	Synopsis Presentation (Week 1 st)	15
2.	Relevance and linkage of the Identify issue with functional area of discipline (Week 1 st)	10
3.	Survey of Literature (Week 2 nd)	10
4.	Research Methodology & Data collection (3 rd to 4 th Week)	15
5.	Overall understanding of the area of study (3 rd to 4 th Week onwards)	10
	Total Marks	60

2. Evaluation Parameter for End Term Assessment (Summer Internship Project)

S. No.	Basis of Evaluation Parameter	Marks
1.	Quality Of Content Design	10
2.	Identification of Contemporary Issue	10
3.	Innovation in learning Process	10
4.	Presentation of Content & Delivery Mechanism	10
	Total Marks	40

**List of Multidisciplinary Courses (MDC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

Cat.	Code	Course Name	L	T	P	Credits
MDC I	23MDC201	Renewable Energy Sources	3	0	0	3
	23MDC202	Electric Vehicle	3	0	0	3
	23MDC301	IPR in Business	3	0	0	3
	23MDC302	Library Information Sciences & Media Literacy	3	0	0	3
	23MDC401	Management Process & Organizational Behaviour	3	0	0	3
MDC II	23MDC203	Introduction to Bio-engineering	3	0	0	3
	23MDC204	Introduction to Robotics	3	0	0	3
	23MDC303	Psychology and Emotional Intelligence	3	0	0	3
	23MDC304	Indian Economy	3	0	0	3
	23MDC402	Creating an Entrepreneurial Mind	3	0	0	3
MDC III	23MDC205	Arduino based programming	3	0	0	3
	23MDC305	Electoral Literacy in India	3	0	0	3
	23MDC403	Personal Financial Planning	3	0	0	3
	23MDC404	Interior Design	3	0	0	3

**List of Ability Enhancement Courses (AEC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

S. No.	Code	Course Name	L	T	P	Credits
1	23AEC101	Functional English I	3	0	0	3
2	23AEC201	Functional English II	3	0	0	3
3	23HIN101 I / 23FLGR201 I / 23FLFR201 I	Hindi – I / German – I / French – I	2	0	0	2
4	23HIN101II / 23FLGR201 II / 23FLFR201 II	Hindi – II / German – II / French – II	2	0	0	2

**List of Value Added Courses (VAC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

S. No.	Code	Course Name	L	T	P	Credits
1	23VAC101	Environment Protection & Sustainable Development	2	0	0	2
2	23VAC102	Indian Constitution & Polity	2	0	0	2
3	23VAC103	Sports, Yoga & Fitness	2	0	0	2

**List of Skill Enhancement Courses (SEC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

Courses on Soft Skills

S. No.	Code	Course Name	L	T	P	Credits
1	23SS151	Effective Communication Skills	0	0	2	1
2	23SS252	Teamwork & Interpersonal Skills	0	0	2	1
3	23SS353	Presentation Skills	0	0	2	1
4	23SS454	Professional Skills	0	0	2	1
5	23AR555	Aptitude & Reasoning	0	0	2	1

Courses on Technical Skills

S. No.	Code	Course Name	L	T	P	Credits
1	23TS101	Digital Literacy & IT Skills	0	0	2	1
2	23SS202	Advanced Excel Skills	0	0	2	1
3	23SS303	Statistical Analysis with SPSS	0	0	2	1
4	23SS404	R language programming	0	0	2	1
5	23SS505	Programming with MATLAB	0	0	2	1

Year/Semester	Ist Year / Ist Semester	Course Category	Multidisciplinary Course
Course Code	23MDC201	Course Title	Renewable Energy Sources
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES

1. To create awareness about sources of energy and able to estimate how long the available conventional fuel reserves will last.
2. To learn the fundamental concepts about solar energy systems and devices.
3. To design wind turbine blades and know about applications of wind energy for water pumping and Electricity generation.
4. To understand the working of OTEC system and different possible ways of extracting energy from Ocean, know about Biomass energy, mini-micro hydro systems and geothermal energy system.

COURSE LEARNING OUTCOMES (CLO) : At the end of the course, the student will be able to

1. Analyze the energy scenario of the world and nation.
2. Carry out a comparative analysis of different types of coal, including their treatment, Liquefaction and gasification.
3. Compare the liquid and gaseous fuels sourced from petroleum including their characterization.
4. Analyze the potential of alternate energy sources and their scope and limitations.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
CO1	x			
CO2		x		
CO3			x	
CO4				x

COURSE CONTENTS:

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction to Energy Sources: World energy futures, Conventional energy sources, Nonconventional energy sources, Prospects of Renewable energy sources. Environmental Aspects of Electric Energy Generation: Introduction Thermal pollution, Atmospheric pollution, Effects of Hydroelectric projects, Nuclear power generation and environment, Green House Gas Effects, Global Environmental awareness, Energy options for Indian Economy.	8
UNIT-II	Solar Energy: Introduction to solar radiation and its measurement, Introduction to Solar energy Collectors and Storage, Solar thermal electric conversion, Thermal	8

	electric conversion systems, Solar electric power generation, Solar photo-voltaic, Solar Cell principle, Semiconductor junctions, Conversion efficiency and power output, Basic photovoltaic system for power generation.	
UNIT-III	Wind Energy and Wind Energy Conversion: Introduction to wind energy conversion, the nature of the wind, Power in the wind, Wind data and energy estimation, Site Selection considerations, basic Components of a Wind energy conversion system, Classification of WEC Systems, Schemes for electric generation using synchronous generator and induction generator, wind energy storage.	8
UNIT-IV	BIOMASS ENERGY Biomass conversion technologies bio mass generation, classification of Bio Gas Plants material used in Bio Gas Plants., Selection of site & applications. MHD & Hydrogen Energy: Basic Principle MHD SYSTEM, advantages, Power OUTPUT of MHD Generation, future Prospects. Principle and classification of fuel cell energy, hydrogen as alternative fuel for Generation of Electrical Energy & applications. Fuel Cell: Fuel Cell, Management of Fuel, Thermonic power generation.	8
UNIT-V	HYDRO POWER AND OTHER RENEWABLE ENERGY SOURCES Hydropower: Introduction, Capacity and Potential, Small hydro, Environmental and social impacts. Tidal Energy: Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation. Geothermal Energy: Introduction, Capacity and Potential, Resources of geothermal energy.	8

TEXT BOOKS

1. Sukhatme. S.P., Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. B. H. Khan, Non-Conventional Energy Resources, The McGraw Hill
3. Twidell, J.W. & Weir, A. Renewable Energy Sources, EFN Spon Ltd., UK, 2006.
4. S. P. Sukhatme and J.K. Nayak, Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw-Hill, New Delhi.
5. Garg, Prakash, Solar Energy, Fundamentals and Applications, Tata McGraw Hill.

REFERENCE BOOKS

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publications, New Delhi, 2011.
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 1996.

3. Khandelwal, K.C., Mahdi, S.S., Biogas Technology – A Practical Handbook, Tata McGraw- Hill, 1986.
4. Tiwari. G.N., Solar Energy – “Fundamentals Design, Modeling & Applications”, Narosa Publishing House, New Delhi, 2002.
5. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
6. Frank Krieth& John F Kreider ,Principles of Solar Energy, John Wiley, New York

Year/Semester	Ist Year / Ist Semester	Course Category	Multidisciplinary Course
Course Code	23MDC202	Course Title	Electric Vehicles
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES

1. To acquire knowledge on the fundamental concepts, principles, and analysis of hybrid electric vehicles.
2. To understand the concept of electrical vehicles and its operations.
3. To understand the need for energy storage in hybrid vehicles.
4. To provide knowledge about various possible emerging technologies that can be used in electric vehicles.

COURSE LEARNING OUTCOMES (CLO): At the end of the course, the student will be able to

1. Realize the importance of electric transportation systems.
2. Understand the basics of electric vehicle components and configuration.
3. Understand the various charging types, comfort and safety methods.
4. Understand the application of electric vehicle in Smart grid.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
CO1	x	x	x	x
CO2	x	x	x	
CO3	x			
CO4				x

COURSE CONTENTS:

UNIT	COURSE CONTENTS	HOURS
UNIT-I	ELECTRIC VEHICLES History of Modern Transportation, Importance of Different Transportation Development Strategies to Future Oil Supply, Introduction to Electric Vehicles, History of hybrid and electric vehicles, Social, environmental importance and key challenges of hybrid and electric vehicles, Specifications of PHEVs, BEVs, EVs, Plug-in Hybrid Vehicle characteristics, The future of	8

	electric vehicles.	
UNIT-II	ENERGY STORAGE AND BATTERY TECHNOLOGY Introduction to Energy Storage system, Battery Requirements for HEVs, PHEVs, and EVs, Types of batteries, Properties of batteries, Working principle and construction of lead-acid, nickel cadmium, nickel metal hydride, lithium ion batteries, Maintenance and charging of batteries, Diagnosing lead-acid battery faults, Advanced battery technology, Developments in electrical storage, Case studies	8
UNIT-III	CHARGING AND STARTING SYSTEMS Requirements of the charging system, Charging system principles, Alternators and charging circuits, Diagnosing charging system faults, Advanced charging system technology, New developments in charging systems, Requirements of the starting system, Starter motors and circuits, Types of starter motor, Diagnosing starting system faults, Advanced starting system technology, New developments in starting systems, Case studies.	8
UNIT-IV	HYBRID ELECTRIC VEHICLE DRIVE TRAIN AND SAFETY Requirement of drive train, Architecture of hybrid drive train, Sizing of components, Series configuration, Parallel configuration, parallel and series configuration, Security, Airbags and belt tensioners, Diagnosing comfort and safety system faults, Advanced comfort and safety systems technology, New developments in comfort and safety systems.	8
UNIT-V	PERIPHERAL INTERFACES EMERGING TECHNOLOGIES Introduction, Electric Vehicle Supply Equipments, Smart vehicles in smart grid, Vehicle-to-grid technologies: Unidirectional and Bidirectional, Need of Charging Station Selection (CSS) server, Smart grid technologies: Applications / Benefits, Smart meter, Smart charger: Purpose and benefits.	8

TEXT BOOKS

1. M. Ehsani, Y. Gao, and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design" Second Edition, CRC Press, ISBN: 978-1-4200-5398-2, Aug. 2009.
2. Tom Denton, "Automobile Electrical and Electronic Systems" Elsevier Butterworth-Heinemann, Third edition, 2004.
3. A. Emadi, "Advanced Electric Drive Vehicles, CRC Press, ISBN: 978-1-4665-9769-3, Oct. 2014.

REFERENCE BOOKS

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & sons inc, 2012.

DEPARTMENT OF LAW			
Year/Semester	I st Year / I st Semester	Course Category	Multidisciplinary Course
Course Code	23MDC301	Course Title	IPR in Business
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite: Nil		L T P: 3 0 0	Credits: 3

COURSE OBJECTIVES:

The objective of this Multidisciplinary Course (MDC) is to familiarize the students with various types of IPR and its relevance to the businesses and their respective streams.

CO 1: To provide students with a basic understanding of various types of IPR and its relevance for business.

CO 2: To acquaint students with the strategies and management techniques associated with intellectual property assets, and the legal considerations and challenges involved.

CO 3: To familiarize the students with the challenges and legal considerations related to intellectual property disputes.

CO 4 To develop skills related to management of intellectual property in business.

COURSE LEARNING OUTCOMES

At the end of this course, the students would be able to:

CLO1: Define and discuss about the various types of IPR and its relevance for business

CLO2: Discuss the adjudicating bodies and mechanisms under each of these IPRs

CLO3: Analyze and resolve business disputes relating to IPR

CLO4: Apply the learning to the real-life situations in business

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES (COs)	COURSE LEARNING OUTCOMES (CLOs)			
	CLO1	CLO2	CLO3	CLO4
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENT

UNIT 1

INTRODUCTION TO INTELLECTUAL PROPERTY AND BUSINESS

- Concept of IPR in business and its types
- International Context - Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO), World Trade Organization (WTO) and the UNESCO
- Innovation as a Business Strategy and relevance of protecting the ideas legally
- National IPR Policy

UNIT 2: COPYRIGHT

- Concept of Copyright and importance for businesses
- Media business – protecting performer's rights
- Performers' and Broadcasters' Rights Law

- Assignment, Transmission, Licensing of Copyrights
- Infringement of Copyrights and remedies

UNIT 3: TRADEMARKS

- Trademark – value of and relevance for businesses
- Protecting brand value- acquiring trademark nationally and internationally
- Trade mark disputes – case studies

UNIT 4: PATENTS

- Protecting innovation – acquiring patents nationally and internationally
- Product and process patents
- Assigning patents and its commercialization
- Patent Disputes

UNIT 5: INDUSTRIAL PROPERTIES

- Industrial designs – protection - Procedure for Registration of Designs • Copyright under Design
- Semiconductor Integrated Circuits Layout-Designs
- Plant varieties – commercialization - Monsanto cases
- Geographical Indications
- Biotechnology and IPR

UNIT 6: REGISTRATION AND ENFORCEMENT MECHANISMS

- Registration authorities of various IPRs
- IP Management and assertion of rights through declarations – use of copyright, trademark signs
- IP Litigation – Approach of courts – landmark cases

TEXT BOOKS:

- WIPO DL-101 General Course on Intellectual Property (online)
- Elizabeth Verkey and Jithin Saji Issac, *Intellectual Property*, Eastern Book Company 2021
- Anurag K. Agarwal, *Business and Intellectual Property: Protect your Ideas*, IIM Ahmedabad. Random House India (2016)
- *Handbook on IP Commercialisation - Strategies for Managing IPRs and Maximising Value* Jakarta: ASEAN Secretariat, November 2019

REFERENCES BOOKS:

- ICSI Study Material, Intellectual Property Rights: Law and Practice, A. Ramaiya, Guide to the Companies Act, LexisNexis, 19th Ed. 2020 (in 6 volumes)
- WIPO, *Enterprising Ideas A Guide to Intellectual Property for Startups*, 2023
- Manuals published by Office of the Controller General of Patents, Designs & Trade (CGPDTM), available at <https://ipindia.gov.in/>
- Guide Books by WIPO –Intellectual Property for Business, available at <https://www.wipo.int/publications/en/series/index.jsp?id=181>

Department of Library & Information Science			
Year/Semester	Ist Year /Ist Semester	Course Category	Multidisciplinary Course
Course Code	23MDC302	Course Title	Library Information Sciences & Media Literacy
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

Course Objectives (CO) - The Course is designed with the following objectives:

CO-1: To know the library collection and their classifications.

CO-2: To discuss the library information services.

CO-3: To understand the importance of media

CO-4: To grasp the significance of motive of media

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

CLO-1: Explain the library collection and their classifications.

CLO-2: Analyse the library information services.

CLO-3: Analyse the media roles.

CLO-4: Analyse the motive of media.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

	CO-1	CO-2	CO-3	CO-4
CLO-1	√			
CLO-2		√		
CLO-3			√	
CLO-4				√

COURSE CONTENTS:

UNIT-1: Library Collection

- Type of Information Sources : Primary, Secondary and Tertiary
- Reference Collection: Type of reference sources
- Indexing and Abstracting Journals
- Multimedia Collection
- Arrangement of Information Sources : Classification

UNIT-2: Information Services

- Bibliography: Type of Bibliography
- Reviews Literature
- Citation Style
- Citation Analysis: Web of Science and Scopus
- Online Databases : Structure and Retrieval

UNIT-3: Media Literacy

- Introduction to Media Literacy
- Type of media: Traditional versus social media
- Bias in media

UNIT-4: Motive of Media

- Media tycoons and conditions in which media works
- Research and Publication ethics

Recommended Books:

1. Richard E. Rubin & Rachel G. Rubin ,Foundations of Library and Information Science, 5th Edition. ISBN-9781783304776, Facet Publication, UK
2. <https://en.unesco.org/themes/media-and-information-literacy/resources>

Year/Semester	Ist Year /Ist Semester	Course Category	Multidisciplinary Course
Course Code	23MDC401	Course Title	Management Process & Organizational Behaviour
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES

1. To understand the functions and responsibilities of managers.
2. To acquaint the students with the fundamentals of managing business.
3. To understand individual and group behaviour at work place so as to improve the effectiveness of an organization.
4. To analyse human behaviour in the organization setting in order to manage it in accordance to the intentions.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate the roles, skills and functions of management.
2. Analyse the causes and consequences of applying different business strategies.
3. Analyse and compare individual behaviour related to motivation and rewards.
4. Identify group behaviour, leadership styles and the role of leaders in a decision making process.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1				
CO 2				
CO 3				
CO 4				

COURSE CONTENTS

Unit 1: Introduction to the management

Management Concept, Nature, Process and significance, levels of management, managerial skills, functions of management, management and administration, evolution of management, Role of management and insights from Indian practices and ethos.

Unit 2: Functions of the management

Planning: Types of Plans & The planning process; Organizing: Common organisational structures; Staffing: features and necessity; leading: types of leaders; Controlling: functions and types

Unit 3: Introduction to Organizational Behaviour

Meaning, importance and scope of OB; abilities: meaning and forms, attitudes: framework, work related attitudes, personality: types, assessment, perception: process, factors influencing perception, perceptual errors

Unit 4: Foundation of Group Behaviour

Defining and classifying groups; need to join groups, stages of group development; group dynamics: group properties as roles, norms and size; group decision making techniques, conflict management

TEXT BOOKS

1. Stephen Robbins, Organizational Behavior, 16th edition (2012), Pearson Education.
2. K. Aswathappa, Organizational Behaviour, 13th edition (2016), Himalaya Publishing House.
3. Fred Luthans, Organizational Behavior, 14th edition (2017), McGraw-Hill.

SUGGESTED READINGS

1. Gregory Moorhead & Ricky W. Griffin, Organizational Behaviour, 11th edition (2009), Jaico Publication.
2. Tripathy PC and Reddy PN, Principles of Management, 6th edition (2011), McGraw-Hill.

Department of Mechanical Engineering			
Year/Semester	I st Year/II nd Semester	Course Category	Multidisciplinary Course
Course Code	23MDC204	Course Title	Introduction to Robotics
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES (CO)

1. Review of Industrial Control Devices and Circuits; Basic Ladder Logic and Control
2. Programmable Logic Controllers and Applications;
3. Robot Fundamentals; Mechanisms and Actuators, Sensors and Detectors;
4. Modeling and Control of Manipulators; Robot Applications and Programming.

COURSE LEARNING OUTCOMES (CLO) : At the end of the course, the student will be able to

1. Explain basic concepts of Programmable Logic Controller (PLC) and Industrial automation.
2. Determine basic programming languages and instructions of a PLC and Use a particular Programmable Logic Controller (PLC) for various applications.
3. Design an automated system for industrial derive to meet defined operational specifications.
4. Explain basic concept, type and components of Robotic system and define the principles and benefits of the various actuators, drives and sensors. Solve forward kinematics of any serial robot, compute position and orientation of end effectors as a function to joint variables.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Objectives	CLO1	CLO2	CLO3	CLO4
CO1	x			
CO2		x		
CO3			x	
CO4				x

COURSE CONTENTS:

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction to Industrial Automation : Introduction to Industrial Automation Review of industrial control devices I/O devices (Electronics Circuit breakers, timers, relays)	8
UNIT-II	Programmable Logic controllers (PLC) 2.1 Introduction to Programmable Logic controllers <ul style="list-style-type: none"> ➤ Introduction to PLCs ➤ Overview of number systems and logic concepts ➤ PLC Programming Procedures and Devices ➤ Inputs (sensors) and Outputs (actuators) connected to PLC ➤ PLC and DCS programming software 2.2 Input/output and Memory Interaction <ul style="list-style-type: none"> ➤ PLC input/output systems and programming devices 	8

	<ul style="list-style-type: none"> ➤ PLC Memory and Input/output Interaction ➤ Discrete input/output system ➤ Analog input/output system ➤ Special input/output modules: PID, Fuzzy-logic.... <p>2.3 Programming a PLC</p> <ul style="list-style-type: none"> ➤ Programming languages and instructions ➤ Programming ON/OFF Inputs ➤ Creating Ladder diagrams ➤ Register Basics ➤ PLC Timers and Counters ➤ PLC Arithmetic functions ➤ Number comparison functions ➤ Data handling Functions ➤ PLC functions with BITS ➤ System programming and implementation: Control task definitions, strategies, program organization and implementations ➤ Programming practice: Siemens“ PLC S7-300, S7-400 (practice on available PLC type) 	
UNIT-III	<p>Introduction, Fundamentals of Robotics</p> <ul style="list-style-type: none"> ➤ Introduction ➤ Types of Robots ➤ Robot Anatomy and Key Components ➤ Sensors and Actuators in robots ➤ Position, Velocity, Acceleration, Force and Torque ➤ Touch and Tactile sensors ➤ Proximity and Range Sensors ➤ Hydraulic and Pneumatic Actuation systems ➤ Robot Applications 	8
UNIT-IV	<p>Robot Motion Analysis (Kinematics)</p> <ul style="list-style-type: none"> ➤ Representation of Rigid body motion ➤ Transformation of Coordinates ➤ Homogenous Transformation ➤ Forward Kinematics ➤ Inverse Kinematics 	8
UNIT-V	<p>Dynamics, Mechanism & Actuation</p> <p>5.1. Dynamic Models of Rigid-Body Systems</p> <ul style="list-style-type: none"> ➤ Euler Lagrange Equations ➤ Newton Euler formulation <p>5.2 Mechanical Structure (Links, Joints, Actuators, transmissions), Joint Mechanisms.</p>	8

TEXT BOOKS

1. J. J. Craig, Introduction to robotics ,3rd edition, Pearson Education,2005
2. Herman Bruyninckx, Robot Kinematics and Dynamics, August 21, 2010

REFERENCE BOOKS

1. B. Siciliano, L. Sciavicco, et al, Robotics modeling planning and control, Springer, 2009

Department of Psychology			
Year/Semester	Ist Year/IInd Semester	Course Category	Multidisciplinary Course
Course Code	23MDC303	Course Title	Psychology and Emotional Intelligence
Continuous Evaluation: 40		End Semester Examination : 60	
Prerequisite: NIL		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES

1. To provide an overview of the basic concepts in psychology
2. To introduce the students with different fields of psychology
3. To enhance their knowledge about environmental and social factors and their impact on our life.
4. To help in better communication and enhance adjustment in life and work.
5. To create awareness about the applications of psychology in various fields of life.

COURSE LEARNING OUTCOMES

1. Describe the basic concepts in psychology
2. Get equipped with various psychological techniques used to assess human behavior at various developmental stages
3. Develop an overview of psychology that would lead to better communication and enhance adjustment in work and personal life
4. Learn the skills for applying knowledge to real life situations so as to improve interpersonal interactions and adjustment in life

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1				
CO 2				
CO 3				
CO 4				
CO 5				

COURSE CONTENTS

Unit-I:

Nature and fields of psychology; Learning, memory and problem solving; Motivation, types of motives

Unit-II:

Psychology and Life , Human-environment relationship; Environmental effects on human behaviour: Noise, pollution, crowding, natural disasters; Promoting pro-environmental behaviour; Psychology and social concerns: Aggression, Violence and Peace, Discrimination and Poverty, health, impact of television on behaviour.

Unit III:

Developing Psychological Skills effective psychological and interpersonal skills for facilitating personal social development. Effective psychological skills: Observational skills, Interviewing skills, Counselling skills — empathy, authenticity, positive regard, and Communication skills — listening.

Unit-IV:

Applications of Psychology in Daily Life: Events, Education, Health, Workplace.

TEXT BOOKS

- 1) Ciccarelli, S. K & Meyer, G.E (2008). Psychology (South Asian Edition). New Delhi: Pearson
- 2) Michael, W., Passer, Smith, R.E.(2007). Psychology The science of mind and Behavior. New Delhi: Tata McGraw-Hill.

REFERENCE BOOKS

- 1) Chadha, N.K. & Seth, S. (2014). The Psychological Realm: An Introduction. Pinnacle Learning, New Delhi.
- 2) Glassman, W.E. (2000). Approaches to Psychology (3rd Ed.) Buckingham: Open University Press.
- 3) Feldman. S.R. (2009).Essentials of understanding psychology (7thEdition), New Delhi: Tata McGraw Hill.

Department of Economics			
Year/Semester	Ist Year / IInd Semester	Course Category	Multidisciplinary Course
Course Code	23MDC304	Course Title	Indian Economy
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES

1. To introduce about different demography terms and trends.
2. To make students familiar with growth and its distribution.
3. To discuss the major changes in agriculture sector over-time.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. review major demographic indicators
2. comprehend the concept of inequality
3. analyse agriculture sector

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)		
	CLO 1	CLO 2	CLO 3
CO 1			
CO 2			
CO 3			

COURE CONTENTS

Unit-I Population and Human Development

Demographic trends and issues; education; health and malnutrition. Demographic features of India's population.

Unit-II Growth and Distribution

Trends and policies in poverty; inequality and unemployment.

Unit-III Agriculture

Importance of Agriculture; Causes of backwardness and low productivity; Land Reforms: Need, Implementation and Critical Evaluation

TEXT BOOKS

1. Jean Dreze and Amartya Sen, 2013. *An Uncertain Glory: India and its Contradictions*, Princeton University Press.
2. Pulapre Balakrishnan, 2007, *The Recovery of India: Economic Growth in the Nehru Era*, *Economic and Political Weekly*, November.
3. Rakesh Mohan, 2008,—Growth Record of Indian Economy: 1950-2008. A Story of Sustained Savings and Investment, *Economic and Political Weekly*, May.
4. S.L. Shetty, 2007,—India's Savings Performances since the Advent of Planning, in

K.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India's Development*.

5. Himanshu, 2010,—Towards New Poverty Lines for India, *Economic and Political Weekly*, January.

Department of ECE			
Year/Semester	IInd Year / IIIrd Semester	Course Category	Multidisciplinary Course
Course Code	23MDC205	Course Title	Arduino Based Programming
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

Course Objectives (CO) - The Course is designed with the following objectives:

1. Provide students with a comprehensive understanding of the Arduino platform, its components, and its applications in various fields.
2. Introduce students to programming using the Arduino IDE, covering topics like variables, data types, control structures, functions, and basic debugging.
3. Teach students how to interface various sensors with Arduino, enabling them to gather real-world data.
4. Enable students to control output devices such as LEDs, motors, and servos using Arduino, expanding their ability to create interactive projects.
5. Guide students through the process of conceptualizing, designing, and implementing Arduino-based projects, fostering creativity and problem-solving skills.

Course Learning Outcomes (CLO):

The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to

1. Demonstrate a clear understanding of Arduino's architecture, components, and capabilities.
2. Write, upload, and debug Arduino sketches using the Arduino IDE.
3. Integrate various sensors and retrieve data from the physical world.
4. Control actuators to produce desired physical effects or actions.
5. Design and complete Arduino-based projects from ideation to implementation.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

	CO1	CO2	CO3	CO4	CO5
CLO1	●				
CLO2		●			
CLO3			●		
CLO4				●	
CLO5					●

COURSE CONTENTS:

Unit -1: Introduction

Brief introduction on embedded system, what is Arduino, types of Arduino and their strengths, installation of Arduino IDE and its interface with hardware, Arduino circuit, First program on LED Blinking: debug the code, restart the program in different ways, basic simulation.

UNIT-3: Programming Basics for Arduino

Introduction to IDE, Variables, Data Types, Functions, Scope, Conditions, Loops, Arrays, Various programming languages, selection of programming language, need of Flow Diagram.

UNIT-3: Sensors

Basic working techniques of following sensors: Infra-Red sensor, Ultrasonic sensor, Color sensor, Light sensor, Sound sensor, DTMF module, DHT module, Selection of sensor, how to interface with sensors, how to design analog/digital sensors, applications of sensors.

Unit -4: Interfacing to Actuators

What are Actuators, DC Motor, DC geared Motor, Stepper Motor, Servo Motor, Driving system, types of driving system, H-Bridge Motor Driver, Advanced Motor Driver, Push Button, Potentiometer, RGB.

Unit -5: Project

LED Blinking, Running LEDs, Sand Glass filling of LEDs, Seven segment display, DC motor driving, Blue-tooth based remote control car, Line follower, obstacle avoider/path finder etc.

RECOMMENDED TEXT BOOKS:

1. Exploring Arduino: Tools and techniques for engineering wizardry by Jeremy Blum, 2nd edition, Wiley.
2. Make: Getting Started with Arduino, 3e: The Open Source Electronics Prototyping Platform, by Massimo Banzi and Michael Shiloh, 3rd edition.

REFERENCE BOOKS:

1. Arduino for Dummies by John Nussey, 2nd edition.
2. Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects, Brian Jepson, Michael Margolis and Nicholas Robert Weldin, 3rd edition, O'Reilly publisher.

Department of Political Science			
Year/Semester	IIInd Year / IIIrd Semester	Course Category	Multidisciplinary Course
Course Code	23MDC305	Course Title	Electoral Literacy in India
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

Course Objectives (CO) - The Course is designed with the following objectives:

1. To know the meaning and nature of the electoral democracy in India
2. To discuss electoral institutions in India
3. To understand the procedural aspect of elections in India
4. To grasp the significance of elections and electoral aspects of democracy, the electoral model code of conduct, issues, and challenges in India's democracy.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. The student shall be able to understand the meaning, definition, and significance of elections in India.
2. The course will help the students to analyse and understand electoral institutions, and their role and functions in the conduct of free and fair elections.
3. The student shall be able to know the party system of India.
4. The course will help the student understand issues and challenges in conducting free and fair elections in India.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Learning Objectives (Cos)	Course Learning Outcome (CLOs)				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1					
CO2					
CO3					
CO4					

COURSE CONTENTS:

UNIT-1: Elections in India

- Suffrage, Types, and Methods of Elections
- Parliamentary elections: Lok Sabha & Rajya Sabha
- Presidential Elections
- State Legislative Assembly Elections
- Local Body Elections

UNIT-2: Electoral Institutions

- Election Commission (EC)
- State Election Commission
- Constitution: Part-15

UNIT-3: Political Parties in India

- One-party, Two Party, Multi-party system
- Model Code of Conduct, Party Funding, and Campaign

UNIT-4: Elections: Issues and Challenges

RECOMMENDED TEXTBOOKS:

1. Subhash C. Kashyap, Our Political System, 2nd, National Book Trust, India, 2008, ISBN: 8123752520
2. D. D. Basu, Introduction to The Constitution Of India, 26th Edition, Lexis Nexis, ISBN: 978-9388548861
3. Bidyut Chakrabarty, Rajendra Kumar Pandey, Indian Government and Politics, Sage Text, ISBN: 8132100581

REFERENCE BOOKS:

1. Sanjay Kumar, Elections in India: An Overview, 1st, Routledge, ISBN: 9781032033136
2. <https://eci.gov.in/>
3. <https://www.lokniti.org/>
4. Websites of State Election Commission
5. NCERT, Chapter-3 Indian Constitution at Work

**List of Ability Enhancement Courses (AEC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

S. No.	Code	Course Name	L	T	P	Credits
1	23AEC101	Functional English – I	2	0	0	2
2	23AEC201	Functional English – II	2	0	0	2
3	23HIN101 I / 23FLGR201 I / 23FLFR201 I	Hindi – I / German – I / French – I	2	0	0	2
4	23HIN101II / 23FLGR201 II / 23FLFR201 II	Hindi – II / German – II / French – II	2	0	0	2

Department of English			
Year/Semester	Ist Year / Ist Semester	Course Category	Ability Enhancement Courses
Course Code	23AEC101	Course Title	Functional English-I
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

Course Objectives (CO) - The Course is designed with the following objectives:

1. To enhance and strength communication skills in English Language
2. To facilitate holistic and integrated development of LSRW skills - Listening, Speaking, Reading Writing abilities
3. To understand a wide range of lexical and prosodic features of the language.
4. To grasp the significance of critical reading-writing capacities and professional communication skills in the students.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Demonstrate comprehensive and fluent communication in standard English – written & spoken
2. Apply the skills to engage in group discussions, debate, deliver speeches and such others.
3. Analyse texts on various parameters expected/demanded during different situations and circumstances
4. Integrate the knowledge and skills to prepare basic/preliminary research documents, official documents and deliver presentations on a given topic

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Educational Objectives (CEOs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO4
CEO 1	√			
CEO 2		√		√
CEO 3			√	√
CEO 4	√	√	√	√

COURSE CONTENTS:

Unit – I : Speaking Skills

English Communication - Aims & Objectives - Basics of Communication - Barriers to Communication - Non-Verbal Communication - Active Listening - Effective Speaking – Speech - Art of Public Speaking – Pronunciation - Stress & Intonation in English – Debate – Conversations-Presentation Skills- Group Discussions – Interviews - Formal Presentations.

Unit-II : Listening Skills-

Types of Listening-Top Down and Bottom-Up Approach- Signposting in Listening-Global listening Vs Local Listening - Interpreting information over spoken language-Understanding tone and intention in spoken language-Listening to understand information and responding to questions asked

Unit – III: Effective Reading

Reading strategies (Skimming, Scanning, Inferring) –Predicting and responding to content – Speed Reading – Note Making – Use of Extensive reading texts – Vocabulary Extension - Guessing from Context –

Unit – IV: Writing Skills

Formal Letters, Memos & Email – Discourse Markers- - Art of Condensation - Report Writing - Article Writing - Writing Proposals – Preparing Minutes of Meeting.

TEXT BOOK

1. Swan, Michael. *Practical English Usage*. New Delhi: Oxford University Press, 2005.
2. Murphy, Herta A. *Effective Business Communication*, New Delhi: McGraw Hill, 2008.

REFERENCE BOOK AND OTHER MATERIALS

1. Koneru, Aruna. *Professional Speaking Skills*. New Delhi: Oxford University Press, 2015.
2. Sanjay Kumar and Pushp Lata. *Technical Communication*, New Delhi: Oxford University Press, 2008.
3. Koneru, Anuna. *Professional Communication*, New Delhi: McGraw Hill Pvt. Ltd, 200.
4. Rizvi, M. Ashraf. *Effective Technical Communication*, New Delhi: McGraw Hill, 2018.
5. Barun K. Mitra, *Personality Development and Soft Skills*, Oxford University Press, New Delhi, 2011.

Department of English			
Year/Semester	Ist Year / IInd Semester	Course Category	Ability Enhancement Courses
Course Code	23AEC201	Course Title	Functional English - II
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

Course Objectives (CO):

The Course is designed with the following objectives:

1. To know the use of descriptive, narrative, and expository modes of writing.
2. To discuss how to recognize and correct basic grammatical errors, specifically errors of subject/verb agreement, verb tense, pronoun agreement, usage of prepositions and articles.
3. To grasp the significance of academic and idiomatic vocabulary.
4. To understand, read, analyze, and respond to assigned readings with an understanding of structure and mechanics.

Course Learning Outcomes (CLO): – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Illustrate the stylistic conventions of academic writing.
2. Analyse readings critically by evaluating the various contexts (social, historical, or personal) surrounding and underpinning each text.
3. Evaluate various texts while identifying and highlighting their main ideas and messages
4. Develop independent perspectives and arguments via persuasive support and successful incorporation of research thus developing their own voice and creating a balance between their own voice and source summaries.
5. Assess counter arguments in order to present a more compelling argument

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Objectives (COs)	Course Learning Outcomes (CLOs)				
	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 1	✓				
CO 2			✓	✓	
CO 3		✓			
CO 4				✓	✓

CONTENTS

Unit 1: Reading strategies

Understanding the basic elements of academic writing: summary, analysis, close reading, claim, evidence and argument, Types of academic writing (descriptive, analytical, persuasive, and critical), Skimming, Scanning and Note Making for Academic Writing

Unit 2: Paragraph Writing

Structure of the paragraph, Use of coherence and cohesion-topic sentence for paragraph
Abstract Writing, Fine tuning title and finalizing keywords, The art of summarizing

Unit 3: Writing Research Proposal

Selecting Research topic, Framing research problem and literature review
Writing Research Proposal – Writing Research questions and Hypothesis
Review of Research paper -Writing Research Proposal – Methodology and conclusion
Critical Review, Conclusions, and Implications -Paraphrasing and Explaining -Finalizing and reviewing Research proposal -Controlling language

Unit 4: Referencing, Citation and Proof Reading

Bringing it all together

TEXT BOOKS

1. Nzanmongi Jasmine Patton et al. *A Handbook For Academic Writing and Composition*. New Delhi: Pinnacle Learning, 2014.
2. Christine Raisanen and Lennart A. Bjork. *Academic Writing: A University Writing Course*. Lund: Studentlitteratur, 2003.
3. Janet Giltrow, Richard Gooding, & Daniel Burgoyne et al. *Academic Writing: An Introduction*. Peterborough, Ontario: Broadview Press, 2005.

REFERENCE BOOKS AND OTHER RESOURCES

1. Liz Hamp-Lyons and Ben Heasley. *Study Writing: A Course in Writing Skills for Academic Purposes*. Cambridge: CUP, 2006.
2. Renu Gupta. *A Course in Academic Writing*. New Delhi: Orient Black Swan, 2010.
3. Ilona Leki. *Academic Writing: Exploring Processes and Strategies* (2nd Ed.). New York: CUP, 1998.
4. Gerald Graff and Cathy Birkenstein. *They Say/I Say: The Moves That Matter in Academic Writing*. New York: Norton, 2009.
5. John Eastwood. *Oxford Practice Grammar*. Oxford: OUP, 2005.
6. Michael Wallace. *Study Skills*. Cambridge: CUP, 2004.

Year/Semester	Ist Year / IIIrd Semester	Course Category	Ability Enhancement Courses
Course Code	23FLGR201 I	Course Title	German - I
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

COURSE OBJECTIVE (CO)

- To develop oral and written skills of understanding, expressing and exchanging Information/ interacting.
- To develops the ability to construct sentences and frame questions.
- To provide German language as a competitive edge in career choices.
- To know the culture of the countries where the German language is spoken.
- This may be useful in the field of employment opportunities as well as helping them to develop projects on browsing German websites

COURSE LEARNING OUTCOMES (CLO)

- After completion of this student will be able to read and write short, simple texts.
- After completion of this student will have Fluency in reading and writing.
- After completion of this student will be able understand a dialogue between two native speakers and to take part in short, simple conversations using the skills acquired.
- Student will able to know the culture of the countries where the German language is spoken.
- Developing pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own CV and developing a fundamental conversation with any German national.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

	CO1	CO2	CO3	CO4	CO5
CLO1	●				
CLO2		●			
CLO3			●		
CLO4				●	
CLO5					●

COURSE CONTENTS

UNIT-I : INTRODUCTION

Grüße, Wortschatz

UNIT-II : THEMEN

Das Alphabet, die Aussprache, die Zahlen, Land und Stadt beschreibung, Berufe, rede über Dinge, die Zeit, Mahlzeiten und Getränke

UNIT-III : GRAMMATIK

Plural, Artikel, Possessive Artikel, Adjektive, Sich vorstellen, Verben (regulär, unregelmäßig, Pronomen), Nominativ Pronomen, Präpositionen,

UNIT-IV : WORTSCHATZ

emanden vorstellen, Nationalitäten, Länder, Zahlen, Über die Wochentage sprechen, Die Monate des Jahres, Die Berufe, Die Farben, Die Gegensätze, Die Sätze mit der Zeit

UNIT-V : MÜNDLICHER AUSDRUCK

Mündliche und Höraktivitäten

TEXT BOOK

1. Tangram aktuell 1 (Lektion 1-4 Kursbuch + Arbeitsbuch, Lektion 5-8 Kursbuch + Arbeitsbuch, Übungsheft)

REFERENCE BOOKS

2. Wolfgang Hieber: Lernziel Deutsch, Teil 1. Max Hueber Verlag
3. Korbinian Braun, u.a.: Deutsch als Fremdsprache IA, Grundkurs. Ernst Klett Stuttgart
4. Rolf Brüseke: Starten Wir! A1. München: Hueber Verlag

Year/Semester	Ist Year / IVth Semester	Course Category	Ability Enhancement Courses
Course Code	23FLGR201 II	Course Title	German - II
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

COURSE OBJECTIVE (CO)

- Students will demonstrate their ability to recognize, identify, extract and/or differentiate key information conveyed in spoken announcements, instructions, and in interactions between native speakers on familiar topics.
- Students will demonstrate effective speaking and listening skills in German on informal and some formal topics related to personal, professional, academic, and leisure activities
- To develop awareness of the nature of language and language learning

COURSE LEARNING OUTCOMES (CLO)

- After completion of this student will be able to read and write short, simple texts.
- After completion of this student will have Fluency in reading and writing.
- After completion of this student will able to use language creatively and spontaneously.
- Students will get awareness of cross-cultural and intercultural difference.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOME COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓		
CO 03			✓	
CO 04				✓

COURSE CONTENTS

UNIT-I : THEMEN

Einkaufen, Tagesablauf, Lebenslauf , Nach dem Weg fragen, Wegbeschreibungen, Der Körper, Ereignisse der Vergangenheit erzählen

UNIT-II : GRAMMATIK

Trennbare und untrennbare Verben, Dativ , Modalverben, Präteritum von sein, haben, Perfekt

UNIT-III : WORTSCHATZ

Kleidung, Haushaltswaren, Sachen zum Essen und Trinken, Verkehrsmittel, Namen von Orten und Sehenswürdigkeiten, Information über Deutschland, Ordinalzahlen

UNIT-IV : KOMPOSITION

Themen zum schreiben wie Deutschland und Delhi, was haben Sie am wochenende gemacht, Traummann/Traumfrau

UNIT-V: Mündlicher Ausdruck

Sprechen über die Stadt, Das Haus, Meine Familie

TEXT BOOK

1. Tangram aktuell 1 (Lektion 1-4 Kursbuch + Arbeitsbuch, Lektion 5-8 Kursbuch + Arbeitsbuch, Übungsheft)

REFERENCE BOOKS

2. Wolfgang Hieber: Lernziel Deutsch, Teil 1. Max Hueber Verlag
3. Korbinian Braun, u.a.: Deutsch als Fremdsprache IA, Grundkurs. Ernst Klett Stuttgart
4. Rolf Brüseke: Starten Wir! A1. München: Hueber Verlag

Website pages:

1. <https://www.nthuleen.com/teach.html>

Year/Semester	Ist Year / IIIrd Semester	Course Category	Ability Enhancement Courses
Course Code	23FLFR201 I	Course Title	French - I
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

COURSE OBJECTIVE (CO)

1. To develop listening, speaking, reading and writing requisites of a language.
2. To develop the ability to construct sentences and frame questions.
3. To equip the students with cultural elements and communication strategies which will help them communicate in varied situations.
4. To familiarize the students with the French and Francophone culture.

COURSE LEARNING OUTCOMES (CLO)

1. After completion of this course, the student will be able to express and interact in French used in daily conversations.
2. The student will be able to write short and simple texts.
3. The student will be able to initiate and respond to various situations using French language skills.
4. The student can understand and respond effectively to the cultural elements of the French and Francophone culture.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

Course Contents

S. No	Unités	Objectifs de Communication	Grammaire	Lexique
1	La Salutation et l'Introduction	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/ Présenter Quelqu'un.	Les Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.

2	On Partage des Renseignements	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Les Adjectifs de Nationalités. L'Interrogation.	Les Adjectifs de Nationalité, Métiers et Secteurs Professionnels, L'Expression des Goûts et Intérêts
3	Ma Ville et Mon Quartier	Décrire et Qualifier une Ville ou un Quartier. Localiser. Demander et Donner la Directions.	Le Verbe Vivre. Les Articles Définis. Il ya/ Il n'y a pas. Les Prépositions. Les Adjectifs Qualificatifs. L'Impératif.	Les Prépositions de Localisation. Le Lexique des Sites. Etablissements et Service d'une Ville.
4	Mes Intérêts et Goûts	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Le Présent des Verbes en -ER, et du Verbe Faire. La Négation, Les Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.

TEXT BOOK

- Version Originale 1, Livre de l'élève: Denyer M. & Agustin Garmendia A. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

- Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. & Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
- Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
- Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, CLE International, Paris, 2013.
- Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan, 201

Year/Semester	Ist Year / IVth Semester	Course Category	Ability Enhancement Courses
Course Code	23FLFR201 II	Course Title	French - II
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

COURSE OBJECTIVE (CO)

1. To develop **listening, speaking, reading and writing** requisites of a language.
2. To develop the ability **to construct sentences and frame questions**.
3. To equip the students with **cultural elements and communication strategies** which will help them **communicate in varied situations**.
4. To familiarize the students with the **French and Francophone culture**.

COURSE LEARNING OUTCOMES (CLO)

After completion of this course, the student will be able

1. **To express and interact in French** used in daily conversations.
2. The student will be able **to write short and simple texts**.
3. The student will be able to **initiate and respond to various situations** using French language skills.
4. The student can **understand and respond** effectively to the cultural elements of the French and Francophone culture.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

Course Contents

1	Journée typique	Parler de Nos Habitudes, Exprimer l'Heure, S'Informer sur l'Heure, le Moment et la Fréquence.	Les Verbes Pronominaux au Présent. Les Verbes Aller et Sortir	L'Heure, Les Moments de la Journée. Les Activités Quotidiennes. Les Adverbes. La Météo.
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2	Achats	S'informer sur un Produit. Acheter et Vendre un Produit. Donner Son Avis. Parler du Temps qu'il Fait	Les Adjectifs Interrogatifs. Les Adjectifs Démonstratifs. Le Genre et le Nombre. Le Verbe Prendre.	Les Vêtements. Les Couleurs. Les Fruits et Les Légumes.
3	Alimentation	Parler des Plats et des Aliments. Commander un Menu dans un Restaurant. Situer une Action dans le Futur	Le Future Proche: Aller +Infinitif. Les Partitifs. Les Pronoms COD. Le Future.	Les Aliments. Le Lexique des Quantités.
4	Expérience Vécue	Parler de Faits Passés. Parler de nos Expériences. Parler de Ce que Nous Savons Faire.	Le Passé Composé. L'Imparfait.	Les Verbes Savoir, Pouvoir et Connaître. Les Adjectifs Qualificatifs. Le Lexique des Savoirs et Compétences. Le Récit de Vie.

TEXT BOOK

- Version Originale 1, Livre de l'élève: Denyer M. & Agustin Garmendia A. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

- Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. & Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
- Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
- Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, CLE International, Paris, 2013.
- Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan,

**List of Value Added Courses (VAC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

S. No.	Code	Course Name	L	T	P	Credits
1	23VAC102	Indian Constitution and Polity	2	0	0	2
2	23VAC101	Environment Protection and Sustainable Development	2	0	0	2
3	23VAC103	Sports, Yoga and Fitness	0	0	4	2

DEPARTMENT OF LAW			
Programme: Undergraduate program			
Year/Semester	Ist Year / Ist Semester	Course Category	Value Added Course (VAC)
Course Code	23VAC102	Course Title	Indian Constitution and Polity
Continuous Evaluation: 30		End Semester Examination: 70	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

Course Objectives (CO) - The Course is designed with the following objectives:

1. To acquaint the students with the fundamental concepts of democracy, diversity and the Constitution.
2. To make students understand the functioning of the three wings of the State
3. To make the students appreciate the purpose of decentralised administration under the Constitution and its functioning
4. To make students analyse and discuss various rights and duties under the Constitution of India

Course Learning Outcomes (CLO) – At the end of this course, the learners are expected to:

1. Explain the concept of democracy, diversity and the Constitutional Values
2. Describe the functioning of the three wings of the State
3. Sketch the functioning of decentralised administration under the Constitution of India and appreciate the political dimensions.
4. Examine the scope of various rights and duties under the Constitution of India.

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES (COs)	COURSE LEARNING OUTCOMES (CLOs)			
	CLO1	CLO2	CLO3	CLO4
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENT

UNIT 1

DEMOCRACY, DIVERSITY AND THE CONSTITUTION

- Concept of democracy and importance of right to vote
- Electoral Politics
- Concepts of diversity and discrimination on the grounds of gender, religion and caste
- Concept of democratic government
- Constitution design and salient features
- Preamble to the Constitution of India

UNIT 2

THE THREE WINGS OF THE STATE

- The definition of State in Constitution of India
- Parliament, the State legislature and the making of laws
- Concept of cooperative federalism
- The Executive and Administration
- Role of Governor and the President of India
- The Judiciary

UNIT 3

LOCAL GOVERNMENT AND ADMINISTRATION

- Panchayati Raj System
- Rural and Urban administration
- Social and Economic Justice for the marginalised
- Directive Principles of State Policy

UNIT 4

RIGHTS AND DUTIES

- Fundamental Rights (Part III of the Constitution)
- Protection of Fundamental Rights – Writ petitions in High Court and Supreme Court of India
- Fundamental Duties
- The concept of Fraternity and secularism
- Public utilities and privatization

RECOMMENDED TEXT BOOKS:

1. J.N. Pandey, *Constitutional Law of India*, 59th Ed. (2022) Central Law Agency
2. *The Constitution of India*, Eastern Book Company (2022) – Bare Act with complete legislative history

REFERENCE BOOKS:

1. M.P. Jain, *Indian Constitutional Law* (8th Ed.) 2018 Lexis Nexis
2. M.P. Singh, *V.N. Shukla's Constitution of India*, 14th Ed (2022), reprint 2023
3. H.M. Seervai, *Constitutional Law of India* (4th Ed., 2008), latest reprint 2023 Law & Justice Publishing

Department of Environmental Sciences			
Programme: Undergraduate program			
Year/Semester	Ist Year / IInd Semester	Course Category	Value Added Course (VAC)
Course Code	23VAC101	Course Title	Environmental Protection and Sustainable development
Continuous Evaluation: 30		End Semester Examination: 70	
Prerequisite: Nil		L T P : 2 0 0	Credits: 2

Course Objectives (CO) - The Course is designed with the following objectives:

1. To provide a comprehensive understanding of the relationship between humans and the environment.
2. Aims to introduce students to the different components of the environment.
3. To develop the understanding of pollution, its causes, and their effects
4. To gain the knowledge of climate change and the contemporary issues

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020 and based on the UGC curriculum framework. Upon completion of this course, learners will be able to:

1. Demonstrate to safeguard the Earth’s environment and its resources.
2. Explain sustainable development, its goals, challenges, and global strategies.
3. Analyse the environmental pollution and sensitize themselves to adverse health impacts of pollution.
4. Appraise the concept of climate change, its science and response measures.

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES (COs)	COURSE LEARNING OUTCOMES (CLOs)			
	CLO1	CLO2	CLO3	CLO4
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENTS

Unit-1 Human and Environment

Introduction to earth environment, Scope and importance. Components of environment: Lithosphere, Hydrosphere, Biosphere, Atmosphere. The man- environment interaction, Population growth and natural resource exploitation, Industrial revolution, and impact on the environment, Global environmental challenges at global, regional and local level.

Unit-2 Natural Resources, Sustainable Development & Sustainable living

Overview of natural resources: Definition of resource; Classification of natural resources-, renewable, and non-renewable. Resources: Forests, wetlands, Status and challenges. Water resources: Types of water resources, issues and challenges; Soil and mineral resources: Important minerals; Environmental problems due to extraction of minerals, Soil as a resource and its degradation. Energy resources: renewable and non-renewable sources of energy. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges, and strategies for SDGs. Ways to live in sustainable manner- Conservation of energy, water at home, plantation, waste segregation, kitchen gardening.

Unit-3 Conservation of Biodiversity and Ecosystems

Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Major ecosystem types in India and their basic characteristics, forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems. Major conservation policies: in-situ and ex-situ conservation approaches; Major protected areas; National and International instruments for biodiversity conservation: The role of traditional knowledge, community-based conservation. Major International Environmental Agreements: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety, Ramsar Convention on Wetlands of International Importance, The Wildlife (Protection) Act, 1972, The Biological Diversity Act, 2002.

Unit-4 Environmental Pollution and Health

Understanding of pollutant and pollution; Types of Pollution, Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants, Indoor air pollution; Adverse health impacts of air pollutants, National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Unit-5 Climate Change: Impacts, Adaptation and Mitigation

Understanding climate change: Natural variations in climate, Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events, Climate change projections for the Indian sub-continent. Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health. the concept of vulnerability, adaptation and resilience, Synergies between adaptation and mitigation measures, Concept of carbon neutrality, net zero targets, Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs).

Unit – 6 Case Studies and Field Work

The students are expected to be engaged in one of the following or similar identified activities.

Field visits to identify local issues, make observations including data collection and prepare a brief report, or Documentation of campus biodiversity or Campus environmental management activities such as solid waste disposal, water management, and sewage treatment.

TEXT BOOKS:

1. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science Englewood Cliffs, NJ: Prentice Hall.
2. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
3. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
4. Environmental Studies for Undergraduate Courses by Erach Bharucha, UGC New Delhi

REFERENCE BOOKS:

1. A.K De Environmental Chemistry New age Publisher, 2016.
2. "Ecology & Environment" P D Sharma, Rastogi Publications, 2009.
3. www.ipcc.org; <https://www.ipcc.ch/report/sixth-assessment-report-cycle/>.
4. Central Pollution Control Board Web page for various pollution standards. <https://cpcb.nic.in/standards/>

Department of Physical Education & Sports			
Programme: Undergraduate program			
Year/Semester	IIInd Year / IIIrd Semester	Course Category	Value Added Course (VAC)
Course Code	23VAC103	Course Title	Sports, Yoga and Fitness
Continuous Evaluation: 80		End Semester Examination: 20	
Prerequisite: Nil		L T P : 0 0.4	Credits: 2

Course Objectives (CO) - The Course is designed with the following objectives:

1. To know about the physical body
2. To discuss about improve range of motion, mobility and coordination in body
3. To understand the ways to improve strength, balance and flexibility.
4. To grasp the significance of yoga and sports in fitness
5. To construct environment for individual and community health.

Course Learning Outcomes (CLO)–The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to :(**BLOOM'S TEXONOMY**)

1. Explain the role of yoga and fitness in life.
2. Apply the rules of healthy and fit life
3. Analyse the ways and methods of yoga and sports
4. Recommend the practices of Asanas and different sports
5. Integrate the concept of yoga and sports in all round development of students and beings.

Mapping Matrix between Course Objectives and Course Learning Outcomes: COURSE CONTENTS:

COURSE OBJECTIVES (COs)	COURSE LEARNING OUTCOMES (CLOs)				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√		
CO4				√	
CO5					√

UNIT-I: Health and Wellness

- Meaning Definition and Importance of Health and Wellness • Dimensions of Health and Wellness
- Role of Exercise in maintaining Health and Wellness
- Stress and Its management through Exercise
- Nutrition for Health and Wellness
- Practical-Exercise for Health and Wellness
 - Warming –Up

- Stretching Exercises
- Strengthening Exercises
- Cardiovascular Exercises
- Flexibility and Agility Exercises → Limbering Down
- Relaxation Techniques (IRT, QRT, DRT etc.)

UNIT-II Yoga and Fitness

- Importance of Yoga and Fitness
- Types and Principles of Asanas
- Fitness Components
- Specific Exercises for Strength, Flexibility, Speed, Agility & Coordinative Abilities
- Yoga, Fitness and Personality
- General Specific Warm up • Aerobics / Zumba Dance
- Asanas
- Recreation for Fitness
- Report preparation, Records and PPT

UNIT-III Sports and Psychology

- Definition of Sports Psychology
- Adolescence-Problems related with Adolescence i.e. physical problems, Peer group Relationship, Career Selection, Drug Abuse, Psychological and Emotion problems
- Importance of Sports Psychology

UNIT-IV Sports and Recreation

- Meaning Definition and Concept of Sports Fitness and Recreation
- Objectives, Characteristics and principles of Sports Fitness and Recreation
- Importance, Purpose, Benefits of Fitness and Recreation
- Types of Recreation
- Recreation through Sports and Games
- Use of Leisure Time Activities and their educational values
- Traditional, Folk and Indigenous Games
- Three Days outdoor camp and Hiking
- Cycling, tie up with District/State Associations
- Visits to Recreational Clubs

TEXT BOOKS:

1. Foundations of Physical Education, Chales A. Bucher
2. Foundations of Physical Eduction, M.L.Kamlesh
3. History and Principles in Physical Education, Dr. Karan Singh
4. Essentials of Physical Education, Dr. Ajmer Singh
5. Foundations of Physical Education, Dr. A.K.Uppal

REFERENCE BOOKS:

1. Physical Education, Manu Sood, New SP Books
2. Health the basis of life: Dr. John Maclay
3. Natural Health & Yoga, Brij Bhushan
4. Health Education, S.K.Mangal
5. Essential of Physical Education, Dr. Ajmer Singh & Dr. Bains

**List of Skill Enhancement Courses (SEC) offered to
Four Year B.Sc. Mathematics programme in the Department of
Mathematics w.e.f. Academic Year 2024-25**

Courses on Soft Skills

S. No.	Code	Course Name	L	T	P	Credits
1	23SS151	Effective Communication Skills	0	0	2	1
2	23SS252	Teamwork & Interpersonal Skills	0	0	2	1
3	23SS353	Presentation Skills	0	0	2	1
4	23SS454	Professional Skills	0	0	2	1
5	23SS555	Aptitude & Reasoning	0	0	2	1

Courses on Technical Skills

S. No.	Code	Course Name	L	T	P	Credits
1	23TS101	Digital Literacy & IT Skills	0	0	2	1
2	23SS202	Advanced Excel Skills	0	0	2	1
3	23SS303	Statistical Analysis with SPSS	0	0	2	1
4	23SS404	R language programming	0	0	2	1
5	23SS505	Programming with MATLAB	0	0	2	1

Department of Training & Placement			
Training Cell			
Programme	Faculty of Science & Humanities		
Year / Semester	1 / 1	Course Category	SEC (soft skills)
Course Code	23SS151	Course Title	Effective Communication Skills
Continuous Evaluation: 70		End Term Examination: 30	
Prerequisite: Nil		L T P: 0 0 2	Credits: 1

Training Objectives (TO): -

- TO1. To define and understand communication and its process.
- TO2. To make student practice on communication skills via LSRW approach via instructing, engaging, assessing and re engaging.
- TO3. To enhance the confidence and motivation of a student by honing his communication skills.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To communicate effectively and interact with people with confidence.
- TLO2. To demonstrate and differentiate between various forms of communication.
- TLO3. To apply effective communication skills confidently which a student need to get ahead in job and life.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) →			
TRAINING OBJECTIVES (TO) ↓	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

Learning Resources

Text Book	<i>Communication Skills</i> by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
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Unit	Course Contents	Student Engagement Activity
Unit-I	Verbal Communication Skills <ul style="list-style-type: none"> • Communication Process & its importance • 7 C's of Communication • Formal & Informal Conversation • Requirements of effective verbal communication 	Conversation Cards Activity
Unit-II	Nonverbal Communication Skills <ul style="list-style-type: none"> • Importance of nonverbal skills in effective communication • Types of nonverbal (body language) skills • Barriers to nonverbal communication 	Power of Body Language Activity
Unit-III	Listening Skills <ul style="list-style-type: none"> • Role of listening skills in effective communication • Barriers to listening • Overcoming listening barriers • Empathetic listening & avoiding selective listening 	Chinese Whisper Activity
Unit-IV	Reading & Writing Skills <ul style="list-style-type: none"> • Types of reading strategies to enhance improve reading skills • Types of written communication 	The What IF Activity
Unit- V	Visual Communication <ul style="list-style-type: none"> • Types of visual communication • Importance of visual communication • Picture narration/description technique 	Interpret The Picture Activity
Suggested Reference Book	<i>Personality Development & Communication Skills-I</i> by C B Gupta: Scholar Tech Press,2019.	

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

**Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation)
for Effective Communication Skills Course**

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Verbal Communication Skills	Speech Activity	15	Written Test	10
II	Non Verbal Communication Skills	Role Play	15		
III	Listening Skills	Oral Assessment / Written Assessment	10		
IV	Reading & Writing Skills		20	Viva	20
V	Visual Communication		10		

Department Of Training & Placement			
Training Cell			
Programme	Faculty of Science & Humanities		
Year / Semester	1 / 2	Course Category	SEC (soft skill)
Course Code	23SS252	Course Title	Teamwork & Interpersonal Skills
Continuous Evaluation: 70		End Term Examination: 30	
Prerequisite: Nil		L T P: 0 0 2	Credits: 1

Training Objectives (TO): -

- TO1. To make the students learn & demonstrate effective teamwork, leadership & interpersonal skills.
- TO2. To equip the students with capability of handling stress and utilization of work time effectively.
- TO3. To make the students understand the importance and application of Emotional Quotient, Critical Thinking & Problem Solving Skills.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To be confident working in a team and leading it as well.
- TLO2. To categorize the work and achieve expected performance within the time frame & will be able to adapt himself to work under various kinds of stress and re-energies himself to bounce back from such situations.
- TLO3. To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
- TLO4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem Solving Skills.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO)→ Training Objectives(TO)↓	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				

Unit	Course Contents	Student Engagement Activity
Unit - I	Team Management <ul style="list-style-type: none"> • Team communication & team conflict resolution • Role of a team leader • Team goal setting & understanding team development • Team dynamics & multicultural team activity • Johari Window Model 	Collaborative Working Game Activity
Unit-II	Time Management <ul style="list-style-type: none"> • Time management matrix • Pareto Principle (80/20 rule) • Development process of plan of action 	What You Did Yesterday Activity
Unit-III	Leadership <ul style="list-style-type: none"> • Difference between leadership & management • Types of leadership style • Core leadership skills 	Lead The Blindfolded Activity
Unit-IV	Stress Management <ul style="list-style-type: none"> • Sign of stress & its impact • Types of stress • Techniques of handling stress 	Keeping Cool Activity
Unit - V	Emotional Intelligence <ul style="list-style-type: none"> • Emotional intelligence & emotional competence • Components & behavioral skills of emotional intelligence 	Guess The Emotion Game Activity
Unit - VI	Critical Thinking <ul style="list-style-type: none"> • Types of thinking & Characteristics • Critical thinking standards • Barriers to critical thinking 	Think Pair Share Activity

Learning Resources	
Text Book	<i>Communication Skills</i> by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	<i>Personality Development & Communication Skills-1</i> by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

**Internal (Continuous Assessment & Evaluation) & End Term
(Assessment & Evaluation) for Teamwork & Interpersonal Skills**

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Team Management	Role Play / Group Activity	10	Written Test	10
II	Time Management		10		
III	Leadership		10		
IV	Stress Management	Assignment	10	Viva	20
V	Emotional Intelligence	Written Test	10		
VI	Critical Thinking		20		

Department Of Training & Placement			
Training Cell			
Programme	Faculty of Science & Humanities		
Year / Semester	2 / 3	Course Category	SEC (soft skill)
Course Code	23SS353	Course Title	Presentation Skills
Continuous Evaluation: 70		End Term Examination: 30	
Prerequisite: Nil		L T P: 0 0 2	Credits: 1

Training Objectives (TO):-

- TO1. To develop the public speaking skills in the student.
- TO2. To make the students learn and adapt to the necessary etiquettes required working and growing in corporate culture.
- TO3. To make the students learn to speak in a debate session by putting his arguments and making others accept his viewpoint convincingly.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To be confident in presenting himself in front of audience.
- TLO2. To become professional in his approach towards work culture.
- TLO3. To enhance the level communication skills while interacting with others.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
Training Learning Outcomes (TLO)→ Training Objectives(TO)↓	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

Unit	Course Contents	Student Engagement Activity
Unit-I	Importance of Presentation Skills <ul style="list-style-type: none"> • 4 P's of presentation skills – plan, prepare, practice & present • Guidelines for effective presentation 	PPT Presentation Activity
Unit-II	Storytelling Skills <ul style="list-style-type: none"> • 4 P's of storytelling skills – people, place, plot & purpose • Types of storytelling techniques • Importance of storytelling skills 	Start From Where I Stopped Activity
Unit-III	Corporate Culture Etiquettes <ul style="list-style-type: none"> • Importance of professional behavior at work place • Understand & implementation of etiquettes at work place • Importance of values & ethics • Types of professional / corporate etiquettes 	Etiquettes Role Play Activity
Unit-IV	Debate / Extempore <ul style="list-style-type: none"> • Difference between debate, extempore & group discussion • Learning argument /counter argument in debate 	Current Affair Topic Speech Activity
Unit-V	Art of Creating Impression <ul style="list-style-type: none"> • Importance of creating first impression • 6 ways to master the art of creating impression 	Speech Activity
Unit-VI	Problem Solving <ul style="list-style-type: none"> • Types of problems & its solutions Problem solving process & tools	Think Pair Share Activity

Learning Resources	
Text Book	<i>Communication Skills</i> by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	<i>Personality Development & Communication Skills-1</i> by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Presentation Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Importance of Presentation Skills	Presentation Activity	20	Written Test	10
II	Storytelling Skills	Speech Activity	15		
III	Corporate Culture Etiquettes	Assignment	10		
IV	Debate/Extempore	Speech Activity / Written Activity	15	Viva	20
V	Art of Creating Impression		10		
VI	Problem Solving				

Department Of Training & Placement			
Training Cell			
Programme	Faculty of Science & Humanities		
Year / Semester	2 / 4	Course Category	SEC (soft skill)
Course Code	23SS454	Course Title	Professional Skills
Continuous Evaluation: 70		End Term Examination: 30	
Prerequisite: Nil		L T P: 0 0 2	Credits: 1

Training Objectives (TO): -

- TO1. To encourage students to learn and apply the effective writing skills.
- TO2. To make the students learn various types of business correspondence letters, cover letters & resume.
- TO3. To encourage students to learn as to how to talk and convince people in GD & interview.
- TO4. To make the students learn to build rapport for building positive relationships professionally at workplace.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To understand the importance of professional writing required in workplace.
- TLO2. To explore different formats in resume, cover letters & other business related letters.
- TLO3. To develop knowledge, skills and understanding people in-group and individually.
- TLO4. To apply communication strategies either in-group or one on one basis and will be confident to lead the discussion among them.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) → Training Objectives(TO) ↓	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				
TO4				

Unit	Course Contents	Student Engagement Activity
Unit-I	Email Writing <ul style="list-style-type: none"> • Importance of email communication skills • Basic rules of effective email writing • Structure of email – address, subject, message text, attachments, signature 	Email Practice Activity
Unit-II	Resume Writing <ul style="list-style-type: none"> • Difference between Resume, CV & Bio data • Guidelines of resume writing • Resume preparation of the student 	Resume Making Activity
Unit-III	Letter Writing <ul style="list-style-type: none"> • Types of Letter Writing – Application, Leave, etc. • Cover letter 	Letter Writing Activity
Unit--IV	Group Discussion (GD) <ul style="list-style-type: none"> • Characteristics of GD & subject knowledge • Do's & Don'ts in GD • Strategies of GD • Types of GD 	Group Discussion Practice Activity
Unit-V	Interview Skills <ul style="list-style-type: none"> • Preparation of the interview & company details information • Do's & Don'ts in interview • Types of Interviews • Strategies of interview 	Mock Interview Practice Activity
Unit-VI	Negotiation Skills <ul style="list-style-type: none"> • Importance of negotiation skills • Four phases of negotiation skills • Barriers to negotiation & overcoming it • Win-win negotiation 	Win-Win Activity

Learning Resources	
Text Book	<i>Communication Skills</i> by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	<i>Personality Development & Communication Skills-1</i> by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

**Internal (Continuous Assessment & Evaluation) & End Term
(Assessment & Evaluation) for Professional Skills**

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Email Writing	Written Assignment	10	Written Test	10
II	Resume Writing		10		
III	Letter Writing		10		
IV	Group Discussion	Group Discussion Activity	15	Viva	20
V	Interview Skills	Mock Interview Activity	15		
VI	Negotiation Skills	Role Play	10		

Department Of Training & Placement			
Training Cell			
Programme	Faculty of Science & Humanities		
Year / Semester	3 / 5	Course Category	SEC (soft skill)
Course Code	23AR555	Course Title	Aptitude & Reasoning
Continuous Evaluation: 70		End Term Examination: 30	
Prerequisite: Nil		L T P: 0 0 2	Credits: 1

Training Objectives (TO): -

- TO1. To understand the basic concepts of quantitative ability and logical reasoning.
- TO2. To make student practice on the concepts of quantitative ability and logical reasoning.
- TO3. To prepare the students for aptitude and reasoning round in placement selection process & other competitive exams.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To understand the basic concepts of quantitative ability.
- TLO2. To solve campus placements aptitude papers covering Quantitative Ability.
- TLO3. To Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) →	TLO1	TLO2	TLO3
TRAINING OBJECTIVES (TO) ↓			
TO1			
TO2			
TO3			

A-Quantitative Ability

UNIT - I

- Number System
- Percentage
- Profit, Loss and Discount
- Simple Interest and Compound Interest

UNIT – II

- Allegation and Mixture
- Average
- Ratio, Proportion and Variation, Problem on Ages and Numbers
- Time and Work
- Time, Speed and Distance

UNIT – III

- Permutation and Combination
- Probability
- Data Interpretation
- Geometry and Menstruations
- Sequence, Series & Progression and Logarithmic

B- Logical Reasoning

UNIT - IV

- Number Series and Alphabet Series
- Direction Sense Test
- Coding -Decoding
- Blood Relation

UNIT – V

- Syllogism
- Dice, Cube and Cuboids
- Seating Arrangement

UNIT – VI

- Clock and Calendar
- Critical Reasoning
- Order and Ranking, Ven diagram, Analogy

Learning Resources	
Text Books	<i>Quantitative Aptitude for Competitive Examinations</i> by R S Aggarwal: S Chand Publishing, 2022.
	<i>A Modern Approach to Logical Reasoning</i> by R S Aggarwal: S Chand Publishing, 2022.

Pedagogy-

- The training will be based on the concept of learning by doing and practice.
- The training will involve 50% of the training time on teaching the concepts and the remaining 50% will be focusing on practice.
- The training will follow a circular approach where students are taught, evaluated and given the

feedback.

**Internal (Continuous Assessment & Evaluation) & End Term
(Assessment & Evaluation) for Aptitude & Reasoning**

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Quantitative Ability	Written Assignment	10	Written Test	30
II			10		
III			10		
IV	15				
V	15				
VI	10				
	Logical Reasoning				

DIGITAL LITERACY & IT SKILLS	
Course Code: 23TS101	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Examination: 40 Marks
L T P : 0 0 2	Course Type: Skill Enhancement course (Technical skills)
Prerequisite: NIL	

COURSE OBJECTIVE

1. To familiarize the students with basic knowledge of computer system along with its components.
2. To understand the working of internet with the discussion of different computer networks.
3. To get in-depth knowledge of the features of MS word and MS presentation in order to fulfill the basic requirement for Managers.
4. To get knowledge of basic and advance features of MS-Excel.
5. To provide broad introduction of data analytics with respect to business domain.
6. To focus on the theoretical understanding of Artificial intelligence and why it plays a major role in business analytics.

COURSE LEARNING OUTCOMES

1. Understand the basic fundamental components of computers including the working of internet.
2. Familiarize in working of MS-Word including creating and modifying the text documents and its conversion into different other formats like pdf. etc.
3. Students will be able to apply different formulas in the Excel sheets to solve complex business problems.
4. Ability to create a good interactive presentation using MS-PowerPoint.
5. Ability to enhance the data analytics practices executed in the business world.
6. Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
7. Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
8. Demonstrate the types of machine learning: Supervise learning, unsupervised learning, and deep learning.
9. Describe popular algorithms Classification, Regression, Clustering, and Dimensional Reduction.
10. Analyse the factors that influenced the advancements of AI in recent years.

MAPPING MATRIX OF COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

Course Objective s	Course Learning Outcomes									
	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6	CLO 7	CLO 8	CLO 9	CLO 10
CO1										
CO2										
CO3										

CO4										
CO5										
CO6										

COURSE CONTENT

UNIT 1

What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), Evolution of computer hardware, problem solving using computers, flow charting techniques and writing algorithms, Computer Memory, Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; World Wide Web; Web Browsing software's, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website

UNIT-2

MS Word: Features, Creating, Saving and Opening Documents in Word, Interface, Toolbars, Ruler, Menus, Keyboard 100 Shortcut, Editing, Previewing, Printing, & Formatting a Document, Advanced Features of MS Word, Find & Replace, Using Thesaurus, Using Auto- Multiple Functions, Mail Merge, Handling Graphics, Tables & Charts, Converting a word document into various formats like- Text, Rich Text format, Word perfect, HTML, PDF etc.

MS Power Point: Introduction to presentation – Opening new presentation, Different presentation templates, setting backgrounds, selecting presentation layouts. Creating a presentation - Setting Presentation style, Adding text to the Presentation. Formatting a Presentation - Adding style, Colour, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc into presentation, Drawing Pictures using Draw. Adding Effects to the Presentation- Setting Animation & transition effect. Printing Handouts, Generating Standalone Presentation viewer.

UNIT-3

MS-Excel: Worksheet basics, creating worksheet, entering into worksheet, heading information, data, text, dates, alphanumeric values, saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Keyboard shortcuts, Working with single and multiple workbook, working with formulae & cell referencing, Auto sum, Copying formulae, Absolute & relative addressing, Worksheet with ranges, formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and Using macros, Multiple worksheets- concepts, creating and using.

UNIT-4

Introduction to data analytics (DA), types of events and characteristics in the business analytics, different sources of data, data preparation, and data cleaning, Analytical tools, Big Data and Cloud technologies, different data science techniques and their applicability in business via case studies, Rules & processes that help an analytical organization run smoothly, like Data Governance, Data Privacy, and Data Quality.

UNIT-5

Introduction to Machine Learning, ML vs Traditional programming, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning (Classification and Regression Trees, Support vector machines), Unsupervised learning (Clustering), Instance-based learning (K-nearest

Neighbour, Locally weighted regression, Radial Basis Function), Reinforcement learning (Learning Task, Q-learning, Value function approximation, Temporal difference learning)., Significance of ML in Business Analytics, Analysing different real-time case studies in business domain with ML application, Introduction to Artificial Intelligence, role of AI in business domain, Practical application of AI.

TEXT BOOKS:

1. Professional Office Procedure by Susan H Cooperman, Prentice Hall
2. Information Technology:Principles , Practices and Opportunities by James A Senn, Prentice Hall
3. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
4. Foundations of Data Science. Avrim Blum, John Hopcroft and Ravindran Kannan. January 2017.

REFERENCE BOOKS:

1. Fundamentals of computers - V.Rajaraman - Prentice- Hall of India
2. Microsoft Office 2007 Bible - John Walkenbach,Herb Tyson, Faithe Wempen, CaryN. Prague, Michael R.groh, Peter G.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd.

Department of Mathematics			
Year/Semester	1 Year/ 2 nd Semester	Course Category	Skill enhancement course (SEC) (Technical Skills)
Course Code	23SS202	Course Title	Advance Excel Skills
Continuous Evaluation: 80		End Semester Examination: 20	
Prerequisite: Nil		L T P : 0 0 2	Credits: 1

COURSE OBJECTIVES (CO)

1. To develop understanding of excel
2. To apply different formulae
3. To understand the making of different charts in excel

COURSE LEARNING OUTCOMES (CLO)

On successful completion of the course, students will be able to do following:

1. To optimize the use of MS-Excel for powerful data analysis.
2. To apply correct data visualization technique to gain optimal presentation of data.
3. To apply enhanced features of MS-Excel

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

CO \ CLO	CLO 1	CLO 2	CLO 3
CO 1	✓		
CO 2		✓	
CO 3			✓

COURSE CONTENTS

Unit I

Workbook and worksheets- Navigation with keyboard, Tabs and ribbons, file menu, quick access toolbar, create print and save workbook, worksheet basics, protecting excel workbook and worksheet, importing and exporting data, co-authoring; Data and Formatting-Adding Data ,Cut Copy Paste , Data fill ,Data Movement , Cell Formatting ,Conditional Formatting, Cell Operations , Reusable Lists , Data Validation , Sorting And Filtering , Tables.

Unit II

Understanding formulas; operators in formula; named ranges; calculations; functions in formulas; relative and absolute addressing; referencing cells outside the worksheet and workbook; functions - logical, summarizing, text, lookup, reference, data and time, math functions; error handling, formula auditing

Unit III

Charts types and uses, Chart depiction – column, line, pie, bar, bubble, histogram Analysis - Pivot Table, Pivot Charts, What If Analysis

TEXT BOOKS/ REFERENCES BOOKS

1. Manisha Nigam, “Data Analysis with Excel”, BPP publications, 2019.
2. Paul McFedries, Excel Data Analysis for Dummies, 5th Edition, 2022.

Department of Mathematics			
Year/Semester	2 nd Year/ 3 rd Semester	Course Category	Skill enhancement course (SEC) (Technical skills)
Course Code	23SS303	Course Title	Statistical Analysis with SPSS
Continuous Evaluation: 80		End Semester Examination: 20	
Prerequisite: Nil		L T P : 0 0 2	Credits: 1

COURSE OBJECTIVES (CO)

1. To train students in SPSS Software
2. To know about the data handling in SPSS
3. To understand about the diagrammatic representation of data

COURSE LEARNING OUTCOMES (CLO)

On successful completion of the course, students will be able to do following:

1. Basics of SPSS
2. Understanding of data handling in SPSS
3. Diagrammatic representation of data

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

CO \ CLO	CLO 1	CLO 2	CLO 3
CO 1	✓		
CO 2		✓	
CO 3			✓

COURSE CONTENTS

Unit I

Data handling: open SPSS data file – save – import from other data source – data entry – labeling for dummy numbers - recode in to same variable – recode in to different variable – transpose of data – insert variables and cases – merge variables and cases.

Unit II

Data handling: Split – select cases – compute total scores – table looks – Changing column - font style and sizes

Unit III

Diagrammatic representation: Simple Bar diagram – Multiple bar diagram – Sub-divided Bar diagram - Percentage diagram - Pie Diagram – Frequency Table – Histogram – Scatter diagram – Box plot.

TEXT BOOKS/ REFERENCES BOOKS

1. Clifford E.Lunneborg (2000). Data analysis by resampling: concepts and applications. Dusbury Thomson learning. Australia.
2. Everitt, B.S and Dunn, G (2001). Applied multivariate data analysis. Arnold London.

3. Jeremy J. Foster (2001). Data analysis using SPSS for windows. New edition. Versions 8-10. Sage publications. London.
4. Michael S. Louis – Beck (1995). Data analysis an introduction, Series: quantitative applications in the social sciences. Sage. Publications. London.

Department of Mathematics			
Year/Semester	2 nd Year/ 4 th Semester	Course Category	Skill enhancement course (SEC) (Technical Skills)
Course Code	23SS404	Course Title	R Language Programming
Continuous Evaluation: 80		End Semester Examination: 20	
Prerequisite: Nil		L T P : 0 0 2	Credits: 1

COURSE OBJECTIVES (CO)

1. To have an idea about the introduction in R language
2. To know about the basics of R
3. To understand the analysis part in excel

COURSE LEARNING OUTCOMES (CLO)

On successful completion of the course, students will be able to do following:

1. Develop an R script and execute it
2. Install, load and deploy the required packages, and build new packages for sharing and reusability
3. Extract data from different sources using API and use it for data analysis

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

CO \ CLO	CLO 1	CLO 2	CLO 3
CO 1	✓		
CO 2		✓	
CO 3			✓

COURSE CONTENTS

Unit I

Introduction: R interpreter, Introduction to major R data structures like vectors, matrices, arrays, list and data frames, Control Structures, vectorized if and multiple selection, functions.

Unit II

Installing, loading and using packages: Read/write data from/in files, extracting data from web-sites, clean data, transform data by sorting, adding/removing new/existing columns, centring, scaling and normalizing the data values, converting types of values, using string in-built functions

Unit III

Statistical analysis of data for summarizing and understanding data, Visualizing data using scatter plot, line plot, bar chart, histogram, and box plot.

TEXT BOOKS/ REFERENCES BOOKS

1. Cotton, R., Learning R: a step-by-step function guide to data analysis. 1st edition. O'reilly Media Inc. Additional Resources:
2. Gardener, M. (2017). Beginning R: The statistical programming language, WILEY.

3. Lawrence, M., & Verzani, J. (2016). Programming Graphical User Interfaces in R. CRC press. (ebook)

Department of Mathematics			
Year/Semester	3rd Year/ 5 th Semester	Course Category	Skill enhancement course (SEC) (Technical Skills)
Course Code	23SS505	Course Title	Programming with MATLAB
Continuous Evaluation: 80		End Semester Examination: 20	
Prerequisite: Nil		L T P : 0 0 2	Credits: 1

COURSE OBJECTIVES (CO)

- To introduce the software MATLAB for numerical simulation and scientific computation
- To enable students to make use of symbol tools of this computer algebra system
- To introduce MATLAB programming

COURSE LEARNING OUTCOMES (CLO)

- Understand the basics of MATLAB.
- Apply MATLAB software for basic matrix computation problems through loops.
- Demonstrate MATLAB software to solve various mathematical problems numerically.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) & COURSE LEARNING OUTCOMES (CLO)

CO \ CLO	CLO 1	CLO 2	CLO 3
CO 1	✓		✓
CO 2	✓	✓	
CO 3			✓

COURSE CONTENT

Unit I

Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files. Data types, Constants and Variables, Character constants, operators, Assignment statements. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.

Unit II

Input-Output functions, Reading and Storing, Data, Vectors and Matrices, commands to operate on vectors and matrices, matrix Manipulations. Arithmetic operations on Matrices, Relational operations on Matrices, Logical operations on Matrices.

Unit III

Polynomial Evaluation, Roots of Polynomial, and Arithmetic operations on Polynomials, Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart. Linear equations.

TEXT BOOKS/RECOMMENDED BOOKS

1. Stephen J.Chapman, "Programming in MATLAB for Engineers", Cengage Learning, 2011.
2. Pratap R., Getting started with MATLAB: A Quick introduction for Scientists & Engineers, Oxford University Press, 2010.

3. Bansal R.K, Goel A.K., Sharma M.K., “MATLAB and its Applications in Engineering”, Pearson Education, 2012.
4. Amos Gilat, “MATLAB-An Introduction with Applications”, Wiley India, 2009