

GLA University, Mathura (NAAC Accredited 'A+' Grade)



NEP-2020 Based Curriculum and Syllabi of

B. Sc. Mathematics With Specialization in Data Science

(w. e. f. Session 2024-2025)

DEPARTMENT OF MATHEMATICS

Institute of Applied Sciences and Humanities

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Head of the Department Mathematics Institute of Applied Sciences & Humanities GLA University, Mathura

1. VISION AND MISSION

Vision and Mission of the University

Vision

We envision ourselves as a pace-setting university of Academic Excellence focused on education, research and development in established and emerging professions.

Mission

- M1: To impart quality professional education, to conduct commendable research and to provide credible consultancy and extension services as per current and emerging socio-economic needs.
- M2: To continuously enhance and enrich the teaching/learning process and set such standards, education and otherwise, that other institutes would want to emulate.
- M3: To be totally student-centric, thus promoting the overall growth and development of intellect and personality of our prime stakeholders, namely students, so that our alumni are worthy citizens and highly sought-after professionals worldwide.
- **M4:** To empower the members of faculty and staff so that the university's ambience is one of harmony, mutual respect, cooperative endeavour and receptivity towards positive ideas.
- **M5:** To proactively seek regular feedback from all the stakeholders and take appropriate measures based on them thus leading to excellent learning process. Be totally student-centric, thus promoting the overall growth and development of intellect and personality of our prime stakeholders, namely students, so that our alumni are worthy citizens and highly sought-after professionals worldwide.

Vision and Mission of the Department

Vision

The department aims to be a center of excellence in Mathematics, computing and is vigorously engaged in both research and teaching.

Mission

- **M1:** To perform widely recognized research in focused areas of mathematical and statistical theory, methodology, and education.
- M2: To explore applications of Mathematics and Statistics and engage in collaborative research in an interdisciplinary environment.
- **M3:** To discover, mentor, and nurture mathematically inclined students, and provide them a supportive environment that fosters intellectual growth.
- **M4:** To prepare our postgraduate students to develop the attitude and ability to apply mathematical methods and ideas in a wide variety of careers.
- **M5:** To provide professional services based on our diverse mathematical and statistical expertise to the scientific, technical, and educational community.

2. BACKGROUND

i) National Educational Policy (NEP) - 2020

The National Education Policy 2020 lays emphasis on making the education more holistic and effective by integration of general (academic) and vocational education while ensuring the vertical and horizontal mobility of students and learners between academic and vocational streams. Built on the foundational pillars of access, equity, quality, affordability and accountability, NEP strives to transform India into a vibrant knowledge society to become a global knowledge superpower.

The NCrF (National Credit Framework) relies on an integrating approach across the education and skilling frameworks enabling the education and skilling eco-system in implementing one single credit – based framework in line with the vision of NEP 2020. While catering to multidisciplinarily and holistic education across sciences, social sciences, arts, humanities and sports, NCrF enables multiple entry-multiple exit pathways in general and vocational education; ensures flexibility for students to choose their learning trejectories and career choices, including option for mid-way course correction or modification as per their talents and intrests.

The NEP 2020 also recommended to establish an 'Academic Bank of Credit (ABC)' and 'Academic Bank for College and University Students of Uttar Pradesh (ABACUS-UP)' which could digitally store the academic credits earned from recognized institutions so that the degrees can be awarded considering credits earned.

The curricular reforms are instrumental for the desired learning outcomes. In view of this, the Department of Mathematics of Institute of Applied Sciences and Humanities of GLA University, Mathura, U. P. took initiative to propose the curriculum of its undergraduate program in alignment with National Education Policy-2020. The key features of the policy were discussed in the meeting of heads of various departments with the hon'ble Vice Chancellor and the action plan was made with well-defined responsibilities and timeline for academic reforms.

The process of finalizing the curriculum started with the series of webinars and discussions conducted by the University to orient the teachers about the key features of the policy, enabling them to propose the curriculum in sync with the policy. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to incorporate the vital aspects of the policy in the revised curriculum focused on creating holistic and innovative individuals equipped with the key skills for the development of an enlightened, socially conscious, skilled and self-sustained nation.

The curricula articulate the spirit of the policy by emphasizing upon—integrated approach to learning; innovative pedagogy and assessment strategies; multidisciplinary education; critical

thinking; ethical values; entrepreneurial and professional skills; social, moral and environmental awareness; holistic, discussion-based, and analytical learning; flexibility in choice of courses; student-centric participatory learning; offering multiple entry and exit points; integration of extracurricular and curricular aspects; closer collaborations between industry and higher education institutions for science programs; and formative assessment tools to be aligned with the learning outcomes, capabilities, and dispositions as specified for each course. The University has also developed consensus on adoption of Blended Learning with 40% component of online teaching and 60% face to face classes for each program.

The curricula of UG program could be devised with efforts of the faculty and head of the department. The draft prepared by the department was discussed in a series of discussion sessions conducted at department and the University level. The Dean, Academic affairs of the University conducted a series of meetings with Heads and Deans to deliberate upon the parameters of the curriculum to formulate a uniform template featuring background, Programme Outcomes (POs), Programme Specific Outcomes (PSOs), Structure of Bachelor's Course, Semester-wise Courses and Credit Distribution, Course-level Learning Outcomes, Teaching-Learning Process. The experts of the Board of Studies contributed to a large extent in giving the final shape to the curriculum.

Advantages of National Credit Framework:

- Establishing equivalence between general and vocational education and training / skilling.
- Mobility between and within general and vocational education and training / skilling.
- Enabling provisions for lifelong learning through multiple entry and multiple exit options.
- Integration and intermingling of education, skilling and work experience.
- Enabling creditization of learning for students with varying learning capacities.

ii) About Mathematics

Mathematics is a vital tool for global knowledge and communication that organizes and prevents chaos in our life. Mathematics aids in our understanding of the world and is a good tool for developing mental discipline. Logical reasoning, critical thinking, creative thinking, abstract or spatial thinking, problem-solving abilities, and even effective communication skills are all fostered by Mathematics. Mathematics is required to know all other fields of sciences. In one way or another, they all rely on mathematics. The scale of mathematics influences the discipline and mastery of any other science or art.

iii) About the programme

(a) **Objectives:** With the continuous advances in technology, large quantities of data are being collected, stored, and efficiently managed, but to analyse them and discover hidden information, the foundation of Mathematics, Statistics, and Data Science is imperative. The Department of Mathematics at GLA University offers a Bachelor of Science (B.Sc.) degree in Mathematics of 3 years and a B.Sc. (Hons. / Hons. with Research) degree in Mathematics of 4 years with a specialization in Data Science. It is an interdisciplinary programme, an amalgamation of the fields of Mathematics and Data Science. It is designed specially to build up a strong foundation in Mathematics to enhance analytical and computational skills of the students.

(b) **Duration:** B.Sc. Mathematics with specialization in Data Science is a full time under graduate level program offered by the Department of Mathematics. This is a 3 year degree program, consisting of six semesters with two semesters per year. However, it can be extended to 4 year degree program if a student chooses to continue for the Hons. / Hons. with Research Degree in the same program.

(c) Eligibility:

- The candidate must have achieved at least 50% marks in 10+2 with Mathematics
- A Valid GLAET score

(d) Four Year UG Degree (Hons.):

A four year UG Hons. Degree in the major discipline will be awarded to those who complete a four-year degree program with 180 credits and have satisfied the credit requirements as per CBCS.

(e) Four Year UG Degree (Hons. with Research):

The students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation (major discipline) under the guidance of faculty member of the University.

iv) Qualification Descriptors (Possible Career Pathways)

Scope of Employability

After successfully completing the course, the students receive a bachelor degree in Mathematics with specialization in Data Science. Upon completion of this course, the students will be able to further extend their research in Mathematics. They will also be expected to develop life skills in addition to mathematical ability, as are required to have a wealthy life.

The following career paths possibly open up as a result of pursuing an undergraduate degree in Mathematics:

- 1. Data Analyst/Scientist
- 2. Statistical Analyst
- 3. Computational Analyst
- 4. Mathematical Analyst/Modeller
- 5. Research Analyst/Scientist
- 6. Government Jobs
- 7. Teaching
- 8. Research
- 9. Chartered Accountancy
- 10. Banking



3. PROGRAMME OUTCOMES (POs)

Students enrolled in the Bachelor's Program offered by the Departments of Mathematics under Institute of Applied Sciences and Humanities will have the opportunity to learn and master the following components in addition to attain important essential skills and abilities:

PO No.	PROGRAMME OUTCOMES (POs)									
	Critical Thinking: Take informed actions after identifying the assumptions that frame									
PO 1	our thinking and actions, checking out the degree to which these assumptions are accurate									
	and valid, and looking at our ideas and decisions (intellectual, organizational, and									
	personal) from different perspectives.									
PO 2	Problem Solving: Understand and solve problems of relevance to society to meet the									
	specified needs using the knowledge, skills, and attitudes acquired from									
	humanities/sciences/ mathematics/social sciences.									
	Effective Communication: Speak, read, write, listen clearly in person and through									
PO 3	electronic media in English and one Indian language, and make meaning of the world by									
	connecting people, ideas, books, media, and technology.									
PO 4	Individual and Teamwork: Function effectively as an individual and as a member or									
	leader in diverse teams and a wide variety of settings.									
PO 5	Ethics: Understand multiple value systems, including your own, the moral dimensions of									
	your decisions, and accept responsibility for them.									
PO 6	Environment and sustainability: Understand the impact of technology and business									
	practices in societal and environmental contexts and sustainable development.									
PO 7	Self-directed and life-long learning: Demonstrate the ability to engage in independent									
	and life-long learning in the broadest context socio-technological changes.									
PO 8	Design Mindset: Represent and develop tasks and work processes for desired outcomes.									
PO 9	Computational Thinking: Understand data-based reasoning through the translation of									
	data into abstract concepts using computing technology-based tools.									
PO 10	Effective Citizenship: Demonstrate empathetic social concern and equity-centered									
	national development and act with an informed awareness of issues and participate in									
	civic life through volunteering									
	er de anderen voluneering.									



4. PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Understand the foundations of mathematics and the importance of logic.
PSO 2	Solve problems of physics using differential equations and vector algebra
PSO 3	Solve problems in algebra, analysis and numerical analysis.
PSO 4	Translate real world problems into mathematical models.

5. STRUCTURE OF BACHELOR PROGRAM

Types of Courses	Nature	Total Credits	%
		Creuits	
	Major Courses as per common minimum syllabus	59	32.77
Program Core Courses (C)	Major Courses offered by same faculty	16	8.88
	Minor Courses offered by other department	32	17.77
Elective Courses (E)	Discipline Specific Elective Courses	9+12*	5/
			6.66
Multidisciplinary Courses (MDC)	Compulsory	9	5
Ability Enhancement Courses (AEC)	Compulsory	8	4.44
Skill Enhancement Courses (SEC)	Compulsory	9	5
Humanities and Social Science Courses	Compulsory	12	6.66
(HSSC)			
Value Added Courses (VAC)	Co-curricular / Compulsory subjects	8	4.44
	(to be chosen from the list of subjects)		
MOOC Course (OE)	Compulsory	2	1.11
Audit Course (ACC)	Compulsory	0	0
Summer Internship (SIP)	Compulsory	4	2.22
Project (J)	Compulsory in 4- year Bachelor's degree	12*	6.66
	(Hons. with Research)		
Non-Graded Course (MNG)	Mandatory	0	0
	Total	180	100%

Note: The Scheme and Syllabus of the programme are subject to change as per the UGC guidelines, National Education Policy (NEP-2020) and University ordinance.

<u>Course Type</u>

Program Core Courses (C)

- 1. Major Courses as per common minimum syllabus
- 2. Major Courses offered by same faculty
- 3. Minor Courses offered by other department of same faculty

Elective Courses (E) Multidisciplinary Courses (MDC) Ability Enhancement Courses (AEC) Skill Enhancement Compulsory Courses (SEC) Humanities and Social Science Courses (HSSC) Value Added Courses (VAC) MOOC Course (NPTEL/SWAYAM) (OE) Audit Compulsory Course (ACC) Summer Internship (SIP) Project (J) Mandatory Non-Graded Course (MNG)

Total Credits: 180, Year-wise distribution of credits: 42 + 50 + 48 + 40

PROGRAM CORE COURSES (C)

1. Major Courses as per common minimum syllabus

S.	Sem.	Course	Course Title	L	Τ	Р	J	Credit
No.		Code						
1	Ι	BMAC 0001	Differential Calculus and Integral Calculus	3	1	0	0	4
2	Ι	BMAC 0801	Practical	0	0	4	0	2
3	II	BMAC 0002	Matrices and Differential Equations and Geometry	5	1	0	0	6
4	III	BMAC 0003	Algebra and Mathematical Methods	5	1	0	0	6
5	IV	BMAC 0004	Differential Equation and Mechanics	5	1	0	0	6
6	V	BMAC 0005	Group Ring Theory and Linear Algebra	4	1	0	0	5
7	VI	BMAC 0006	Metric Space and Complex Analysis	3	1	0	0	4
8	VI	BMAC 0007	Numerical Analysis and Operations Research	3	1	0	0	4
9	VI	BMAC 0802	Practical-I	0	0	4	0	2
10	VII	BMAC 0008	Real Analysis	4	1	0	0	5
11	VII	BMAC 0009	Ordinary Differential Equations	4	1	0	0	5
12	VIII	BMAC 0010	Topology	4	1	0	0	5
13	VIII	BMAC 0011	Functional Analysis	4	1	0	0	5



PROGRAM CORE COURSES (C)

S. No.	Sem.	Course	Course Title	L	Т	Р	J	Credit
		Code						
1	Ι	BMAC 0101	Statistics for Data Science-I	3	1	0	0	4
2	III	BMAC 0102	Statistics for Data Science-II	3	1	0	0	4
3	V	BMAC 0103	Multivariate Statistics	3	1	0	0	4
4	VI	BMAC 0104	Time Series and Stochastic Processes	3	1	0	0	4

2. Major Courses offered by same faculty

3. Minor Courses offered by other department of same faculty

S.	Sem.	Course	Course Title	Offering	L	Т	Р	J	Credit
No.		Code		Dept.					
1	Ι	BCAC 0102	Data Science-I	CEA	3	0	0	0	3
2	Ι	BCAC 0182	Data Science-I Lab	CEA	0	0	2	0	1
3	II	MCAC 0009	Database Management System	CEA	3	0	0	0	3
4	II	MCAC 0807	Database Management System Lab	CEA	0	0	2	0	1
5	II	BCAE 0003	Programming Logic using Python	CEA	3	0	0	0	3
6	II	BCAE 0809	Python Programming Lab	CEA	0	0	2	0	1
7	III	BCAE 0004	Data Science-II	CEA	3	0	0	0	3
8	III	BCAE 0810	Data Science-II Lab	CEA	0	0	2	0	1
9	IV	BCSC 0018	Data Visualization	CEA	3	0	0	0	3
10	IV	BCSC 0815	Data Visualization Lab	CEA	0	0	2	0	1
11	IV	BBAC 0016	Fundamentals of Research Methodology	IBM	4	0	0	0	4
12	VII		Data Structures and Algorithms	CEA	3	0	0	0	3
13	VII		Data Structures and Algorithms Lab	CEA	0	0	2	0	1
14	VIII		Cryptography and Network Security	CEA	3	0	0	0	3
15	VIII		Cryptography and Network Security Lab	CEA	0	0	2	0	1

ELECTIVE COURSES (E) [any ONE]

S. No.	Sem.	Course	Course Title	L	Т	Р	J	Credit
		Code						
1	V	BMAE 0001	Number Theory and Game Theory	4	1	0	0	5
2	V	BMAE 0002	Graph Theory and Discrete Mathematics	4	1	0	0	5
3	V	BMAE 0003	Differential Geometry & Tensor Analysis	4	1	0	0	5

1. Major Courses as per common minimum syllabus

2. Major Courses offered by same faculty

S.	Sem.	Course	Course Title	Offering	L	Т	Р	J	Credit
No.		Code		Dept.					
1	VII		Soft Computing	CEA	3	1	0	0	4
2	VII		Introduction to Big Data Analytics	CEA	3	0	0	0	3
3	VII		Big Data Analytics Lab	CEA	0	0	2	0	1
4	VII		Cloud Computing	CEA	3	0	0	0	3
5	VII		Cloud Computing Lab	CEA	0	0	2	0	1
6	VII	BMAE 0004	Operational Research-I	Maths	3	1	0	0	4
7	VII	MMAE 0019	Mathematical Modeling	Maths	4	0	0	0	4
8	VII	MMAE 0024	Coding Theory	Maths	4	0	0	0	4
9	VII	MMAE 0102	Regression Analysis and Predictive Modelling	Maths	4	0	0	0	4

Multi disciplinary Courses (MDC)

1. Courses offered by other faculty

S.	Sem.	Course	Course Title	Offering	L	Т	Р	J	Credit
No.		Code		Department					
1	II	BBAO 8004	Project Management	IBM	3	0	0	0	3
2	IV	BMEE 0402	Product Design and Development	ME	3	0	0	0	3
			Econometrics/ Cyber Ethics & Laws/	Economics/	3	0	0	0	3
3	V		Satellite Communication and Remote Sensing	CEA/					
_				Physics					



Ability Enhancement Course (AEC)

S.	Sem.	Course	Course Title	Offering	L	Т	Р	J	Credit
No.		Code		Department					
1	Ι	BELA 0003	Language Skills-I	English	2	0	0	0	2
2	II	BELA 0004	Language Skills-II	English	2	0	0	0	2
3	III	BELA 0007	Technical Writing	English	2	0	0	0	2
4	IV	BELA 0012	Workplace Communication	English	2	0	0	0	2

Skill Enhancement Courses (SEC)

S.	Sem.	Course	Course Title	Offering	L	Т	Р	J	Credit
No.		Code		Dept.					
1	Ι	BMAK 0801	R-Programming Lab	Mathematics	0	0	6	0	3
2	III	BBAK 2804	Applications of MS Excel	IBM	2	0	2	0	3
3	VI	BMAK 0101	Statistical Computation and Simulation	Mathematics	3	0	0	0	3

Value Added Courses (VAC)

S.	Sem.	Course	Course Title	Offering	L	Т	Р	J	Credit
No.		Code		Department					
1	Ι	BPSO 0005	First Aid and Basic Health	IPR		Ν		2	
2	II	BCHO 0012	Human Values and Environment Studies	Chemistry and English	NA				2
3	III	BEDO 0001	Physical Education and Yoga	Sports	0	0	0	0	2
4	IV		Social Responsibility and Community Engagement		0	0	0	0	2

Project (J)

S. No.	Sem.	Course Code	Course Title	L	Т	Р	J	Credit
1	VIII		Project	0	0	0	12	12

Online Course Credit Transfer:

Courses other than major and minor may be done through online platforms like **SWAYAM** / **NPTEL** / other approved platforms by the University. The online courses should have similar course content as mentioned in the course structure of the particular program. The same credits will be transferred in the credit bank of the student.

Elective Courses

(Offered by Mathematics department to other departments)

Minor Courses

S.	Course	Course Title	L	Τ	Р	J	Credit
No.	Code						
1	BMAE 0101	Algebra and Calculus	4	0	0	0	4
2	BMAS 0505	Statistics and Numerical Methods	4	0	0	0	4
3	BMAE 0103	Ordinary and Partial Differential Equations	4	0	0	0	4
4	BMAE 0111	Mathematics I	4	0	0	0	4

Multidisciplinary Courses

S.	Course Code	Course Title	L	Τ	Р	J	Credit
No.							
1	MMAS 0501	Advanced Biostatistics	3	0	0	0	3
2	BMAS 0203	Business Mathematics	3	0	0	0	3
3	BMAS 0204	Business Statistics	3	0	0	0	3
4	BMAS 1204	Business Statistics	4	0	0	0	4

Skill Enhancement Courses

S. No.	Course Code	Course Title	L	Т	Р	J	Credit
1	BMAK 0801	R-Programming Lab	2	0	2	0	3
2	BMAK 0101	Statistical Computation and Simulation	3	0	0	0	3

Humanities and Social Science Courses

S.	Course Code	Course Title	Offering	L	Т	Р	J	Credit
No.			Department					
1.	BSDH 0301	Soft Skills-I	T&D	3	0	0	0	3
2.	BSDH 0302	Soft Skills-II	T&D	3	0	0	0	3
3	BSDH 0303	Soft Skills-III	T&D	3	0	0	0	3
4	BSDH 0304	Soft Skills-IV	T&D	3	0	0	0	3

MOOC Course

S.	Course Code	Course Title	Offering	L	Т	Р	J	Credit
No.			Department					
1		MOOC Course	NPTEL/	Onsight Mode			2	
			SWAYAM	(M	in. 8	We	eks)	

MNG Course*

S.	Course Code	Course Title	Offering	L	Т	Р	J	Credit
No.			Department					
1	BEDM 0001	Rashtra Gaurav	Faculty of	2	0	0	0	0
			Education					

*This course will be offered from the second semester onwards. Passing this course is compulsory before taking exit from the UG program as per the guidelines of NEP-2020.



5. SEMESTER-WISE COURSES AND CREDIT DISTRIBUTION

SEMESTER-I

Total Credits: 21 (Major C: 10, Minor C: 4, AEC: 2, SEC: 3, VAC: 2)

Sr. No.	Course No.	Course Code	Course Title	L	Т	Р	J	Hrs/Week	Total Credits
Maj	or Core C	Courses (C)				1			
1	1	BMAC 0001	Differential Calculus and Integral Calculus	3	1	0	0	4	4
2	2	BMAC 0801	Practical	0	0	4	0	2	2
3	3	BMAC 0101	Statistics for Data Science-I	3	1	0	0	4	4
Min	or Core C	Courses (C)				1			
4	1	BCAC 0102	Data Science-I (offered by CEA Dept.)	3	0	0	0	3	3
5	2	BCAC 0182	Data Science-I Lab (offered by CEA Dept.)	0	0	2	0	2	1
Abil	ity Enhar	cement Course	e (AEC)			1			
6	1	BELA 0003	Language Skills-I (offered by English Dept.)	2	0	0	0	2	2
Skill	Enhancer	nent Courses (S	SEC)						
7	1	BMAK 0801	R-Programming Lab	2	0	2	0	4	3
Valu	e Added (Courses (VAC)	[from the list given on page no. 13]	•		•	•		
8	1	BPSO 0005	First Aid and Basic Health (offered by IPR)		N	A		0	2

SEMESTER-II*

Total Credits: 21 (Major C: 6, Minor C: 8, MDC: 3, AEC: 2, VAC: 2)

Sr.	Course	Course	Course Title	L	Т	P	J	Hrs/Week	Total
INO.	N0.	Code							Credits
Maj	or Core (Courses (C)							
1	4	BMAC 0002	Matrices and Differential Equations and Geometry	5	1	0	0	6	6
Min	or Core (Courses (C)							
2	3	MCAC 0009	Database Management System (offered by CEA Dept.)	3	0	0	0	3	3
3	4	MCAC 0807	Database Management System Lab (offered by CEA Dept.)	0	0	2	0	2	1
4	5	BCAE 0003	Programming Logic using Python (offered by CEA Dept.)	3	0	0	0	3	3
5	6	BCAE 0809	Python Programming Lab (offered by CEA Dept.)	0	0	2	0	2	1
Mul	ti disciplir	nary Courses	(MDC)				1	II	
6	1	BBAO 8004	Project Management (offered by IBM)	3	0	0	0	3	3
Abil	ity Enhan	cement Cour	se (AEC)						
7	2	BELA 0004	Language Skills-II (offered by English Dept.)	2	0	0	0	2	2
Valu	e Added	Courses (VA	C) [from the list given on page no. 13]						
8	2	BCHO 0012	Human Values and Environment Studies (Offered by Chemistry & English Depts.)		N	Ά		0	2

* The students who opt to exit after completion of I year (semester II) and have secured minimum 42 credits will be awarded a **UG Certificate** if, in addition, they complete vocational course (skill oriented) of 4 credits during summer vacation of I year.

* **Rashtra Gaurav** course is mandatory for all students as a Mandatory Non-graded course (MNG), according to the government guidelines and NEP-2020. Passing this mandatory course is compulsory before taking exit from the UG program.

SEMESTER-III

Total Credits: 24 (Major C: 10, Minor C: 4, AEC: 2, SEC: 3, HSSC: 3, VAC: 2)

Sr.	Course	Course	Course Title	L	Т	Р	J	Hrs/Week	Total Credite
110.	NU.	Code							Creans
Maj	or Core (Courses (C)							
1	5	BMAC 0003	Algebra and Mathematical Methods	5	1	0	0	6	6
2	6	BMAC 0102	Statistics for Data Science-II	3	1	0	0	4	4
Min	or Core (Courses (C)				•		· · ·	
3	7	BCAE 0004	Data Science- II (offered by CEA Dept.)	3	0	0	0	3	3
4	8	BCAE 0810	Data Science- II Lab (offered by CEA Dept.)	0	0	2	0	2	1
Abil	ity Enhan	cement Cou	rse (AEC)						
5	3	BELA 0007	Technical Writing (offered by English Dept.)	2	0	0	0	2	2
Skill	Enhance	ment Course	es (SEC)						
6	2	BBAK 2804	Applications of MS Excel (offered by IBM)	2	0	2	0	3	3
Hun	nanities ar	nd Social Sci	ence Course (HSSC)						
7	1	BSDH 0301	Soft Skills-I (offered by T&D Dept.)	3	0	0	0	3	3
Valu	e Added	Courses (VA	C) [from the list given on page no. 13]			1		1. J	
8	3	BEDO 0001	Physical Education and Yoga (offered by Sports Dept.)	0	0	0	0	0	2



SEMESTER-IV*

Total Credits: 26 (Major C: 6, Minor C: 8, MDC: 3, AEC: 2, HSSC: 3, VAC: 2, MOOC: 2)

Sr. No.	Course No.	Course Code	Course Title	L	Т	Р	J	Hrs/Week	Total Credits
Maj	or Core (Courses (C)							
1	7	BMAC 0004	Differential Equation and Mechanics	5	1	0	0	6	6
Min	or Core (Courses (C)							
2	9	BCSC 0018	Data Visualization (offered by CEA Dept.)	3	0	0	0	3	3
3	10	BCSC 0815	Data Visualization Lab (offered by CEA Dept.)	0	0	2	0	2	1
4	11	BBAC 0016	Fundamentals of Research Methodology (offered by IBM)	4	0	0	0	4	4
Mul	ti discipliı	nary Course	s (MDC)						
5	2	BMEE 0402	Product Design and Development (offered by ME Dept.)	3	0	0	0	3	3
Abil	ity Enhan	cement Cou	rse (AEC)						
6	4	BELA 0012	Workplace Communication (offered by English Dept.)	2	0	0	0	2	2
Hun	nanities ar	nd Social Sci	ence Course (HSSC)						
7	2	BSDH 0302	Soft Skills-II (offered by T&D Dept.)	3	0	0	0	3	3
Valı	e Added	Courses (VA	C) [from the list given on page no. 13]			•	•		
8	4		Social Responsibility and Community Engagement	0	0	0	0	0	2
MO	OC Cours	se							
9	1		NPTEL/SWAYAM Platform		() ())nsi ∕Iin.	ght] 8 V	Mode Veeks)	2

* The students who opt to exit after completion of II year (sem. IV) and have secured minimum 90 credits will be awarded a UG Diploma if, in addition, they complete vocational course (skill oriented) of 4 credits during summer vacation of I year.



SEMESTER-V

Total Credits: 24 (Major C: 9, E: 9, MDC: 3, HSSC: 3)

Sr. No.	Course No.	Course Code	Course Title	L	Т	Р	J	Hrs/Week	Total Credits
Maj	or Core (Courses (C)	I					11	
1	8	BMAC 0005	Group and Ring Theory and Linear Algebra	4	1	0	0	5	5
2	9	BMAC 0103	Multivariate Statistics	3	1	0	0	4	4
Elec	tive Cour	ses (E) [Any	TWO]	l		I	I	II	
	1	BMAE 0001	Number Theory and Game Theory						
	2	BMAE 0002	Graph Theory and Discrete Mathematics	4	1	0	0	5	5
3	3	BMAE 0003	Differential Geometry & Tensor Analysis						
	4	BCSE 0152	Data Mining and Warehousing	3	0	0	0	3	3
	5	BCSE 0181	Data Mining and Warehousing Lab	0	0	2	0	2	1
Mul	ti disciplir	nary Courses	(MDC) [Any ONE]			1	1	II	
	3		Econometrics (offered by Economics Dept.)						
4	4		Cyber Ethics & Laws (offered by CEA Dept.)	3	0	0	0	3	3
	5		Satellite Communication and Remote Sensing (offered by Physics Dept.)						
Hun	nanities ar	nd Social Scie	ence Course (HSSC)			•	•		
5	3	BSDH 0303	Soft Skills-III (offered by T&D Dept.)	3	0	0	0	3	3



SEMESTER-VI**

Total Credits: 20 (Major C: 14, SEC: 3, HSSC: 3) + 4** (SIP: 4)

Sr. No	Course No	Course Code	Course Title	L	Т	Р	J	Hrs/Week	Total Credits
Maj	or Core (Courses (C)	I						Creatis
1	10	BMAC 0006	Metric Space and Complex Analysis	3	1	0	0	4	4
2	11	BMAC 0007	Numerical Analysis and Operations Research	3	1	0	0	4	4
3	12	BMAC 0802	Practical-I	0	0	4	0	4	2
4	13	BMAC 0104	Time Series and Stochastic Processes	3	1	0	0	4	4
Skil	Enhance	ment Courses (S	SEC)	•		•		· · ·	
5	3	BMAK 0101	Statistical Computation and Simulation	3	0	0	0	3	3
Hun	nanities an	d Social Science	e Course (HSSC)	•		•	-	· · · ·	
6	4	BSDH 0304	Soft Skills-IV (offered by T&D Dept.)	3	0	0	0	3	3

Sun	Summer Internship* (SIP)										
7	1	Summer Internships	0	0	0	4	_	4			

*All students will undergo **Summer Internships (SIP)** / Apprenticeships of 4 credits in a firm, industry, or organization or training in labs with faculty and researchers in their own or other HEIs / research institutions during the summer term.

****** The students who wish to go for 3 year UG Program will be awarded **UG Degree** in major discipline after successful completion of three years, securing 140 credits and satisfying the minimum credit requirements as per CBCS.

***It is mandatory for all the students to pass one **Non-Credit Audit c**ompulsory course (ACC) at any stage of their exit from the program.

Rashtra Gaurav course is mandatory for all students as a Mandatory Non-graded course (MNG), according to the government guidelines and NEP-2020. Passing this mandatory course is compulsory before taking exit from the UG program.



SEMESTER-VII

Total Credits (for Hons. students without Research): 26 (Major C: 10, Minor C: 4, E: 12) Total Credits (for Hons. students with Research): 14 (Major C: 10, Minor C: 4)

Sr. No.	Course No.	Course Code	Course Title	L	Т	Р	J	Hrs/Week	Total Credits
Maj	or Core (Courses (C)				•	•		
1	14	BMAC 0008	Real Analysis	4	1	0	0	5	5
2	15	BMAC 0009	Ordinary Differential Equations	4	1	0	0	5	5
Min	or Core (Courses (C)				I			
3	12		Data Structures and Algorithms (offered by CEA Dept.)	3	0	0	0	3	3
4	13		Data Structures and Algorithms Lab (offered by CEA Dept.)	0	0	2	0	2	1
Elec	tive Cour	ses* (E) [any	THREE]						
5A	6		Soft Computing (offered by CEA Dept.)	3	1	0	0	4	4
5B	7		Introduction to Big Data Analytics (offered by CEA Dept.)	3	0	0	0	3	3
5C	8		Big Data Analytics Lab (offered by CEA Dept.)	0	0	2	0	2	1
5D	9		Cloud Computing (offered by CEA Dept.)	3	0	0	0	3	3
5E	10		Cloud Computing Lab (offered by CEA Dept.)	0	0	2	0	2	1
5F	11	BMAE 0004	Operational Research-I	3	1	0	0	4	4
5G	12	MMAE 0019	Mathematical Modeling	4	0	0	0	4	4
5H	13	MMAE 0024	Coding Theory	4	0	0	0	4	4
51	14	MMAE 0102	Regression Analysis and Predictive Modelling	4	0	0	0	4	4

*Hons. students who are not taking research need to take 3 courses of 12 credits.



SEMESTER-VIII

Total Credits (for Hons. students without Research): 14 (Major C: 10, Minor C: 4) Total Credits (for Hons. students with Research): 26 (Major C: 10, Minor C: 4, Project: 12)

Sr. No	Course	Course Code	Course Title	L	Т	Р	J	Hrs/Week	Total Credits
Maj	or Core C	Courses (C)	I						Creatis
1	16	BMAC 0010	Topology	4	1	0	0	5	5
2	17	BMAC 0011	Functional Analysis	4	1	0	0	5	5
Min	or Core (Courses (C)				•	•		
3	14		Cryptography and Network Security (offered by CEA Dept.)	3	0	0	0	3	3
4	15		Cryptography and Network Security Lab (offered by CEA Dept.)	0	0	2	0	2	1
Proj	ect* (J)								
1	1		Project	0	0	0	12		12

*Hons. students who are taking research need to take up research project of 12 credits under the guidance of a faculty member. The students are expected to complete the Research Project in the 8th semester. The research outcomes of their project work may be published in peer-reviewed journals or presented in conferences / seminars or may be patented.

SYLLABI OF SUBJECTS

First Year Courses

1. COURSE-LEVEL LEARNING OUTCOMES

Course No:	1	Course Name: Differential Calculus & I	ntegral Cal	cul	us	Co	urs	e Code:	BMAC 00	001		
Batch:		Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	T	Р	J	Credits	Contact H Per Weel	Irs k: 4		
2024-2028			Ι	3	1	0	0	4	Total Ho	urs: 48		
Total Evalua	atio	n Marks: 100	Examination Duration: Mid Term (2 hours), End Term (3 hours) Pre-requisite of course: Nil									
Theory Asse Internal Ass	essn essi	nent: 75 Marks ment: 25 Marks	Nature of Course: Major Course as per common minimum syllabus									
Course Objective	Th div ma cui vea em	is course will develop a profound understa vergence of series, continuity and differen- ike the students able to know partial differen- rves. Further, a deep understanding of Rie- ctor differentiation and integration will b aployability and skill development aligned	nding of sec tiability an crentiation a mann integ e develope with all CC	que d e and ral, d in D's.	nce xpa its im n th	es, su ansic app prop nis c	ub-s on o olica oer i	sequence of a func ations al integrals se. This	es, converg etion. This ong with tr , multiple i s course fo	ence and will also racing of ntegrals, cuses on		
 After studying these topics, the students will be able to: CO1: The programme outcome is to give foundation knowledge for the students to underst basics of mathematics including applied aspect for developing enhanced quantitative sl and pursuing higher mathematics and research as well. CO2: By the time students complete the course, they will have wide ranging application of subject and have the knowledge of real valued functions such as sequence and series. T will also be able to know about convergence of sequence and series. Also, they h knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesia well as parametric curves. CO3: The main objective of the course is to equip the student with necessary analytic technical skills. By applying the principles of integral he learns to solve a variety practical problems in science and engineering. CO4: The student is equipped with standard concepts and tools at an intermediate to advance I that will serve him well towards taking more advance level course in Mathematics. 								derstand twe skills on of the es. They hey have tesian as ytic and ariety of nce level				
Module No.		Con	tent							Hours		
Ι	[C Int De sec inf Ser int tes Su dif En poi cui	ourse Outcome(s) No.: 1, 2 and 4] roduction to Indian Ancient Mathematics finition of a sequence, theorems on lim quences, Cauchy's convergence criterion, erior of a sequence, subsequence, ries of non-negative terms, convergence a egral test, Ratio tests, Root test, Raabe's ts, alternating series, Leibnitz's theorem, a ccessive differentiation, Leibnitz theorem ferentiation, Euler's theorem on homo velops and evolutes, Tests for concavity ints, Parametric representation of curves a rves in Cartesian and Polar forms.	and Mather its of sequ Cauchy se and diverge logarithmic bsolute and n, Maclaur geneous fu and convex and tracing	mation eque ence to te l co in's int; ity, of j	icia ces enc enc s, C st, ndi s an ion Po par	ans. , bo e, li Comp de N ition nd T , A pints ame	und mit Vor al c Fayl sym of tric	led and superio son test gan and converge lor's ser ptotes, inflexio curves,	monotonic r and limit s, Cauchy's l Bertrand's ence. ries, Partia Curvature n, Multiple Tracing of	24		

	[Course Outcome(s) No.: 1, 3 and 4]
	Riemann integral, Integrability of continuous and monotonic functions, Fundamental
	theorem of integral calculus, Mean value theorems of integral calculus, Differentiation
	under the sign of Integration.
п	Improper integrals, their classification and convergence, Comparison test, µ-test, Abel's 24
	test, Dirichlet's test, quotient test, Beta and Gamma functions.
	Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's
	theorem for multiple integrals.
	Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional
	Derivative, Vector Integration, Theorems of Gauss, Green, Stokes and related problems.
Text Book	s:
\checkmark	R.G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 2000.
\checkmark	S. Balachandra Rao & C.K. Shantha, Differential Calculus, New Age Publications, 1992.
\checkmark	T.M. Apostol, Calculus (Vol. I & II), John Wiley & Sons Inc., 1967.
\succ	Shanti Narayan & P.K. Mittal, Integral Calculus, S. Chand, 2005.
\succ	H. Kishan, A. L. Pathak, S.K.S. Bhadauria, M. Sharma & V. Singh, Differential Calculus, RP
	Publications, 2021.
\checkmark	H. Kishan, R. C. S. Chandel, R. K. Shrivastav & K.M. Agrawal, Integral Calculus and Vector
	Calculus, RP Publications, 2021.
\checkmark	H. Anton, I. Birens & S. Davis, Calculus, John Wiley and Sons Inc., 2002.
Reference	Books:

- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2011.
 G.B. Thomas & R.L. Finney, Calculus, Pearson Education, 2007.
 Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS.

- Course Books published in Hindi.

Course No:	2 Course Name: Practical			С	our	se Co	de: BMAC	0801			
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	TP	, 1	Cred	its Contact	Hrs k. 2			
2024-2028	(with specialization in Data Science)	Ι	0	0 4	. 0	2	Total Ho	urs: 24			
Total Evalu	ation Marks: 100	Examinati	ion	Dur	atio	n: E	nd Term (2)	hours)			
		Pre-requis	site	of c	our	se:	Nil				
Internal: 5() Marks	Nature of	Сот	urse	: M	ajor C	Course as per				
Attendance	· 10 Marks	common m	inin	num	syll	abus					
Course	This lab aims to develop an understanding of t	olotting of gr	aph	s of	vari	ous fu	nctions, poly	nomials			
Objective	and curves. This course focuses on employabi	bility and skill development aligned with all CO's.									
	After studying these topics, the students will b	e able to:									
Course	CO1: The main objective of the course is to the different types of equations by plo such as Mathematica /MATLAB /Map. CO2: After completion of this course, stud	equip the stu otting the gra le /Scilab/Ma lent would	iden aph axin be	t to usin na et able	plot g di c.	differ fferen know	the converse	nd solve software			
Outcomes	 sequences through plotting, verify Bolzano-Weierstrass theorem through plotting to sequence, Cauchy's root test by plotting nth root and ratio test by plotting the ratio of and (n + 1)th term. CO3: Student would be able to plot complex numbers and their representations. Operations lip 										
	CO3: Student would be able to plot complex numbers and their representations, Operations										
	addition, substraction, multiplication, division, modulus and graphical representation										
CO4: Student would be able to perform following task of matrix as addition, multiplic inverse, transpose, determinant, rank, Eigenvectors, Eigenvalues, characteristic equ								lication			
								equation			
	and verification of the Cayley-Hamilto	n theorem, so	olvi	ng tł	ie sy	vstems	of linear eq	uations.			
	COURSE SYL	LABUS						1			
Module No.	. Cont	ent						Hours			
	Practical / Lab work to be performed in con List of the practicals to be done using Mathem etc.	mputer lab. natica / MAT	TLA	B/N	Iapl	e /Scil	lab/Maxima				
	1. Plotting the graphs of the following fu	nctions:									
	(i) ax										
	(11) $\begin{bmatrix} x \end{bmatrix}$ (greatest integer function)										
	(iii) x^{2n-1} ; $n \in N$ (iv) x^{2n-1} ; $n \in N$										
	$(\mathbf{N}) \frac{1}{n} \mathbf{n} \in \mathbf{N}$										
	$(v) \frac{1}{x^{2n-1}}, n \in N$										
	$(v_1) \xrightarrow{x^{2n}} , n \in \mathbb{N}$										
	(vii) $\sqrt{ax + b}$, $ ax + b $, $c \pm ax + b $										
	(viii) $\frac{ x }{x}$, $\sin\left(\frac{1}{x}\right)$, $x \sin\left(\frac{1}{x}\right)$, e^x , e^{-x} for x	≠ 0						24			
I	(ix) e^{ax+b} , $\log(ax+b)$, $\frac{1}{ax+b}$, $\sin(ax+b)$	+ b), cos(ax	(+)	b), :	sin(ax +	b) ,	24			
	Observe and discuss the effect of changes in t (2) By plotting the graph, find the solution of $\frac{1}{2}$	he real const the equation	ants	a ar	nd b	on the	e graphs.				
	$x = e^{x}, x^{2} + 1 = e^{x}, 1 - x^{2} =$	$e^x, x = lc$	9g ₁₀	(<i>x</i>),	cos	(x) =	х,				
	$x = e^{-}, x^{-} + 1 = e^{-}, 1 = x^{-} = e^{-}, x^{-} = \log_{10}(x), \cos(x) = x,$ $sin(x) = x, \cos(y) = \cos(x), sin(y) = sin(x) \text{ etc}$ (3) Plotting the graphs of polynomial of degree 2, 3, 4 and 5 and their first and second derivatives										

derivatives. (4) Sketching parametric curves, e.g. Trochoid, Cycloid, Epicycloid and Hypocycloid etc.

	(5) Tracing of conic in cartesian coordinates.
	(6) Graph of circular and hyperbolic functions.
	(7) Obtaining surface of revolution of curves.
	(8) Complex numbers and their representations, Operations like addition, Multiplication,
	Division, Modulus. Graphical representation of polar form.
	(9) Find numbers between two real numbers and plotting of finite and infinite subset of R
	(10) Matrix Operations: Addition, Multiplication, Inverse, Transpose, Determinant,
	Rank, Eigenvectors, Eigenvalues, Characteristic equation and verification of the
	Cayley-Hamilton theorem, Solving the systems of linear equations.
	(11) Study the convergence of sequences through plotting.
	(12) Verify Bolzano-Weierstrass theorem through plotting of sequences and hence
	identify convergent subsequences from the plot.
	(13) Study the convergence/divergence of infinite series by plotting their sequences of
	partial sum.
	(14) Cauchy's root test by plotting n^{th} root.
	(15) Ratio test by plotting the ratio of n^{th} and $(n + 1)^{th}$ terms.
ext Bo	
	K.G. Bartie & D.K. Snerbert, introduction to Keal Analysis, John Wiley & Sons, 2000.
	• 1.1vi. Apostoi, Calculus (voi . 1 & 11), John whey & Sons Inc., 1907.

Shanti Narayan & P.K. Mittal, Integral Calculus, S. Chand, 2005.

Reference Books:

- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2011.
 G.B. Thomas & R.L. Finney, Calculus, Pearson Education, 2007.
 Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS.

Course No: 3	Course Name: Statistics for Data Science-I			C	our	se Co	de: BMAC	0101			
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	T	, 1	Credi	its Contact Per Wee	Hrs ek: 4			
2024-2028		Ι	3	1 () ()	4	Total Ho	ours: 40			
Total Evalua	tion Marks: 100	Examination Duration:									
		Mid Term ((2 h	ours), E	nd Ter	m (3 hours))			
		Pre-requis	ite	of co	ours	e: Nil	~				
Ineory Asse Internal Ass	ssment: 75 Marks essment: 25 Marks	Nature of (Coi	arse:	M	ajor- 2	Course				
	This course will develop a profound understand	ding of level	l of	mea	sure	ment a	nd represen	tation of			
~	data, measures of central tendency and dispers	ion, nature of	of f	reque	ency	distril	oution and f	itting of			
Course	nolynomial curves. This will also make the stu	dents able to	kn	ow a	hou	t correl	ation and re	oression			
Objective	analysis of data random variable and its proper	ties Further	2	deen	und	erstand	ling of math	ematical			
expectation moment generating function and probability generating function will be developed								loned in			
	this course. This course focuses on employability and skill development aligned with all CO's										
	After studying these topics, the students will be able to:										
	After studying these topics, the students will be able to:										
	tendency and dispersion	cal analysis,	var	lable	s, a	ata and	measures of	or central			
Course	CO2: Apply the methods to actual quantitative	data and inte	erni	eting	, the	results	s of the anal	vsis			
Outcomos	CO3: Perform correlation and regression analy	sis of given of	data	i.	, the	result	, or the unu	<i>y</i> 515.			
Outcomes	CO4: Learn the concept of probability and probability	ability distri	ibut	tion,	mas	s and d	lensity funct	tions.			
	CO5: Measure the marginal and conditional dis	stributions.					2				
	CO6: Calculate mathematical expectation, mor	nent and pro	bab	oility	gene	erating	functions.				
	COURSE SYLI	LABUS						T			
Module No.	Conte	ent						Hours			
	[Course Outcome(s) No.: 1, 2, and 3]						2				
	Types of data and level of measurement-nom	inal, ordinal	, in	terva	ul ar	id ratio	, frequency	7			
-	distribution, diagrammatic and graphical repres	entation. Me		ires o	or ce	entral te	endency and	20			
1	Fitting of polynomial curves and curves reducil	ss & Kullos de to polyno	18 U mis	y ui al for	5 1110 m		or moments	. 20			
	Correlation: Karl Pearson's coefficient Spearm	an's rank con	rrel	ation	nn. COE	fficient	Partial and	1			
	Multiple (only two independent variables case)	and Regress	ion	lines	600 5.	meren	i, i urtiur und	•			
	[Course Outcome(s) No.: 4, 5 and 6]	0	-								
	Review of conditional probability and Bayes' th	neorem.									
	Random variables, Probability mass function	(pmf), Prob	abi	lity o	lens	ity fur	ction (pdf)	,			
II	Cumulative distribution function (cdf), Joint p	robability m	nass	func	ctior	n, Joint	probability	20			
	density function, Joint probability distribut	ion function	n,	Marg	ginal	and	conditional	l			
	distribution, Transformation of one-dimensio	onal variable	e.	Math	ema	atical I	Expectation	,			
	Moment generating function and probability ge	nerating fund	ctio	n.							
P. Mu S. C.	 P. Mukhopadhyay, An Introduction to the Theory of Probability, World Scientific, 2012. S. C. Gupta & V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2014. 										
Kelerence Bo											

- J. E. Freund, Mathematical Statistics, PHI, 2001.
- > A. M. Goon, M. K. Gupta & B. Dasgupta, Fundamentals of Statistics, Vol I, World Press, 1991.
- C. E. Weatherburn, A first course of Mathematical statistics, Cambridge University Press, 1961.

Course No:	: 1 Course Name: Data Science – I (Offered by CEA Departm	nent)	Course Code: BCAC 0102						102			
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	T	Р	J	Credits	Contact H	Irs.			
2024-2028	(with specialization in Data Science)	I	3	0	0	0	3	Total Ho	urs: 40			
Total Evalı	ation Marks: 100	Examination Duration: Mid Term (2 hours), End Term (3 hours)										
Theory Acc	aggement 75 Marilia	Pre-requisi	te	of	ίςοι	arse	e: Ni	1				
Internal As	sessment: 75 Marks	Nature of C	0' m	ur	se:	Mi	nor Cou	rses offere	ed by			
Course	This course introduces and helps to understa	nd and imple	me	ent		san berv	rised lea	rning techn	iaues.			
Objective	This course focuses on employability and sk	ill developme	ent	t al	igne	ed v	vith all (CO's.	-1			
	After studying these topics, the students will	be able to:			0							
Course	CO1: Explain the basic concepts, principles and challenges of supervised machine learnin CO2: Select and apply appropriate regression or classification algorithms to solve real- problems using Python.											
 Outcomes CO3: Evaluate and compare the performance and accuracy of different supervised machine learning models using various metrics and techniques. CO4: Enhance their supervised machine learning models using ensemble methods such as bagging, boosting and stacking. CO5: Design and implement an end-to-end machine learning solution with supervised lear for a given problem domain. 								nine as earning				
	COURSE SY	LLABUS										
Module No	o. Con	tent							Hours			
Ι	[Course Outcome(s) No.: 1 and 2] Introduction to supervised machine learning: main challenges and applications? Regression algorithms: Linear regression regression, logistic regression, etc. How to f How to handle outliers, multicollinearity, or for linear regression.	: What is it? v n, polynomia it, evaluate a verfitting and	wh 1 nd u	iy i reg co nd	s it gress omp erfit	use sior are tting	ful? wha n, ridge regressi g, Gradi	at are the and lasso on models. ent descent	20			
 [Course Outcome(s) No.: 3, 4 and 5] Classification algorithms: Support vector machines (SVM), decision trees, random forests, k-nearest neighbors (kNN), naive Bayes classifier, etc. How to fit, evaluate and compare classification models. How to handle imbalanced data, feature selection, and performance metrics. Ensemble methods: What are they, how do they work, what are the benefits and drawbacks of using them? Bagging, boosting, stacking, etc. Popular ensemble algorithms such as adaBoost. XGBoost and CatBoost 							20					
Text Book:									1			
>	Müller, C. Andreas, & S. Guido, Introduction Scientists, O'Reilly Media Inc., 2016.	to machine l	ea	rni	ng v	witł	n Pythor	: A Guide	for Data			
Reference I	Book: S. Shalev-Shwartz, & S. Ben-David. Understar Cambridge University Press, 2014.	nding machin	e	lea	rnin	ıg: I	From the	eory to algo	orithms,			

Course No:	2 Co	ourse Name: Data Science – I Lab	Course Code: BCAC 01						182				
		(Offered by CEA Departm	nent)										
Batch:	Pr	ogramme: B. Sc. Mathematics	Semester:	L	Т	Р	J	Credits	Contact H	Irs.			
	()	With specialization in Data Science)							Per Weel	x: 2			
2024-2028			Ι	0	0	2 0 1 Total Hours							
Total Evalua	ation N	/arks: 100	Examination Duration: End Term (2 hours)										
Internal: 50	Marks		Pre-requisite of course: Nil										
External: 40) Marks	8	Nature of Course: Minor Courses offered by										
Attendance:	10 Ma	rks	other department of same faculty										
Course	This la	ab course introduces and helps to under	stand and im	npl	em	ent	sup	ervised l	earning tec	hniques.			
Objective	This c	ourse focuses on employability and sk	ill developm	en	t al	igne	ed v	with all C	CO's.				
Course	After	studying these topics, the students will	be able to:										
Outcomes	Outcomes CO1: Use software packages for data				zati	on.							
CO2: Apply machine learning for data analysis.													
CO3: Build machine learning models.													
CO4: Evaluate the performance of machine learning models.													
	CU3.	COURSE SY	L LABUS		anu								
Module No		Con	tent							Hours			
		Installation on tools and its basics								Hours			
		Demonstrate simple linear regression											
		Demonstrate regularization in linear re	.i.										
I & II		Demonstrate multiple linear regression	,gression.							20			
		Demonstrate gradient descent in linear	regression										
		Demonstrate classification using logis	tic regression										
		Demonstrate classification using SVM											
		Demonstrate classification using Decision	sion Tree										
		Demonstrate classification on kNN	51011 11ee.										
	 Demonstrate classification using païve Bayes Classifier 												
Tort Dools	Demonstrate chassification using harve Dayes chassificiti												
$\begin{array}{c} 1 \text{ ext book:} \\ & \searrow \\ & \searrow \\ & & S \end{array}$	/lüller, cientis	C. Andreas, & S. Guido, Introduction ts, O'Reilly Media Inc., 2016.	to machine l	ear	min	ıg w	vith	Python:	A Guide f	or Data			
Reference B ≻ S	 eference Book: S. Shalev-Shwartz, & S. Ben-David. Understanding machine learning: From theory to algorithms, 												
Cambridge University Press, 2014.													

Course No:	1 Course Name: Language Skills-I (Offered by Department of F	English)	Course Code: BELA 0003						
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester: L T	r: L T P J Credits Contact Hrs. Per Week: 2						
2024-2028		I 2 0	0 0 2 Total Hours: 30						
Total Evalua	ation Marks: 100	Examination D	uration:						
		Mid Term (2 hou	urs), End Term (3 hours)						
		Pre-requisite of	course: Nil						
Theory Asse Internal Ass	ssment: 75 Marks essment: 25 Marks	Nature of Cours	se: AEC						
Course	The objective of the course is to help st	udents attain a b	asic proficiency in reading and	written					
Objective	communication. The course focuses on lea	arning English laı	nguage through context, develop	ment of					
	reading skills for correct comprehension of a	text, and enhanced	ment of writing skills by using app	oropriate					
	language structures and suitable vocabulary.	This course focus	es on employability and skill deve	lopment					
	aligned with all CO's.								
Course	After studying these topics, the students will	be able to:							
Outcomes	CO1: Enhance their reading skills,								
	CO2: Comprehend a text and answer the que	estions based on it	· •						
	CO3: Enrich their vocabulary, and								
	CO4: Express their ideas in writing in correct	et English.							
	COURSE	SYLLABUS							
Module No.		Content		Hours					
	[Course Outcome(s) No.: 1.2 and 4]								
	Introducing the course details and assessn	nent structure							
	Spoken Activity: Introducing self, Talking a	about daily routine	; talking about one's native place						
	Reading for understanding the content and content below:	ontext and to iden	tify certain language aspects as						
	Text 1: "An Island of Trees" by Ruskin Bond								
	• Sentence: Types (Functional/S	Structural).							
	 Parts of a sentence: Subject/Predicate/Object/Compliment Identifying Parts of speech: Based on Application in the prescribed text Text 2: Essay: "How should one read a book" by Virginia Woolf 								
• Subject -Verb Concord: Agreement of number and person									
Enhancing Word Power: Homophones, homonyms and homographs (Word list will be give									
	Reading Comprehension (Enabler): Reading of a passage and its comprehension.								
	Writing Skill: Application within university for various purposes.								
	[Course Outcome(s) No.: 1, 3 and 4]								
	Reading for understanding the content and	context and to ide	entify certain language aspects as	5					
	given below:								
	Text: "Three Blind Men Describe an Elepha	nt" by E Santhosh	Kumar						
II	Determiners : Articles, Quantifiers,	Distributives							
	Tense: Present, Past and Future; various aspects of tenses and their usage based on								
aforesaid text.									
	1 ext: "Selfitis- the obsessive need to post selfies- is a genuine mental disorder, say psychologists"								
	by Sarah Knapton (An article published in The Telegraph, 15 December 2017, United Kinge								
	Voice: Identification and transformation								
	Writing complaint to authorities about social	issues (power cut	, traffic system, safety issues)						
	Vocabulary: Antonyms/Synonyms (A list o	t selected words w	vill be provided)						
	Story Review: Characterization; language a	spects; social impa	act; moral; theme						
	Theme based writing: Describing relevant i	national/internatio	nal issues, social issues						

Text Books:

- > R. Murphy, Intermediate English Grammar, Cambridge University Press, 1999.
- ▶ G. Leech, & J. Svartvik, A Communicative Grammar of English, Longman, 2003.
- M. Swan, Practical English Usage, OUP, 2016.
- > J. C. Nesfield, English Grammar: Composition and Usage, Macmillan Publishers India, 2019.

Reference Books:

- A. S. Hornby, Advanced Learners' Dictionary of Current English, OUP, 2015.
- > D. Jones, English Pronouncing Dictionary, Cambridge University Press, 2006.

Course No:	1	Course Name: R- Programming Lab	Course Code: BMAK 0						K 0801				
Batch:		Programme: B. Sc. Mathematics	Semester:	L	T	P	J	Cre	dits	Contac	t Hrs		
2024-2028		(with specialization in Data Science)	I 2 0 2 0 3 Total Hour							Hours: 40			
Total Evalua	`otal Evaluation Marks: 100 Examination Duration: End Term (2 h							hours)					
Internal: 50) Ma	rks	Pre-requis	site	of c	cou	rse	e:	Nil				
External: 40 Marks													
Attendance	Attendance: 10 Marks												
Course	Thi	s lab aims to develop an understanding of	f R Studio and R environment, types of different data										
Objective	obje	ects, importing and exporting data, looping	in R and gra	aphi	cal	visu	ıal	izati	on of	data. T	his course		
	focu	uses on employability and skill developme	ent aligned with all CO's.										
	Afte	er studying these topics, the students will	be able to:										
	CO	1: Install and use packages of R.											
	CO	2: Understand types of different data obje	ects.										
Course	CO	3: Import and export data.											
Outcomes	CO	4: Write functions and looping in R.	i R.										
	CO	5: Visualize the data graphically.											
	CO6: Generate random numbers.												
	COURSE SYLLABUS												
Module		Cont	ent								Hours		
N0.	10												
		burse $Outcome(s)$ No.: 1, 2, 3, 4, 5 and	6]						1	(D			
	Intr	oduction to R, R Studio and R environm	nent. Installi	ng	and	usi	ing	; pac	kage	es of R.			
	Types of different data objects : vectors, matrices, factors, arrays, lists and data frames.								ta				
									or				
	vector antimetic, generating regular sequences, nanoling missing values, character												
Т/ТТ	Importing and exporting data. Combining different datasets, Operations on vectors								*0				
1/11									13				
	proprocessing												
	proprocessing. Craphical viewalization of data, Wate groups have also stars loof from a second stars								n				
	nie chart and agive Customization of plot settings, adding lagends and taxt to a plot												
	Generating random numbers and sampling procedures									<i>.</i>			
Toyt Books:	UCI	ierating random numbers and sampling	procedures.										
Text DOORS.	N	Condenan Designing D. The Statistics			La			~ W		2012			
		I. Gardener, Beginning K. The Statistica	r Flogrammi	inng ati a	Lai	ngu	lag	e, w	ney	$\frac{2012}{100}$			
	C N	ambridge University Press, 2007.	irse in Statis	stica	1 1 P	rog	rai	nmi	ng w	nn K,			
Reference R	ook												
		[I Crowley Statistics: An Introduction	Liging D W	lila-	., า (015							
	Γ IV. S T	Albert & M Dizzo D by Examples Co	USING K, W		y, ∠(013	·.						
	J.	Albert & W. KIZZO, K by Examples, Sp	1111gel, 2012	<u>-</u> .									

Course No:	1 Course Name: First Aid and Basic Health	1	1		Co	ur	se	Cod	e: B	PSO ()005
Batch:	Programme: B. Sc. Mathematics	Semester:	L	Т	P	J	C	redit	sCo	ntact	Hrs
	(With specialization in Data Science)	т	_	_		_			Pe	r Wee	ek: 2
2024-2028			2	0	0	0		2	То	tal Ho	ours: 30
Total Evalu	ation Marks: 100	Examinati	on	Du	rat	10	n:	End	Tern	n (3 h	ours)
Theory Asso	essment: 100 Marks	Pre-requis	site	of	cou	Irs	se:	Nil			
Course	The objective of the course is to develop the ski	skills in students to assess illness, provide CPR to hel									R to help
Objective	persons. It focuses on learning sex education to youth and help them to understand natural								l change		
	of adolescence. This course focuses on employa	ability and s	kill	dev	velo	pn	nei	nt alig	gned	with a	all CO's.
	After studying these topics, the students will be	able to:									
Course	CO1: Learn the skill needed to assess the ill or	or injured person.									
Outcomes	CO2: Learn the skills to provide CPR to infants	the skills to provide CPR to infants, children and adults.									
Outcomes	CO3: Learn the skills to handle emergency child birth. CO4: Learn the Basic sex education and help young people navigate thorny questions responses										
										oonsibly.	
	CO6: Help to understand natural changes of ad	olescence	ers	tanc	1 56	X	1S 1	iorma	al.		
	CO7 : Learn the skill to identify Mental Health	olescelice.	SVC	hol	ممنا	ral	Fi	rst A	id		
	COURSE SYLI		syc	1101	ogn	<i>-</i> ai		IST A	iu.		
Module No	. Conte	ent									Hours
	[Course Outcome(s) No. 1.2 and 2]	-									
	[Course Outcome(s) No.: 1, 2 and 5] Basic First Aid										
	• Aims of first aid & First aid and the law	7									
	 Dealing with an emergency Resuscitation 	on (basic Cl	PR								
	Becovery position Initial top to toe asset	assmant	· • •								
	 Hend weaking and Hugiana 										
	• Hallu washing and Hygiene										
	• Types and Content of a First Aid Kit										
	Dressings and Bandages										
	 Dressings and Bandages. Fast evacuation techniques (single rescuer). 										
	• I ransport techniques.										
-	Basics of Respiration										
I	 No breathing or difficult breathing Dro 	wning Cho	kin	σS	trar	וסו	ปล	tion a	nd		15
	hanging,	, ming, eno		5, 0		-8.					
	 Swelling within the throat, Suffocation by smoke or gases and Asthma. First aid related with Heart, Blood and Circulation Basics of The heart and the blood circulation. 										
	Chest discomfort, bleeding.										
	 First aid related with Wounds and Injuries Type of wounds, Small cuts and abrasions Head, Chest, Abdominal injuries Amputation, Crush injuries, Shock 										
	First aid related with Bones, Joints Muscle re	elated injur	ies								
	Basics of The skeleton, Joints and Muse	cles.									
	• Fractures (injuries to bones).										
	First aid related with Nervous system and U	nconsciousr	less	5							
	• Basics of the nervous system.			F	•1						
	• Unconsciousness, Stroke, Fits – convuls	sions – seizu	ires	5, EJ	pile	ps	у.				
	PITSE and related with Gastrointestinal Tract										
	Dastes of the gasitofilesullar system. Diambag Each paigoning										
	• Diarrnea, Food poisoning.										
	r irst aid related with Skin, Burns										

	• Basics of The skin.	
	• Burn wounds, Dry burns and scalds (burns from fire, heat and steam).	
	• Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke.	
	• Frost bites (cold burns), Prevention of burns, Fever and Hypothermia.	
	First aid related with Poisoning	
	• Poisoning by swallowing, Gases, Injection, Skin	
	First aid related with Bites and Stings	
	• Animal bites, Snake bites, Insect stings and bites	
	First aid related with Sense organs	
	 Dasic of Sense organ. Expression chicasta in the avector mass on skin 	
	Foleign objects in the eye, ear, nose of skin.	
	• Swallowed loreign objects. Specific emergency satisfion and disaster management	
	• Emergencies at educational institutes and work	
	Road and traffic accidents	
	Freegencies in rural areas	
	 Disasters and multiple casualty accidents 	
	Triage	
	Emergency Child birth	
	[Course Outcome(s) No.: 4, 5, 6 and 7]	1
	Basic Sex Education	
	• Overview, ground rules, and a pre-test	
	Basics of Urinary system and Reproductive system.	
	• Male puberty — physical and emotional changes	
	• Female puberty — physical and emotional changes	
	Male-female similarities and differences	
II	• Sexual intercourse, pregnancy, and childbirth	15
	• Facts, attitudes, and myths about LGBTQ+ issues and identities	
	Birth control and abortion	
	• Sex without love — harassment, sexual abuse, and rape	
	• Prevention of sexually transmitted diseases.	
	Mental Health and Psychological First Aid	
	Mental Health and Psychological First Aid	
	• What is Mental Health First Aid?	
	Mental Health Problems in the India	
	The Mental Health First Aid Action Plan	
	Understanding Depression and Anxiety Disorders	
	Crisis First Aid for Suicidal Behavior & Depressive symptoms	
	• What is Non-Suicidal Self-Injury?	
	 Non-crisis First Aid for Depression and Anxiety 	
	Crisis First Aid for Panic Attacks, Traumatic events	
	Understanding Disorders in Which Psychosis may Occur	
	Crisis First Aid for Acute Psychosis	
	Understanding Substance Use Disorder	
	Crisis First Aid for Overdose, Withdrawal	
	Using Mental Health First Aid	

Text Books:

- > P. Orenstein, Girls and sex: Navigating the complicated new landscape, Harper, 2017.
- E. Schwiegershausen, The Cut. www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html.
- > G. Wiggins and J. McTighe, Understanding by design. Alexandra, VA: ASCD, 2008.

References:

- D. Finkelhor, The prevention of childhood sexual abuse. Durham, NH: Crimes Against Children Research Center. www.unh.edu/ccrc/pdf/CV192. Pdf, 2009.
- L. Kantor and N. Levitz, Parents' views on sex education in schools: How much do Democrats and Republicans agree? PLoS ONE, 12 (7): e0180250, 2017.
- https://marshallmemo.com/marshall-publications.php#8
- https://mhfa.com.au/courses/public/types/youthedition4
- Red Cross First Aid/CPR/AED Instructor Manual
- > Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf
| Course No: | 4 Course Name: Matrices and Differential Equ | ations and | | | С | ou | rse C | ode: BMA | C 0002 | | | |
|---------------------|--|-----------------------|---------------------------|--------------|-------------|--------------|---------------------|----------------|--------------|--|--|--|
| | Geometry | 1 | | | | 1 | r | 1 | | | | |
| Batch: | Programme: B. Sc. Mathematics | Semester: | L | Т | P | J | Cred | lits Contact | Hrs | | | |
| | (With specialization in Data Science) | | ~ | 1 | 0 | 0 | | Per We | ek: 6 | | | |
| 2024-2028 | / M 1 100 | | 5 | | 0 | 0 | 6 | Total H | ours: 60 | | | |
| Total Evalua | ation Marks: 100 | Examinati
Mid Torm | $\frac{\mathbf{on}}{(2)}$ | Du | rai | tioi
5. | n:
nd Tai | rm (2 hour | .) | | | |
| | | Pro-requis | (2 I
vita | | (S) | , El
Irc | | |) | | | |
| Theory Asse | ssment: 75 Marks | Differentia | | or u
alcu | ilm | u 5
s ai | c.
nd Int | eoral Calci | ilus | | | |
| Internal Ass | essment: 25 Marks | Nature of | | urs | e: | Ma | aior C | ourse as pei | | | | |
| | | common m | inir | num | 1 SV | ylla | bus | ourse us per | | | | |
| | This course will develop a profound understand | ding of oper | atic | ons o | on | ma | trices, | , Eigen valu | es, Eigen | | | |
| Course | vectors of a matrix, complex functions and its properties, formation and solution of c | | | | | | | | | | | |
| Course
Objective | differential equations of first and higher order | s. This cour | se | will | al | lso | provi | de the know | vledge of | | | |
| Objective | three-dimensional coordinate geometry and its | applications | s. T | his | co | urse | e focu | ses on emp | loyability | | | |
| | and skill development aligned with all CO's. | 11 | | | | | | 1 | 5 5 | | | |
| | After studying these topics, the students will be | able to: | | | | | | | | | | |
| | CO1: The subjects of the course are design | ed in such | av | vav | th | at | thev t | focus on d | eveloping | | | |
| | mathematical skills in algebra, calculu | is and analy | vsis | an an | d | giv | e in | depth know | vledge of | | | |
| Course | geometry, calculus, algebra and other the | eories. | ,
, | | | C | | 1 | U | | | |
| Outcomes | CO2: The student will be able to find the ra | nk, eigen v | alu | es o | of 1 | mat | rices | and study | the linear | | | |
| | homogeneous and non-homogeneous eq | uations. The | e co | ourse | e ii | n di | ifferer | ntial equation | n intends | | | |
| | to develop problem-solving skills for | solving vari | ous | typ | pes | of | diffe | rential equ | ation and | | | |
| | geometrical meaning of differential equa | tion. | | - h | | | ndinat | a accession | and laam | | | |
| | to describe some of the surface by using | analytical or | as a | auou | u c | :00 | lumau | e geometry | | | | |
| | CO4: On successful completion of the course | e students | hav | ve ø | y.
vair | ned | knov | vledge aboi | it regular | | | |
| | geometrical figures and their propertie | s. They hav | e t | he f | fou | inda | ation | for higher | course in | | | |
| | Geometry. | · | | | | | | e | | | | |
| | COURSE SYL | LABUS | | | | | | | | | | |
| Module No. | Conte | nt | | | | | | | Hours | | | |
| | [Course Outcome(s) No.: 1, 2, and 3] | | | 1.0 | | | c | . • • | | | | |
| | Matrices: Rank of a Matrix, Echelon form of a | a Matrix, No | orm | al to | orn | n o | t a Ma | atrix, Invers | e | | | |
| | of a Matrix by elementary operations, Sy homogeneous equations. Theorems on consistent | stem of h | nea | r n
nof | on
E 1: | 10g | eneou | s and nor | l- | | | |
| | values Figen vectors and characteristic equation | n of a matrix | C | n or
avle | v-1 | nea
Har | nilton | theorem an | d | | | |
| T | its use in finding inverse of a matrix. | i oi u muunx | , 0 | uyic | y I | Iui | miton | theorem un | 30 | | | |
| 1 | Complex functions and congration into rea | I and imag | ino | 111 7 | n 01 | rta | Evn | opontial op | 4 | | | |
| | Logarithmic functions Inverse trigonometric a | nd hyperboli | nna
c fi | inct | pa
ior | 118,
19 | Ехр | mential an | u | | | |
| | Comparent L. Concept equation of second dos | raa Sustam | | | | 10.
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| | Confocal confest, Foral equation of confest and fits | i abt ling in (| 1111 | | | | sional | coordinate | 5, | | | |
| | Projection and direction cosines, Plane and Stra | light line in (| Inte | e di | me | ens | ions. | | | | | |
| | [Course Outcome(s) No.: 1, 5 and 4]
Differential Equations: Geometrical manning | of a differen | ntio | 1 00 | 110 | tion | ı Fau | ation of fin | at | | | |
| | order and first degree Exact differential equa | tions and e | 111a
111a | tion | lua
s r | uoi
œdi | i, Equ
icible | to the exa | su
st | | | |
| | form. First order higher degree equations sol | vable for x. | 144
V. | p: | Cl | aira | aut's e | equation an | d | | | |
| II | singular solutions, Orthogonal trajectories, Line | ar differenti | al e | quat | tio | n o | f order | r greater tha | n 30 | | | |
| | one with constant coefficients, Cauchy- Euler f | orm, Simulta | ane | ous | dif | ffer | ential | equations. | | | | |
| | Geometry II: Sphere, Cone and Cvlinder. Cen | ral conicoid | s. F | Paral | bol | loid | ls, Pla | ne section of | of | | | |
| | conicoids, Generating lines, Confocal conicoids | s, Reduction | of | seco | onc | <u>l d</u> e | egree e | equations. | | | | |

- Stephen H. Friedberg, A.J Insel & L.E. Spence, Linear Algebra, Pearson, 2022.
- S.L. Loney, The Elements of Coordinate Geometry, McMillan, 2016.
- B. Rai, D.P. Choudhary & H. J. Freedman, A Course in Differential Equations, Narosa, 2002.
- > H. Kishan, N. Swaroop & S. S. Shukla, Matrices and Differential Equations, RP Publications, 2022.
- S. P. Nigam, S. S. Gangwar & H. Kishan, Coordinate Geometry, RP Publications, 2022.
- R. S. Gupta & R. D. Pathak, Conic Sections, Pothishala Pvt. Ltd., 1998.

- > D.A. Murray, Introductory Course in Differential Equations, Orient Longman, 2017.
- > Robert J.T Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan, 1994.
- S.P. Nigam, S.S. Gangwar & H. Kishan, Coordinate Geometry, RP Publications, 2021.
- > P.R. Vittal, Analytical Geometry 2D & 3D, Pearson, 2013.
- Suggested digital platform: NPTEL/SWAYAM/MOOCs
- Course Books published in Hindi

Course No:	3	Course Name: Database Management	System		0	Cour	rse	e Code	: MCAC (009		
	(Offered by CEA Department)											
Batch:		Programme: B. Sc. Mathematics	Semester:	L	T]	P J		Credit	s Contact	Hrs		
0004 0000		(With specialization in Data Science)	TT	2	0			2	Per Wee	k: 3		
2024-2028	. 4 ° 1	Marshar 100	11	3	0	0 0)	3	Total He	ours: 36		
Total Evalua	ation I	vlarks: 100	Examination Duration:									
			Mid Term	(21	100	rs),	E	nd Teri	m (3 hours	s)		
Theory Asse	ssmen	nt: 75 Marks	Pre-requis	site	of	cou	rs	e: Nil				
Internal Ass	essme	nt: 25 Marks	Nature of Course: Minor course offered I									
	_		other department of same faculty									
Course	To ac	quire the knowledge of database design,	, data model	s a	nd	data	ba	ise lang	uages and	to study		
Objective	the ph	iysical and logical database designs, datal	base modelin	1g,	rela	ation	al	, hierar	chical, and	network		
	After	studying these topics, the students will h	and skill dev	vei	opn	nent	a	igned v	vith all CO	S.		
	COL	Studying these topics, the students will be	e able to.	of a	lata	haa						
Course	COI:	Design EP Model and Palational Datab	pplications (01 C	rata	Dase	e S Serl	ystems d appli	cotion giv	on		
Outcomes	CO2.	unambiguous problem statement	ase Schema	101	100	u wu	Л	lu appli	cation, giv	CII		
	CO3:	Implement SOL queries to access data.	given relatio	nal	da	taba	se	schem	a.			
	CO4:	Implement views, constrains and index,	PL/SQL pro	oce	dur	es a	nd	functio	ons for a gi	ven		
		scenario.							C C			
	CO5:	Develop relational algebra expressions,	given the re	lati	ona	ıl da	ta	base scl	hema.			
	CO6:	Understand and apply database normali	zation princi	iple	s.							
	CO 7:	Describe the concepts of transaction and	d classificati	on	of c	latal	oa	se.				
	1	COURSE SYL	LABUS							1		
Module No.		Conte	ent							Hours		
	[Coul Intro	rse Outcome(s) No.: 1, 2, 3, 5 and 6] duction: An Overview of Database Man	agamant Sw	ator	n I	Jata	ha	so Syst	om Va File			
	Susta	System Database System Concert and Architecture Data Model Scheme and Instances										
т	Doto	Independence Database Language and	Interfaces (יויי	Jue		ne IT		Database	,		
-	Data	lopmont Life Cycle (DDL C) with Cose S	tudios		۳L,		L	, DCL)	, Database			
	Deve	Modeling Using the Entity Deletionsk	in Model	БD	М	o dal	C	oncont	Notation			
		Modeling Using the Entity-Relations		CK	IVI - 1:		C	Concept	s, inotation	l		
		EK Diagram, Mapping Constraints,	Keys, Sp Tables Este	Jec.)[] /	, Gene	eranzation	' 18		
	Aggre	egation, Reduction of an ER Diagram to) Ladies, Extended EK Model.									
	Relat	Ional Data Model and Language: Re	egrity Keys Constraints Domain Constraints									
	Const	traints, Entity Integrity, Referential Integr	ity, Keys Co	onst	ran	nts, I	D	omain C	onstraints	,		
	Relati	ional Algebra.	1.0	1		P		17	ъ ·			
	Data	base Design & Normalization I: Function	onal Depend	den	cie	s, Pi	:1n	nary Ke	ey, Foreign	L		
	Key,	Candidate Key, Super Key, Normal Fo	rms, First, S	Sec	onc	1, 11	111	d Norn	nal Forms	,		
	BCN	F, Non-Redundant Cover, Canonical Cov	ver.									
	[Cou	rse Outcome(s) No.: 3, 4, 6 and 7]	Namaal Fam		7.4h	Nor		al Earra				
	Join I	Decompositions MVD and IDs Inclusion	NOMIAI FOM n Dependen	II, .	JUI	INOI	Ш	al Forn	n, Lossiess	5		
п	File (Organization: Indexing Structure of 1	Index files	and	tv	nes	T	Dense a	and Sparse	18		
	Index	ing.			, cj	P•0,	-		and Spans	10		
	Tran	saction Processing Concept: Transac	tion System	n,	Tes	sting	5	of Seri	alizability	,		
	Serial	lizability of Schedules, Conflict & Vie	w Serializa	ble	Sc	ched	ul	e, Reco	overability	,		
	Reco	very from Transaction Failures, Log Base	ed Recovery	, D	ead	lock	c F	Iandlin	g.			
	Conc	urrency Control Techniques: Concu	rrency Cont	trol	, L	ock	ın	g Tech	niques for	ſ		
	Conci	urrency Control, 2PL, Time Stampir	ng Protocol	S 1	or	Co	nc	currency	y Control	,		
	v and Dictri	auon Dascu Fiolocol. ihuted Database. Introduction of Distr	ibuted Data	hae	ا م	Data	F	Tranmer	ntation and	1		
	Repli	cation.	Louiou Daid	Jus	с, I	Jaid	. 1	iuginei	itution ail	•		

R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Pearson, 2010.

- > C. J. Date, An Introduction to Database Systems, Pearson, 1999.
- A. Silberschatz, H. Korth, S. Sudarshan, Database Systems Concepts, McGraw-Hill Education, 2005.
- B. C. Desai, An Introduction to Database Systems, Gagotia Publications, 2010.
- A. Majumdar & P. Bhattacharya, Database Management System, McGraw Hill Education, 2017.

Course No: 4	(o: 4 CourseName: Database Management System Lab Course Code: MCAC									C 0807		
Batch:		Programme: B. Sc. Mathematics	Semester:	nt) emester: L T P J Credit Contact Hi								
2024-2028		(With specialization in Data Science)	Π	0	0	2	0	1	Per V Total	Veek: 2 Hours:24		
Total Evalua	tion 1	Marks: 100	Examination Duration: End Term (2 hour:									
Internal: 50	Mark	ζS	Pre-requis	site	of	co	ur	se: Nil		,		
External: 40 Attendance:) Mar 10 M	ks Iarks	Nature of other depar	Co tme	ours ent	se: of	M	linor co me facu	urse offe ltv	ered by		
Course Objective	To in focus	nplement the concept of entity relationsh es on employability and skill developmen	ip approach at aligned wit	an th a	d d 11 (lata CO	ibas 's.	se langu	ages. T	'his course		
Course	After	studying these topics, the students will be	e able to:									
Outcomes	CO1 CO2 CO3	Apply SQL queries for DML and DDL. Develop the SQL queries for real life sce Implement the procedural language (PL/	enarios. SQL) and Tr	rigg	gers	5.						
Module No.		COURSE SYLLABUS										
I / II	•	Introduction of Data Definition Langua Alter, Drop, Rename). Introduction of Data Manipulation Lan Update, Delete). Introduction of Transaction Control La Language(D.C.L.) Creation, altering and dropping of table constraints while creating tables) exam Queries using Aggregate functions (CC GROUP BY, HAVING and Creation a Queries using Conversion functions (to functions (Concatenation, Ipad, rpad, It substr and instr), date functions (Sysda months_between, least, greatest, trunc, To implement concept of Joins in SQL	age (DDL) an guage (DMI nguage (DMI nguage (T.C es and inserti ples using SI OUNT, SUM nd dropping o_char, to_nu rim, rtrim, lo te, next_day, round, to_cl	nd] .) a .L) ng ELI , A of umb owe , ad nar,	Its of nd &I rov EC' VC Vie per to to	Its Dat WS :: T c G, N ews and upp mo _da	nm Co ca C into om /IA s. d to per, nth ite)	ands. (Command Control	Create, s (Insert e (use MIN), string , length, lay,	t, 24		
Text Books: → R. Eli → P. Sac Persis	masri dalage stence	& S. B. Navathe, Fundamentals of Databa e, & M. Fowler, NoSQL Distilled: A Brief , Addison Wesley, 2012.	ase Systems, f Guide to th	Pe e E	ars me	on, rgi	, 20 ng	010. World o	of Polyg	lot		

- C. J. Date, An Introduction to Database Systems, Pearson, 1999.
 A. Silberschatz, H. Korth & S. Sudarshan, Database Systems Concepts, McGraw-Hill Education, 2010.
- > E. Redmond & J. R. Wilson, Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, O'Reilly, 2012.

Course No: :	Course Name: Programming Logic Using (Offered by CEA Departme	Python nt)			Cou	rse	Code	: BCAE	0003
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	T	P .	I Cr	edits	Contact Per Wee	Hrs ek: 3
2024-2028	(with specialization in Data Science)	II	3	0	0 ()	3	Total H	ours: 40
Total Evalua	tion Marks: 100	Examinati	on	Du	rati	on:	-		
		Mid Term	(21	hou	rs), I	End '	Term	(3 hours)
		Pre-requis	ite	of	cour	se:]	Nil		
Theory Asse	ssment: 75 Marks	Nature of	Co	urs	e: N	lino	r cour	se offered	l by
Internal Ass	essment: 25 Marks	other depart	tme	ent	of sa	me f	faculty	<u>/</u>	D 1
Course Objective	programming, construct data structure using O course focuses on employability and skill deve	ntax and s O concepts a lopment alig	sen and ned	its wi	conr th all	and hective CO	func vity w 's.	vith datab	Python ase. This
	After studying these topics, the students will be	e able to:							
	CO1: Identify the Python's data type - numbers	s, list, tuple, s	stri	ng,	dicti	onar	y, clas	ss.	
G	CO2: Recognize Python syntax, semantics, a	nd flow con	trol	l —if	felse	e, fo	r loop	o, while l	oop, and
Course	function.	1							
Outcomes	CO3: Apply the concepts of file handling and p	ackages.							mhiana af
	cO4: Oliderstand the basic concepts - abstraction	on, encapsui	anc	л, і	mer	itanc	e, and	i porymor	pinsin oi
	CO5. Describe the basic concepts of regular ex	nressions							
	CO6: Demonstrate database connectivity with	applications							
	COURSE SYL	LABUS							
Module No.	Conte	ent							Hours
	[Course Outcome(s) No.: 2 and 5]								
I	 [Course Outcome(s) No.: 2 and 5] Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving: Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming. Overview of Python Programming: History, Features, Structure of a Python Program, Elements of Python, IDEs for python, Python Interpreter, Using Python as calculator, Python shell, Indentation. Introduction to Python: Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator). Creating Python Programs: Input and Output Statements, Control statements (Looping- while Loop, for Loop, Loop Control, Conditional Statement- ifelse, Difference between break, continue and pass). 								
II	 Structures: Numbers, Strings (Introduction, Accessing String Functions), Lists (Introduction, Accessing list, Basic Op Tuples (Introduction, Accessing tuples, Functions), Sets (Introduction, Accessing sets, Basic Op Dictionary (Introduction, Accessing v dictionaries), 	s, Basic perations, W Basic Opera perations, W alues in o	Or ork ttio ork dic	ing ns, ing tion	tions with Wor with aries	, S List king sets , w	String s, Fur g with , Func vorkin	slices, nctions), n tuples, ctions), ng with	20
	Functions: Defining a function, calling a Arguments, Anonymous functions, Global and	function, T d local varia	ype ble	es o es.	of fu	Inctio	ons, I	Function	

	Introduction to Advanced Python: Objects and Classes, Inheritance, File Handling,	
	Regular Expressions, Event Driven Programming, GUI Programming. Basic concepts of	
	concepts of Package and modules.	
Text Books:		

- > C. R. Severance, Python for Informatics: Exploring Information, CreateSpace Independent Publishing Platform, 2013.
- > P. Wentworth, J. Elkner, Allen B. Downey & C. Meyers, how to Think Like a Compter Scientist: Learning with Python, Open Book Project, 2012.

- M. Lutz, Learning Python: Powerful Object-Oriented Programming, O'Reilly, 2013.
- ▶ W. J. Chun, Core Python Applications Programming, Pearson Prentice Hall, 2012.
- A. Martelli, Python in a Nutshell, Oreilly & Associates Inc, 2006.

Course No: 6	: 6 Course Name: Python Programming Lab Course Code: BCAE 08											
	(01	ffered by CEA Depart	ment)									
Batch:	Programme: B. (With specializ	Sc. Mathematics zation in Data Science)	Semester	: L	T	Р	J	Credit	Contact H Per Weel	Hrs. k: 2		
2024-2028			II	0	0	2	0	1	Total Ho	urs: 24		
Total Evaluati	on Marks: 100		Examinat	ion	Du	rati	ion:	End Te	erm (2 hour	·s)		
Internal: 50 M	larks		Pre-requi	isite	e of	cou	irse	e: Ni	1			
External: 40 N	Aarks		Nature of	f Co	our	se:	Miı	nor cour	se offered	by other		
Attendance: 10	0 Marks		departmen	t of	sar	ne f	acul	lty				
Course T	The course is designed to provide basic knowledge of Python. Python programming is											
Objective _{fo}	for software engineers, system analysts, program managers and user support personnel											
to	b learn the Pytho	n programming langua	ige. This co	urse	e fo	cuse	es o	n empl	oyability a	ind skill		
d	evelopment aligne	ed with all CO's.										
Course A	fter studying thes	e topics, the students wi	ill be able to:									
Outcomes C	CO1: To develop	proficiency in creating	g based appl	icat	tion	s us	sing	the Py	thon Prog	ramming		
	Language.											
C	CO2: To be able	to understand the varie	ous data stru	ctu	res	avai	ilab	le in Py	thon prog	ramming		
	language and	dapply them in solving	computation	al p	rob	lem	5.					
	CO3: To be able to	o do testing and debuggi	ing of code w	ritt	en i	n Py	ytho	n.				
	CO4: To be able to	do text filtering with re	egular expres	S101	ns 1	n Py	tho	n.				
		COURSE S	Y LLABUS									
Module No.		Co	ontent							Hours		
I & II 1	 Write a Python Write a menu Celsius and vio Write a menu rectangle, squa user. WAP to calcul each of the threa following crite Grade A: Perco Grade B: Perco Grade B: Perco Grade C: Perco Grade E: Perco Grade D: Perco	a program to convert all a program to convert all a program to convert all r odd and prints an appr driven program to conver- ce versa depending upor driven program, using are, circle and triangle b ate total marks, percenta es subjects are to be inpu- tria: entage >=80 entage>=70 and <80 entage>=60 and <70 entage>=40 and <60 entage<40 y the first n terms of Fih actorial of the given num um of the following seri- late the sum and produc- driven program to creat	y) (x - y). time units in es whether a opriate mess- ert the given n user's choic user-defined by accepting age and grade ut by the user bonacci serie nber. tes for n term t of two com	to s giv age ten ce. d fu sui e of f : As s. s. s. s.	-2 ble 3D	nds. num he u ratur ions le in ude n gr 2/2! mat obje	+ 3/ rrice	(accep om Fah find th parame Marks o s accord	ted by the renheit to a area of eters from btained in ling to the n/n!.	24		

- A. B. Downey, Think Python: How to Think Like a Computer, Shroff/O'Reilly, 2016.
- P. Wentworth, J. Elkner, Allen B. Downey, & C. Meyers, How to Think Like a Computer Scientist: Learning with Python, Open Book Project, 2012.

- > J. V. Guttag, Introduction to Computation and Programming Using Python, MIT Press, 2013.
- R. Nageswara Rao, Core Python Programming, Dreamtech Press, 2018.
- > W. J. Chun, Core Python Programming, Pearson Education, 2007.
- M. T. Goodrich, R. Tamassia & M. H. Goldwasser, Data Structures and Algorithms in Python, Wiley, 2013.

Course No:	1 Course Name: Project Management (Offe	ered by IB	M)	Cou	irse	Code	BBAO 8	8004
Batch:	Programme: B. Sc. Mathematics Sec.	emester:]	L T	Р	JC	credits	sContact I	Irs.
	(With specialization in Data Science)						Per Wee	k: 3
2024-2028		II	3 0	0	0	3	Total Ho	urs: 40
Total Evalı	iation Marks: 100 E	xaminatio	n Dı	ırat	ion:			
	M	lid Term (2	2 hou	ırs),	End	l Term	(3 hours)	
Theory Ass	essment: 75 Marks	re-requisit	te of	cou	rse:	N11	1. 0	
Internal As	sessment: 25 Marks	ature of C	ours	se:	Mul	tidiscip	plinary Cou	irse
Course	The course is designed to provide basic know	vledge of t	vpes	of r	oroje	cts, te	chniques c	f project
Objective	management, project identification and selectio	n. It also pr	ovide	es kr	iowl	edge o	f project sc	heduling
Ū	and networking along with EVA and proje	ct terminat	ion	proc	cess.	This	course for	cuses on
	employability and skill development aligned w	ith all CO's	s.	r				
Course	After studying these topics the students will be	e able to:						
Outcomes	CO1: Develop work breakdown structure of a	project						
outcomes	CO2: Identify the costs associated to the project	ct managen	nent.					
	CO3: Apply the techniques like CPM and PER	RT.						
	CO4: Identify the sources of finance for the pu	rpose of pr	oject	: fun	ding	5.		
	COURSE SYLL	ABUS						
Module No	o. Conte	nt						Hours
	[Course Outcome(s) No.: 1, 2 and 4]							
	Definitions & Characteristics of Project, Types	of Projects	s, Pro	oject	Life	e Cycle	e,	
	Project Management Process: Introducti	on, Tools	&	Te	chni	ques	of Projec	t
Ι	Management.		-					
	Project Team and Scope of Project Managemen	nt, Project (Jrga	nizat	tion.		1	
	Project Identification & Selection: Identification	tion, Gener Madey Ma	ation	1 ו ו 0 ת-ג	laeas	s, Appi	olucie	20
	Techniques: Survey & Trend Projection Meth	ods Project	t Ris	αĽ kM:	anao	inu An rement	aly818	20
	Project Costing: Fundamental components of	f Project C	ost.	Tvp	es of	f Costs	s: Direct.	
	Indirect, Recurring, Non-Recurring, Fixed, V	ariable, No	orma	ıl, E	xpec	lite co	sts. Projec	t
	Financing and Budgeting: Sources of F	Finance, So	ocial	Co	ost l	Benefi	t Analysis	5
	(SCBA) of Project.							
	[Course Outcome(s) No.: 3]							
II	Project Scheduling and Network Analy	vsis: Steps	in	Pro	ject	Schee	duling and	1
	Network design, Introduction to CPM and PE	KT. Moni	torin	ig ar	nd C	ontrol	: Planning	20
	Analysis and Tracking Gantt chart	agement m	TOLL	iatio	n S	ystem.	Milestone	20
	Earned Value Analysis (EVA): Planned	Value(PV)) E	arne	d V	alue (EV) Cos	t
	Variance (CV). Schedule Variance (SV). C	ost perform	nanc	e In	ıdex	(CPI)	. Schedule	
	performance Index (SPI).	1				· · ·	,	
	Project Termination: Types of Termination	ns, Project '	Tern	nina	tion	Proce	ss.	
Text Book:					-			
	P. Chandra, Project- Preparation, Appraisal, Bud	geting and	Impl	eme	ntatı	on, TN	ИН, 1987.	
Reference 1	Books:		_		. .			
	J. R. Meredith & S. J. Mantel Jr., Project Manage Sons 2008	ement- A M	lanag	geria	ıl Ap	proacl	h, John Wi	ley &
	S. Marwah, Project Management, Dreamtech Pre	ess, 2011.						
\succ	M. R. Gopalan, Project Management Core Text I	Book, Wile	y, 20	14.				
\succ	N. D. Vohra, Quantitative Techniques in Manage	ement, McC	Graw	Hill	l Edı	ication	, 2017.	
	M. B. Shukla, Entrepreneurship and Small Busin	ess Manage	emen	it, K	itab	Mahal	, 2007.	

Course No: 2	2 Course Name: Language Skills- II (Offered by English Departm	nent)			Co	irse Co	de: BELA	. 0004				
Batch•	Programme: B. Sc. Mathematics	Semester.	T	Т	P 1	Credit	s Contact	Hrs				
Daten.	(With specialization in Data Science)	Semester.	L	T	J	Cicuit	Per We	ek: 2				
2024-2028		II	2	0	0 0	2	Total H	ours: 30				
Total Evalua	ation Marks: 100	Examinati	ion	Du	ratio	on:						
		Mid Term	(21	hour	rs), E	and Tern	n (3 hours)				
		Pre-requis	site	of c	cour	se: Nil						
Theory Asse	ssment: 75 Marks	Nature of	Co	urse	e: A	bility En	hancemen	t Course				
Internal Ass	essment: 25 Marks											
Course	The objectives of this course are to											
Objective	• Sharpen oral skills of the learners,	1 (1 1	• •	Ŧ		1 .11						
	• Equip the learners with some added knowle	• Equip the learners with some added knowledge of English Language skills,										
	• Enable them to write English with correction	ess,		1.:	11							
	• Make the learners contextually apply the ac	equired langu	lag	e ski	IIS, a	ind						
	• Enhance their reading competence.	1-:11 41		.4 .1		1: 41 11	CO'					
	• This course focuses on employability and s	kill developi	net	n all	gnec	i with all	CU S.					
	CO1. Orally describe a situation in success the	aute to:										
Course	CO1: Orally describe a situation in present and $CO2$: Read & comprehend a text with proper i	i pasi, inderstanding	~									
Outcomes	CO3: Enhance their writing skills	muerstanum	g ,									
	CO4: Analyze graphical data in writing.											
	CO5: Apply the acquired language skills in co	ntext, and										
	CO6: Enrich their vocabulary in terms of conte	extual and sit	tuat	tiona	ıl bad	ckground	l.					
	COURSE SYL	LABUS										
Module No.	Cont	ent						Hours				
	[Course Outcome(s) No.: 1, 2, 3 and 4]											
	Introducing the course details and assessme	nt structure										
	Describing Situations through Pictures: Des	cribing Pictu	res	ora	lly &	in writte	en form					
	Reading: Reading a text to understand the con	tent, identify	an	d us	e lan	guage as	pects as					
	given below: Toyt: "The Only American from Our Village"	hu Amın Ioal	h;					20				
I	Punctuation Marks: capitalization fu	Uy Aluli Josi Il ston		ano	tion	mark or	alamatar	20				
	• Functuation Warks. capitalization, fu	n stop, com	na,	que	stion	mark, ez	Clamatory	y				
	Word Formation: Inflection Derivati	on Compour	ndi	no I	Rlend	ling & C	linning					
	Ouestion Tags: Formation and usage	on, compou	iiui.	16, 1	JICIN	ing a c	npping					
	Reading Comprehension: Reading of a passa	ge and its co	mp	rehe	nsio	n.						
	Writing Skills:	0	1									
	1. Film Review 2. Developme	ent of story u	sin	g ke	y exp	pressions						
	Presentation skills: Planning and delivery											
	[Course Outcome(s) No.: 1, 2, 3, 5 and 6]											
	Spoken Activity: Describing a past event	1										
	Reading: Reading to understand the content, in	dentify and u	se	lang	uage	aspects	as given					
TT	Delow: Text: "How the Camel Got his Hump" by Pud	vord Kinling	-					20				
11	Narration: Direct into Indirect narratic	yaru Kipiling on and its cor	; nve	rsin	1			20				
	Conditional Sentences: Types and usa		IVC	15101	1.							
	Arranging ideas systematically: Jumbled Ser	itences										
	Comprehension of Graphical Data: Describi	ng graphs										
	Vocabulary: One word substitution	50 T										
	Writing Skills:											
	Precis Writing											
	• Letter to the Editor											

- R. Murphy, Intermediate English Grammar. Cambridge University Press, 2018.
- G. Leech & J. Svartvik., A Communicative Grammar of English. Longman, 2003.
- M. Swan, Practical English Usage, OUP, 2016.

- > D. Jones, English Pronouncing Dictionary, Cambridge University Press, 2006.
- > J. C. Nesfield, English Grammar: Composition and Usage, Macmillan Publishers, 2019.
- A. S. Hornby, Advanced Learners' Dictionary of Current English, OUP, 2015.

Course No: 2	2 Course Name: Human Values and En (Offered by Chemistry & English	vironment : Departmen	studi ts)	ies	Co	our	se Coo	de: BCHC	0 0012
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	Т	Р	J	Credit	sContact l Per Wee	Hrs. k: 2
2024-2028		II	2	0	0	0	2	Total Ho	ours: 30
Total Evalua	ation Marks: 100	Examinati Mid Term	on I (2 h	Dur	at s),	ion Ene	: d Tern	n (3 hours)	
		Pre-requis	site o	of c	ou	rse	: N	il	
Theory Asse Internal Ass	ssment: 75 Marks essment: 25 Marks	Nature of	Cou	rse	: `	VA	С		
Course	The mission of the course on 'Human Valu	ies and Env	ironı	mer	ıtal	l St	udies'	is to create	e morally
Objective	articulate solutions to be truthful and just and	to become r	espo	nsił	ole	tow	vards h	umanity. T	he course
	seeks to establish a continuous interest in the	learners to i	mpr	ove	th	eir 1	though	t process w	ith intent
	to develop a new generation of responsible	citizens ca	pable	e of	fac	ddre	essing	complex cl	hallenges
	faced by the society due to disruptions in hur focuses on employability and skill developm	nan interact ent aligned	ions with	effe all	ecti C(ing D's.	humar	n values. Th	is course
	After studying these topics, the students will	be able to:							
	CO1: Building fundamental knowledge of	the interplay	of 1	nar	ket	ts, e	thics, a	and law	
	CO2: Identify various challenges faced by in	ndividual to	cour	nter	un	leth	ical iss	sues	
Course	CO3: Understand core concepts for business	s ethic and c	ore c	cond	cep	ots c	of anti-	corruption	
Outcomes	CO4: Conceptualize a morally articulate solu	ution evolve	r to r	nan	ag	eme	ent issu	ies in gener	al, Issues
	of sustainable development for a bette	er environme	ent.						
	CO5: Apply environmental degradation tech	nniques for s	usta	inał	ole	dev	velopm	ient.	
	CO6: Analyze the negotiations and internati	onal efforts	to sa	ive	env	viro	nment	•	
	CO7: Understand the efforts made by UN in	Sustainable	e Dev	velo	opn	nen	t.		
	COURSE SYI	LLABUS							
Module No.	Con	tent							Hours
I	[Course Outcome(s) No.: 1, 2, 3, 4 and 5 Human Values- Introduction- Values, Char in Indian Organization Understanding Va (Personal, Professional & Social Ethics) Fu Honesty Values in Business Management, value-ba values in Management. Swami Vivekananda's philosophy of Charact APJ Abdul Kalam view on role of parents ar Self-Exploration and Self Development Human Values and Present Practices – Issu Web and social media, Cyber threats, Online Introduction to sustainable policies and p Ethics Case Studies: 1. The Violation of Privacy 2. Giving In or Giving Up, 3. May the Truth Be with You	5] acteristics, 7 lue Educati indamental ased Organi er Building, ad Teachers. es: Corrupti e Shopping e ractices in	Type: on I Valu zatic Gan on a otc. F Indi	s, D Ethi nes: on, ndhi an an	Dev ics, H Tr 's c Br ned Ec	eloj , M umi ans conc ibe, ies ono	ping V lorality ility, Ii –cultu cept of Privac UK Br omy. P	falue systen & Value ntegrity and ural Human Seven Sins cy Policy in ibery Act, rinciples o	n s d n 15 n f
	Secular and Spiritual Values in Manage values, features, Levels of value Implementat	ement- Intro	oduc s of :	tior spir	n- itu	Sec al V	ular a /alues,	nd Spiritua The Pursui	ll t

	of Purushartha: Dharma, Artha, Kama & Moksha Documentaries:	
	1. The Modern Times	
	2. Right Here Right Now	
	3. Story of Stuff	
	Corporate Social Responsibility- Nature, Levels, Phases and Models of CSR, Corporate	
	Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premii and Bill Gates.	
	Ecosystem: Concept, structure & functions of ecosystem: producer, consumer,	
	decomposer, food web, food chain, energy flow, Ecological pyramids Conservation of	
	Biodiversity-In-situ & Ex-situ conservation of biodiversity Role of individual in Pollution	
	control Human Population & Environment Sustainable Development India and UN	
	Sustainable Development Goals Concept of circular economy and entrepreneurship	
	[Course Outcome(s) No : 1 6 and 7]	
	Holistic Approach in Decision making. Decision making the decision-making process	
	The Bhagayad Gita: Techniques in Management Dharma and Holistic Management	
	Ethical Decision Making: Rationality Critical Thinking Problem Solving & Decision	
	Making	
	Making. Discussion through Dilammas Freedom Individual Dights & Social Walfare Approach	
	Dilemmas in Marketing and Pharma Organizations, moving from Public to Private	
	menonely context. Dilemme of privatization. Dilemme on liberalization. Dilemme on	
	inonopoly context, Dilemina of privatization, Dilemina of fiberatization, Dilemina of	15
II	social media and cyber security, Dilemma on Organic 1000, Dilemma on standardization,	15
	Dhennina on Quanty standards.	
	Case Studies:	
	1. Cyber Harassment	
	2. The case of Surrogacy	
	3. The Case of Euthanasia	
	Environmental Laws - International Advancements in Environmental Conservation Role	
	of National Green Tribunal Air Quality Index.	
	Importance of Indian Traditional knowledge on environment, Bio assessment of	
	Environmental Quality, Environmental Management System, Environmental Impact	
	Assessment and Environmental Audit.	
Text Books:		1
▶ R. R	. Gaur, R. Sangal & G. P. Bagaria, A foundation Course in Human Values and Professiona	.1
Ethic	cs, Excel Books, 2010.	
> M. J.	. Sandel, JUSTICE: What's the Right Thing to Do?, Penguin Books Ltd., 2010.	
A. N	I. Impaini, Human values, New Age International, 2019.	
▶ N. K	. Uberoi, Environmental Management, Excel Books, 2004.	
🖌 🎽 D. K	anneman, Thinking, Fast and Slow, Penguin, 2011.	
References		
bttne	://www.up.org/sustainabledevelopment/sustainable_development_goals/	

https://www.india.gov.in/my-government/schemes
 https://www.legislation.gov.uk/ukpga/2010/23/contents

SYLLABI OF SUBJECTS

Second Year Courses

Course No: 5	5 C	Course I	Name:	Algeb	ora and M	Iathemati	cal Metho	ds		Co	urs	se Code	e: BN	MAC	0003	
Batch:	P	rogran	nme: F	B. Sc. 1	Mathema	atics	Semester	r: L	Δ T	Р	J	Credits	Cor	ntact]	Hrs	
2024 2028	(With sp	peciali	zation	in Data S	Science)							Per	Wee	k: 6	
2024-2028							III	5	1	0	0	6	Tot	al Ho	ours: 60	
Total Evalua	tion N	Marks:	100				Examina	ntion	Dur	ati	on:					
							Mid Terr	n (2 ł	nour	s), l	End	Term	(3 ho	ours)		
							Pre-requ	isite	of c	oui	se:	Differe	entia	l Calo	culus	
Theory Asses	ssmen	nt: 75 M	larks				&Integra	l Cal	culu	s, N	latr	rices, D	iff. I	Equati	ions	
Internal Asse	essme	ent: 25 N	Aarks				Nature o	of Co	urse	: N	Aajo	or Cours	se as	per c	ommon	
							minimum syllabus									
	This	course	will	develo	p a pro	ofound u	nderstand	ing (of g	rou	p,	subgrou	ip a	nd th	neir types,	
Course	homomorphism and isomorphism, ring, subring, integral domain and field. This will											make the				
Objective	studei	nts able	to prov	ve the r	esults ba	sed on gro	oups, subg	roups	s and	lrin	gs. '	This co	urse	will a	lso provide	
	the ki	nowledg	ge of L	Laplace	transfor	m and it	s propertie	es, Fo	ourie	r tr	anst	form al	ong	with o	calculus of	
	variat	tions. Th	nis cou	rse foc	uses on e	employab	ility and s	kill d	evel	opm	nent	aligned	l wit	h all (CO's.	
	After	studvin	g these	e topics	s. the stud	dents will	be able to):		-						
	CO1:	Group	theory	is one	of the h	uilding h	locks of n	noder	n alo	vebr	a (Dhiectiv	e of	this c	course is to	
	001	introdu	ice stu	dents to	o basic c	oncepts o	f Group. H	Ring t	heor	v ai	nd t	heir pro	perti	ies.	000150 15 to	
Course	CO2 :	A stuc	lent le	arning	this cou	rse gets	a concept	of G	roup), R	ing	, Integr	al D	omaiı	n and their	
Outcomes		proper	ties. T	his cou	urse will	lead the	student to) basi	c co	urse	e in	advanc	ed r	nathe	matics and	
outcomes		Algeb	a.													
	CO3 :	The co	ourse g	gives en	mphasis	to enhan	ce student	s' kn	owle	edge	e of	function	ons c	of two	variables,	
		Laplac	e Tran	sforms	s, Fourier	Series.										
	CO4: On successful completion of the course, students should have knowledge about												out higher			
	different mathematical methods and will help him in going for higher studies and research												racarah			
		unitere	m mai	nemati	cal meth	ous and v			5°	0		igner st	udies	s and	research.	
		unitere	III IIIai	nemati	cal meth	JRSE SY	LLABU	S	80m	0	/	igner st	uales	s anu .		
Module No.						JRSE SY Con	(LLABU)	S	5011	0			uales		Hours	
Module No.	[Cou	rse Ou		(s) No	<u>cal meth</u> <u>COU</u> .: 1, 2, 3	JRSE SY Con and 4]	(LLABU)	<u>S</u>							Hours	
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dependent on more than one independent variable, Variational problems in parametric form.	

- > J.B. Fraleigh, A first course in Abstract Algebra, Addison-Wesley, 2003.
- > T.M. Apostol, Mathematical Analysis, Pearson, 2004.
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- Suggested digital plateform: NPTEL/SWAYAM/MOOCS

Batch: Programme: B. Sc. Mathematics (With specialization in Data Science) Semester: L T P J Credits Contact Hrs Per Week: 4 2024-2028 0 4 Total Hours: 40 Fotal Evaluation Marks: 100 Examination Duration: Mid Term (2 hours), End Term (3 hours) Per-requisite of course: Statistics for Data Science - I Fheory Assessment: 25 Marks Nature of Course: Major - 2 Course This course will develop a profound understanding of discrete and continuous probability distributions, Statistical inference and non-parametric statistics. This will also make the students able to know about central limit theorem, types of sampling, statistical hypotheses and analysis of variance (ANOVA). Further, a deep understanding of errors in sampling, level of significance, t distribution, chi-square distribution and F distribution will be developed in this course. This course focuses on employability and skill development aligned with all CO's. Course Dutcomes Co1: Apply the discrete and continuous probability distributions. CO2: Understand the central limit theorem, law of large numbers and Statistical inference analysis. CO3: Identify sampling errors and make statistical hypotheses to apply different distributions. CO4: Learn the concept of analysis of variance and use different tests in non-parametric statistics. CO4: Learn the concept of analysis of variance and use different tests in non-parametric statistics. CO4: Learn the concept of analysis of variance and use different tests in non-parametric statistics. Continuous Probability Distributions: Binomial, Poisson, Negative Binomial, and Geometric distributions. Continuous Probability Dis	Course No: 6	Course Name: Statistics for Data Science-II				Co	our	se Cod	e: BMAC	0102			
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- V. K. Rohatgi & A. K. Md. E Saleh, An Introduction to Probability and Statistics, Wiley, NY, 2005.

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Course No:	7	Course Name: Data Science	II			Cou	rse (Code: BO	CAE 0004	
Batch:		Programme:	Semester:	L	T	Р	J	Credits	Contact I Per Wee	Hrs ek: 3
2024-2028		B. Sc. Mathematics - DS	III	3	0	0	0	3	Total Ho	urs: 40
Total Evalu	ation I	Marks: 100	Examinatio	n D	ura	tion:	1		I	
			Mid Term (2	hou	ırs),	, End	Ter	m (3 hou	rs)	
Theory Ass	essmen	ıt: 75 Marks	Pre-requisit	e of	cou	irse:	Data	a Science	Ι	
Internal As	sessme	nt: 25 Marks	Nature of Co department of	ours of sa	e: M ume	1inor facul	Cou ty	rse offere	ed by other	r
Course	The c	course offers a comprehensive	exploration of	mac	hine	lear	ning	and Dee	p learning	in data
Objective	Scien	ce, covering supervised and u	unsupervised le	arni	ng,	clust	tering	g method	ls, dimens	sionality
	reduc	tion techniques, foundational p	orinciples of art		al no		netv	vorks, co	nvolutiona	ul neural
	devel	opment aligned with all CO's	works. This o	cour	se	locus	es o	on emplo	yadinty a	na skin
	After	studying these topics, the stude	nts will be able	to:						
	CO1:	Understand the concept of	machine learning	ng.	incl	uding	g sur	pervised	and unsu	pervised
Course		learning approaches with the	importance of c	lime	ensio	onalit	y rec	luction te	chniques.	L
Outcomes	CO2 :	Gain a comprehensive ur	nderstanding of	f A	rtifi	cial	Net	ıral Netv	works, bi	ological
	G Q Q	underpinnings, and wide-rang	ging application	s in	data	a scie	nce			
	CO3:	Select and implement approp	oriate optimizers	s to e	enha	ince 1	raini	ing efficie	ency, conv	ergence
	CO4	speed, and model performance Grasp Convolutional Neur	al Networks	VOľK CN	(arc	nitec	tures	5. Dessing t	hair arch	itactura
	04.	components and key propert	ies		115),	enc	Joint	assing t	nen aren	necture,
	CO5:	Understand RNNs. encompa	ssing the handli	ng c	of se	auen	tial c	lata. RNN	architect	ure, and
		variants like LSTM and GRU	J	0		1		,		
		COUR	SE SYLLABI	JS						
Module No	•		Content							Hours
	[Cou	rse Outcome(s) No.: 1 and 2]								
	Mach	ine Learning: Supervised lear	ning, Unsupervi	ised	lear	ning	, Def	inition ar	nd purpose	÷
	of Clu	ustering, Types of clustering alg	gorithm: Hierar	chic	al c	luster	ring,	K-mean	clustering,	,
-		Istering, Sen-Organizing Ma	ap, Dimension	rec	iuci	ion	lecm	inques: 1	CA, and	20
1	Artif	, icial Neural Network : Introd [,]	uction. Historic	al c	over	view.	Bio	logical i	nspiration.	20
	Appli	cations in Data science, Basi	cs of Artificial	neu	iron	s: Ne	euror	n model,	activation	1
	functi	ions, Weighted sum and bias	, Single-layer	Perc	eptr	on: a	archi	tecture, 1	Perceptron	L
	learni	ng rule, Multi-layer Percept	ron: Architectu	ure,	Fee	ed F	forwa	ard and	backward	l
	propa	gation.								
		rse Outcome(s) No.: 3, 4 and	[5] 66			1			DMG	
	Gradi	ent Descent Stochastic Grad	ient Descent (9	SGP	orn D) r	nini_	i ner batel	works:	KMSprop, SGD_with	,
	mome	entum. AdaGrad. Adam.	ient Deseent (, 1	111111-	Jaio	1 50D, 1		L
	Deep	Neural Network : Convolution	n neural networ	k (C	CNN): Ar	chite	ecture, co	mponents.	
II	Prope	erties of CNN, Convolution of	operation (1D,	$2\dot{D}$), a	ctiva	tion	function	s, pooling	5
	techn	iques (max, min, average, globa	al), padding, stri	de,	filte	r, flat	ten l	ayers, ful	ly connect	t 20
	layer,	Regularization techniques (D	ropout, batch r	orm	naliz	ation	, We	eight reg	ularization	L
		2). rrant Naural Natwarks (DNN	Je). Introduction	م مf	500	mont	ial 4	ata Arah	itactura of	
	RNN	Types of RNN· Long short-ter	m memory (LS'	ΓΜ	and	Gate	ai u ed re	aia, Aich current m	nit (GRII)	-
	Forw	ard propagation and backwa	ard propagatio	n t	hrou	igh	time	, Encode	er-decoder	•
	archit	cecture.	1 1 0			U				

- S. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall, 1998.
- > I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, The MIT Press, 2016.

- > A. J. Izenman, Modern Multivariate Statistical Techniques, Springer, 2008.
- > K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Course No: 8	8	Course Name: Data Sci	ence II Lab			Co	our	se Code	BCAE 08	510	
Batch:		Programme:	Semester:	L	T	P	J	Credit	Contact H	Irs	
2024 2028		B Sc Mathematics DS	111	0	0	2	0	1	Per Wee	k: 2	
2024-2028		D. Sc. Mathematics- DS		0	0	2	0	1	Total Ho	urs: 20	
Total Evalua	tion I	Aarks: 100	Examination Duration: End Term (2 hours)								
Internal: 50	Mark	S	Pre-requisite of course	e:]	Bas	ic ı	und	erstandin	g of progra	amming	
External: 40) Marl	KS	concepts, familiarity with	h f	unc	lam	lent	tal Data S	cience con	cepts	
Attendance:	10 M	arks	Nature of Course: Mine same faculty	or (cou	rse	off	fered by c	other depar	tment of	
Course	This l	ab course provides hands-	on experience with Pythor	n pi	rog	ram	ımi	ng langua	age for data	a science	
Objective	applic	ations. Through practica	al exercises and projects	, 5	stud	lent	ts v	will learr	n essential	Python	
	progra	amming skills and technic	lues. This course focuses	on	en	nplo	oya	bility and	l skill deve	lopment	
	aligne	ed with all CO's.									
	After	studying these topics, the	students will be able to:						D (1 1'1		
Course	COI:	Apply Python programm	ing skills to perform data	pr	e-pi	roc		ing using	Python lib	raries.	
Outcomes	CO_2 :	Construct Artificial nou	machine learning algorith	nm uti	is u	sing	g P	ytnon.	ntra fon na	1 month	
outcomes	COS:	roblems	iral network and Convol	uu	опа	.1 11	eur	a netwo	rks for rea	ar world	
	CO4:	Build RNN architecture	like LSTM and GRU to s	مام	ze d	lata	SC	ience pro	hlems		
	001	C	OURSE SYLLABUS	01							
Module No.			Content							Hours	
	•	Introduction of Jupyter	Notebook Google Colab e	env	iro	nm	ent	, python l	ibraries for	r	
		Data Science									
	•	Demonstrate data Pre-p	rocessing								
	•	Demonstrate Hierarchic	cal clustering								
	•	Demonstrate K-mean c	lustering								
I & II	•	Demonstrate Self-Orga	nizing Map							20	
	•	Demonstrate dimension	reduction by PCA							20	
	•	Demonstrate prediction	by ANN model with vari	iou	is o	ptii	miz	zers			
	•	Demonstrate prediction	by DNN model								
	•	Demonstrate the implementation of the complete the comple	nentation of L1, L2 Regul	lari	izat	ion					
	•	Demonstrate the proces	sing of sequential data usi	ing	g RI	NN					
	•	Demonstrate the implement	mentation of LSTM and G	RI	J.						
Text Books: ➤ A. Gé Techr ➤ W. M	éron, H niques IcKinn	lands-On Machine Learni to Build Intelligent Syste ey, Python for Data Anal	ng with Scikit-Learn, Kera ms, Shroff/ O'Reilly, 2019 ysis, O'Reilly Media, 2017	as a Ə. 7.	and	Te	nso	orFlow: C	concepts, T	ools and	

- A. C. Müller and S. Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly, 2016.
- M. Swamynathan, Mastering Machine Learning with Python in six steps: A Practical Implementation Guide to Predictive Data Analytics Using Python, A Press, 2017.

Course No:	3 Course Name: Technical Writing				Co	our	se (Code: BELA	0007		
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	Τ	P	J	Cr	edits Contact Per We	t Hrs ek: 2		
2024-2028		III	2	0	0	0	2	2 Total H	[ours: 28		
Total Evalu	ation Marks: 100	Examinati	ion	Du	ira	tio	n:				
		Mid Term	(2 ł	nou	rs)	, E1	nd 7	Ferm (3 hours	5)		
Theory Ass	essment: 75 Marks	Pre-requis	site	of	co	urs	e: 1	Nil			
Internal As	sessment: 25 Marks										
Course	Technical Writing seamlessly blends the art	of communio	cati	on	wit	th t	he 1	nuances of te	chnology.		
Objective	Tailored for a diverse audience, this course s	serves as a b	eac	on,	gu	uidi	ng	participants to	oward the		
	creation of effective technical documents tailor	red to special	lize	d aı	udi	enc	es.	This course f	ocuses on		
	employability and skill development aligned w	vith all CO's.									
	After studying these topics, the students will be	e able to:									
Course	CO1: Demonstrate rhetorical knowledge to cre	eate effective	tec	chni	ical	l wi	ritin	g documents :	for end		
Course	users.							-			
Outcomes	CO2: Apply and adapt flexible writing process	s strategies to	o pr	odu	ice	cle	ar, ł	nigh-quality			
	deliverables in a multitude of technical	writing genre	es.								
	CO3: Use professional technical writing conve	entions of cle	an	and		ear	des	ign, style, and	layout		
	of written materials.	a that is ann	0.00	into	to	T.O.	fi	ald as domor	stratad		
	by reading and analyzing documents ar	d citing sour	opr.		i lu rrea	y0 ctlv	ui 11	eiu, as demoi	Istrated		
	CO5: Write clearly correctly and concisely	ia ching sour	ces			ctry	•				
	COURSE SYL	LABUS									
Module No	. Cont	ent							Hours		
	[Course Outcome(s) No + 1 and 2]										
	Principles and Style of Technical Writing Si	mplicity									
Т	Avoiding Ambiguity										
-	• Avoiding phrasal verbs and Idiomatic ex	pressions									
	Using Simple Verb Forms										
	Avoiding Redundancies										
	Avoiding Nominalizations										
	Clarity										
	Avoiding Loosely Connected Words and	l Phrases									
	Avoiding Confusing Terms	Maariaaa									
	Avoiding words that Can Have Opposite Avoiding Abbreviations, Contractions, a	e Meanings	,						1.4		
	• Avoluting Abbreviations, Contractions, a	ind Actonyms	,						14		
	Avoiding Figurative Language in General	al									
	Avoiding Technical Terms in Non-Tech	nical Context	s								
	Avoiding Sarcasm and Irony										
	Avoiding Humor and Wordplay										
	Consistency										
	Cohesion										
	Coherence										
	Grammatical consistency Sentence Structure										
	Preferring Simple Sentences to Compour	nd and Comp	lex	Sen	iter	nces	2				
	 Preferring the Active Voice 	ind und comp	ien	Sen	n en		,				
	(Situations and Conditions where passives can be	e useful)									
	Writing Letters and Emails	,									
	Formality and Persuasiveness										
	• Using the 'You Attitude'										
	• Focusing on the benefits for the reader										
	Using a positive tone										

	[Course Outcome(s) No.: 3 and 4]	
	Preparing Agenda and Minutes of Meeting	
	Writing manuals	
II	Writing modular content	
	• Thinking like a user	
	Maintaining a consistent style	
	Writing content	
	Business and Academic Proposals	
	• Types	
	• Style and Format	
	• Writing the draft	
	Revising the content	14
	Reporting	
	• Style and Format	
	• Determining the purpose	
	• Collecting the data	
	• Analyzing the data	
	Organizing the information	
	• Writing the draft	
	Revising the content	
Text Books	5:	
≻ R. I	E. Burnett, Technical Communication, Cengage Learning, 2004.	
> C. C	Glenn and L. Grey. The Writer's Harbrace Handbook, Cengage Learning, 2012.	
≻ M.	A. Rizvi, Effective Technical Communication, McGraw Hill Education, 2017.	
Reference	Books:	

- > M. Raman and S. Sharma, Technical Communication: Principles and Practice, OUP, 2005.
- E. H. Weiss, The Elements of International English Style, Routledge, 2005.
 https://www2.latech.edu/~bmagee/303/eng303.html

Course No: 2	2 Course Name: A	Applications of MS	S Excel			Coi	ırse	e Code:	BBAK 2	804
Batch:	Programme: B. Sc. Mat	hematics-DS	Semester:	L	T	Р	J	Credits	Contact Per We	Hrs ek: 3
2024-2028	6	and	III	3	0	0	0	3	Total Ho	ours: 40
	M. Sc. N	Iathematics								
Total Evalua	ation Marks: 100	Examination Du	iration: End	Te	rm ((2 ho	ours)		
		Pre-requisite of	course: Basic	c k	now	ledg	ge o	f comput	ers and fa	miliarity
Internal: 50	Marks	with MS-Office	applications,	esj	peci	ally	MS	S-Excel,	is recom	mended.
External: 40) Marks	Prior understandin	$r_{\rm s}$ of fundame	nta	u ma	athe	mat	ical conce	epts and a	nalytical
Attendance	10 Marks	skills will be bene	dra of MS E		very	eng	agir	ig with th	tion and	material.
	w Equip students with	i practical knowled	uge of MS E	xce		n du	ISIII	ess analy	ues and e	lecision-
	 Provide a comprehe 	nsive understanding	g of data entry	z fe	orm	attin	o a	nd visual	ization te	chniques
	in Excel.		8	, -						
Course	Develop proficiency	y in advanced Exce	el functions an	nd f	form	nulas	s foi	efficient	t data ana	lysis.
Objective	✤ Enable students to c	create and interpret	complex spre	ead	shee	et m	odel	s for bus	iness scei	narios.
	✤ Foster the ability to	use Excel's advan	nced tools for	da	ta n	nani	pula	tion, cus	tom char	ting, and
	automation using m	acros and VBA.		1		-4 -1	•	1 41 1	1 CO'-	
	After studying these for	vice the students w	ill be able to:	lop	me	iii ai	igne	a with a	I CO S.	
	CO1. Utiliza basic and	l advanced Excel f	functions and	fo	rm11	100.1	for	offective	data anal	veic and
Course	manipulation		unctions and	10	imu	145			uata alla	lysis and
Outcomes	CO2: Apply data visual	lization techniques	to create and	int	terpi	ret c	hart	s and gra	phs.	
	CO3: Implement adva	nced features such	h as PivotTal	ble	s, N	/lacr	os,	and What	at-If Ana	lysis for
	complex data sce	enarios.								
	CO4: Integrate and ana	alyze data from var	rious sources	to	sup	port	bus	iness dec	cision-ma	king and
	reporting.	COURSE S	YLLABUS							
Module No.		Co	ontent							Hours
	Definition and historic	cal evolution of s	spreadsheets,	in	npor	tanc	e c	of spread	sheets in	ı
	business analytics, expl	oration of Microso	ft Excel and C	Goo	ogle	She	eets,	user inte	erface and	l
Ι	customization options,	spreadsheet compo	onents (cells,	rov	ws,	colu	mns	s), cell re	ferencing	g 20
	and addressing, applica	tion of spreadsheet	ts in business	an	alyt	tics,	data	a entry te	chniques	,
	font formatting options	, cell alignment an	nd merging ce	ells	, foi	rmat	ting	tools, co	onditional	L
	formatting rules for data	visualization, crea	ting heat map	s, c	colo	r sca	les,	and data	bars, data	ı
	cleaning, arithmetic op	erators and basic for	ormulas, abso	olut	te ai	nd re	elati	ve cell re	eferences	,
	common functions: SU	M, AVERAGE, C	COUNT, IF an	nd	VL	OOI	KUF	P function	ns, nestec	1
	formulas, debugging an	d troubleshooting f	formula errors	s, a	idva	nceo	d fu	nctions a	nd logical	l
	operations: IF-ELSE,	AND, OR, LEFT,	, RIGHT, M	ID	, SI	JBS	TIT	UTE, R	EPLACE	,
	COUNTA, CEIL, FLO	OR, IFS, MAXIF, N	MAXIFS, MI	NII	F, M	IINI	FS,	SUMIF,	SUMIFS	,
	AVERAGEIF, AVERA	GEIFS, COUNTI	F, COUNTIF	FS,	INI	DEX	K, M	IATCH,	OFFSET	,
	VLOOKUP, HLOOKU	P, XLOOKUP, FII	LTER, and ad	va	ncec	l filt	er.			
	Creating bar, line, an	d pie charts, add	ing trendline	es,	dat	a la	bels	s, and en	ror bars,	,
	customizing chart elem	ents for visual imp	pact, PivotTa	ble	es ar	nd P	ivot	Charts,	advanced	l
Π	formulas, array form	ulas, data valida	tion and pr	ote	ectic	on,	Goa	al Seek,	What-I	
	Analysis, Data Analy	sis ToolPack, IFI	ERROR, cus	tor	n a	nd (dyn	amic cha	arts, data	20
	import from various s	sources, Flash Fil	1. Macro, VI	ΒA	. b	uild	ing	decision	models.	,
1					, -		0			
	integration of external	data sources, slice	ers and timelin	nes	s, da	shb	oard	l creation	n, custom	L

- M. Alexander, R. Kusleika and J. Walkenbach, Excel 2019 Bible, Wiley, 2018.
- > P. Gupta, Microsoft Excel 2019: The Ultimate Guide, BPB Publications.

Reference Book:

≻ K. N. Berk and P. Carey, Data Analysis with Microsoft Excel, Duxbury Press, 2009.

Course No:	1	Course Name: Soft Sk	ills-I			Course Code: BSDH 0301							
Batch:		Programme: B. Sc. Mathematics-DS	Semester: I/III	L	Т	Р	J	Credits	Contact H Per Weel	Hrs s: 3			
2024-2028		and		3	0	0	urs: 40						
		M.Sc. Mathematics											
Total Evalua	ation N	Aarks: 100	Examination	n Dur	ation:	End [Гerm (.	3 hours)					
Theory Asse	essmen	t : 100 Marks	Pre-requisit	e of c	ourse:	Nil							
	The fo	ocus is on the English gra	mmar error co	orrectio	on algo	rithm	which	is an impo	rtant task o	f natural			
	langu	age processing that encou	arages student	ts to re	ecogniz	ze and	correc	t various p	ossible syr	ntactical,			
Course	lexica	l, grammatical, and punc	tuation errors	often	commi	itted b	y a nor	n-native lar	iguage lear	mer. The			
Objective	object	ive is to ease the comp	lexity of gran	nmar :	rules, a	ambig	uity of	semantics	and ambi	iguity of			
	grami	nar. The students must	have the abil	ity to	use a	wide	range	of algebra	ic, geome	tric, and			
	statist	ical tools which are requ	ired in many	fields	of pos	stseco	ndary e	education s	so that the	students			
	gain a	appropriate skills to succ	eed in prelin	ninary	select	ion pr	ocess :	for recruiti	nent. I ni	s course			
	Δfter	studying these topics, the	students will	be ab	lgiicu v	viui ai		•					
	COL	Justanosa the praviously	v learned basi	oc of t	he grav	nmor	with th	a racantly	acquired				
	COI.	intermediate skills of a s	y-learned basi		ne grai	ntonce	witti ti Javal	to augmen	t the know	how of			
Course		the usage of the language	a in a variety	of stra	at a se	mence	e level,	to augmen	t the know	-110w 01			
Outcomes	coz.	Lettison the confusion a	e in a variety	of suit	the mi	nds of	the st	idante as fe	r os tha ru	les of			
	CO2.	the language are concern	nd complexity	nom	uie iii	nus oi	uie su	idents as ra					
	CO3.	Inclanguage are concern Juggerpout the students	to the master	rofa	muriad	ofm	thoma	tical modu	las majorly	. 7			
	0.05.	algebra geometry and	to the mastery	yora	iliyilau	01 1116	unema		ics, majorr	y			
		algebra, geoffieu y, allu s	statistics.										
			COLIDCE CU	7TTA	DIIC								
Module No			COURSE SY	ZLLA ntent	BUS					Hours			
Module No.	[Cou	rse Outcome(s) No • 1	COURSE SY Co 2 and 31	(LLA ntent	BUS					Hours			
Module No.	[Cou	rse Outcome(s) No.: 1, NTITATIVE APTITUD	COURSE SY Co 2 and 3] E AND LOG	<u>(LLA</u> ntent	BUS	SONI	NG			Hours			
Module No.	[Cou QUA PURE	rse Outcome(s) No.: 1, NTITATIVE APTITUD E ARITHMETIC-II: Ar	COURSE SY Co 2 and 3] DE AND LOG ithmetic Proj	TLLA ntent GICAI gressio	BUS	SONI eomet	NG ric Pro	ogression,	Harmonic	Hours			
Module No.	[Cou QUA <u>PURE</u> Progr	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions.	COURSE SY Co 2 and 3] DE AND LOG ithmetic Proj	ZLLA ntent GICAI gressi	BUS C REA on, G	SONI eomet	NG ric Pro	ogression,	Harmonic	Hours			
Module No.	[Cou QUA PURE Progr COM	rse Outcome(s) No.: 1, NTITATIVE APTITUD E ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca	(LLA ntent GICAI gressionalenda	BUS C REA on, Go ur, Ratio	SONI eomet o Prop	NG ric Pro portion	ogression, -I.	Harmonic	Hours			
Module No.	COM PURE Progra COM	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC BAL ABILITY	COURSE SY Co 2 and 3] DE AND LOG ithmetic Proj -II: Clocks, Ca	LLA ntent GICAI gressionalenda	BUS C REA on, Go ar, Ratio	SONI eomet o Prop	NG ric Pro portion-	ogression, -I.	Harmonic	Hours 20			
Module No.	[Cou QUA PURH Progra COM VER	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME	COURSE SY Co 2 and 3] E AND LOG ithmetic Proj -II: Clocks, Ca <u>NT</u> : Synonym	(LLA ntent GICAI gressionalenda	BUS C REA on, Go ur, Rationation	SONI eomet o Prop	NG ric Pro portion-	ogression, -I. s. Idioms a	Harmonic and Phrasal	Hours 20			
Module No.	[Cou QUA PURE Progr COM VER VOC.	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca <u>NT</u> : Synonym Parts of Spee	<u>ZLLA</u> ntent GICAI gressid alenda ns, An ech.	BUS C REA on, Go r, Rati- tonym	SONI eomet o Prop s, Odd	NG ric Pro portion- l Word	ogression, -I. s. Idioms a	Harmonic and Phrasal	Hours 20			
Module No.	[Cou QUA PURI Progr COM VER VOC. Verbs VERI	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different BAL REASONING: Word	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca <u>NT</u> : Synonym Parts of Spee d Analogy, Se	<u>ALLA</u> ntent GICAI gressio alenda as, An ech. ntence	BUS C REA on, G r, Rati- tonym	SONI eomet o Prop s, Odd	NG ric Pro portion- l Word &Text (ogression, -I. s. Idioms a Completion	Harmonic and Phrasal	Hours 20			
Module No.	[Cou QUA PURE Progra COM VERI VOC. Verbs VERI Equiv	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: An ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different BAL REASONING: Word alence.	COURSE SY Co 2 and 3] DE AND LOG ithmetic Pro- ithmetic Pro- ithmetic Pro- Pro- ithmetic Pro- Pro- ithmetic Pro- Pro- theta Synonym Parts of Spee d Analogy, Se	CLLA ntent GICAI gressionalenda alenda ns, An ech. ntence	BUS C REA on, Go r, Rati- tonym	SONI eomet o Prop s, Odd ction d	NG ric Pro portion- l Word &Text	ogression, -I. s. Idioms a Completion	Harmonic and Phrasal	Hours 20			
Module No.	[Cou QUA PURE Progr COM VER VOC. Verbs VERE Equiv	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different BAL REASONING: Word alence. rse Outcome(s) No.: 1,	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca <u>NT</u> : Synonym Parts of Spee d Analogy, Sec 2 and 3]	<u>A</u>LLA ntent GICAI gressio alenda as, An ech. ntence	BUS C REA on, G ur, Rati- tonym	SONI eomet o Prop s, Odd	NG ric Pro portion- l Word &Text (ogression, -I. s. Idioms a Completion	Harmonic and Phrasal	Hours 20			
Module No.	[Cou PURH Progr COM VERI VOC. Verbs VERH Equiv [Cou QUA	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: An ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different BAL REASONING: Word alence. rse Outcome(s) No.: 1, NTITATIVE APTITUD	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca <u>NT</u> : Synonym Parts of Spee d Analogy, Sec 2 and 3] DE AND LOG	CLLA ntent GICAI gressionalenda alenda as, An ech. ntence	BUS REA on, Generation tonymic Corre	SONI eomet o Prop s, Odd ction d SONI	NG ric Pro portion- l Word &Text - NG	ogression, -I. s. Idioms a Completion	Harmonic and Phrasal	Hours 20			
Module No.	[Cou PURE Progr COM VERI VOC, Verbs VERI Equiv [Cou QUA COM	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: Ar ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different 3AL REASONING: Word alence. rse Outcome(s) No.: 1, NTITATIVE APTITUD MERCIAL ARITHMETI	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca NT: Synonym Parts of Spee d Analogy, Se 2 and 3] DE AND LOG <u>(C-II</u> : Ratio F	CLLA ntent GICAI gressid alenda ns, An ech. ntence GICAI Propor	BUS C REA on, Go ur, Rati- tonym- c Corre C REA ction-II	SONI eomet o Prop s, Odd ction d SONI , Mixt	NG ric Pro oortion- l Word &Text (NG ures &	ogression, -I. s. Idioms a Completion Solutions,	Harmonic and Phrasal h, Sentence Average.	Hours 20			
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Module No. I II	[Cou PURE Progr COM VERI VOC, Verbs VERI Equiv QUA COM DIRE proble COM Boat a FRR	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: An ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different 3AL REASONING: Word alence. rse Outcome(s) No.: 1, NTITATIVE APTITUD MERCIAL ARITHMETI CTION SENSE: Cardia ems, shadow based proble MERCIAL ARITHMETI and Stream, Time and Wo BAL ABILITY: OR ANALYSIS: Identifi	COURSE SY Co 2 and 3] E AND LOG ithmetic Pro- -II: Clocks, Ca NT: Synonym Parts of Spee d Analogy, Se 2 and 3] E AND LOG C-II: Ratio H nal directions ems. C-III: Time so ork, Pipe and co cation of Erro	ZLLA ntent Alenda gressid alenda as, An ach. ntence GICAI Propor s, intence peed a cistern urs, Sev	BUS C REA on, Go ur, Rati- tonym- e Corre C REA ction-II er caro and Dis t.	SONI eomet o Prop s, Odd ction d SONI , Mixt dinal stance,	NG ric Pro portion- l Word &Text (NG ures & directi , Races	ogression, -I. s. Idioms a Completion Solutions, ons, comp , Problems	Harmonic and Phrasal n, Sentence Average. bass based on Trains,	Hours 20 20 20			
Module No.	[Cou PURH Progr COM VERI VOC. Verbs VERI Equiv [Cou QUA COM DIRE proble COM Boat a VERI Boat a	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: An ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different 3AL REASONING: Word alence. rse Outcome(s) No.: 1, NTITATIVE APTITUD MERCIAL ARITHMETI CTION SENSE: Cardia ems, shadow based proble MERCIAL ARITHMETI and Stream, Time and Wo BAL ABILITY: OR ANALYSIS: Identifi	COURSE SY Co 2 and 3] DE AND LOG ithmetic Prog -II: Clocks, Ca <u>NT</u> : Synonym Parts of Spee d Analogy, Se 2 and 3] DE AND LOG <u>C-II</u> : Ratio F nal directions ems. <u>(C-III:</u> Time spork, Pipe and co cation of Erro	ZLLA ntent ntent GICAI gressid alenda ns, An cch. ntence GICAI Propor s, inte peed a cistern rrs, Sen	BUS C REA on, G ur, Rati- tonym c Corre C REA tion-II er caro and Dis t. ntence	SONI eomet o Prop s, Odd ction d SONI , Mixt dinal stance.	NG ric Pro- portion- l Word &Text - NG ures & directi , Races ction.	ogression, -I. s. Idioms a Completion Solutions, ons, comp , Problems	Harmonic and Phrasal a, Sentence Average. bass based on Trains,	Hours 20 20			
Module No. I I Text Books: ≻ A. Sh	[Cou PURE Progr COM VERI VOC. Verbs VERI Equiv Equiv QUA COM DIRE proble COM Boat a VERI Boat a	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: An ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different BAL REASONING: Word alence. rse Outcome(s) No.: 1, NTITATIVE APTITUD MERCIAL ARITHMETI CTION SENSE: Cardia ems, shadow based proble MERCIAL ARITHMETI and Stream, Time and Word BAL ABILITY: OR ANALYSIS: Identifi How to prepare for Quan	COURSE SY Co 2 and 3] E AND LOG ithmetic Pro- ithmetic Pro- ithmetic Pro- ithmetic Pro- ithmetic Pro- section Speed I Analogy, Section Analogy, Section 2 and 3] DE AND LOG C-II: Ratio H nal directions ems. C-III: Time spork, Pipe and co cation of Erro titative Aptitu	ZLLA ntent ntent GICAI gressid alenda ns, An cch. ntence GICAI Propor s, inta peed a cistern ins, Sen inde for	BUS C REA on, Go ar, Rati- tonyma c Corre C REA tion-II er caro and Dis ntence	SONI eomet o Prop s, Odd ction d SONI , Mixt dinal stance, <u>Corre</u> TMH	NG ric Pro- portion- l Word &Text - NG ures & directi , Races ction. public	ogression, -I. s. Idioms a Completion Solutions, ons, comp , Problems ation, 2024	Harmonic and Phrasal n, Sentence Average. bass based on Trains,	Hours 20 20			
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I I I Text Books: ▷ A. Sh ▷ M. K	[Cou PURE Progro COM VERI VOC. Verbs VERI Equiv QUA COM DIRE proble COM Boat a VERI Boat a	rse Outcome(s) No.: 1, NTITATIVE APTITUD ARITHMETIC-II: An ession, Functions. ERCIAL ARITHMETIC BAL ABILITY ABULARY ENRICHME . Same Words –Different BAL REASONING: Word alence. rse Outcome(s) No.: 1, NTITATIVE APTITUD MERCIAL ARITHMETI CTION SENSE: Cardii ems, shadow based proble MERCIAL ARITHMETI CTION SENSE: Cardii ems, shadow based proble MERCIAL ARITHMETI and Stream, Time and Wo BAL ABILITY: OR ANALYSIS: Identifi How to prepare for Quan ey, Analytical Reasoning	COURSE SY Co 2 and 3] DE AND LOG ithmetic Pro- ithmetic Pro- ithmetic Pro- ithmetic Pro- ithmetic Pro- section of Spee d Analogy, Sec 2 and 3] DE AND LOG C-II: Ratio I nal directions ems. C-III: Time spork, Pipe and co cation of Erro titative Aptitu , BSc Publishi	ZLLA ntent ntent GICAI gressid alenda ns, An cch. ntence GICAI Propor s, interce peed a cistern ors, Ser ide for ing Co	BUS C REA on, G tonyma c Corre C Corre C REA tion-II er card and Dis	SONI eomet o Prop s, Odd ction d SONI , Mixt dinal stance, <u>Corre</u> TMH Ltd, 20	NG ric Pro- portion- l Word &Text NG ures & directi , Races <u>ction.</u> public 009.	ogression, -I. s. Idioms a Completion Solutions, ons, comp , Problems ation, 2024	Harmonic and Phrasal h, Sentence Average. bass based on Trains,	Hours			

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- R. S. Aggarwal, Quantitative Aptitude, S. Chand Publishing, 2022. Jaikishan and Premkishan, How to Crack Test of Reasoning in All Competitive Examinations, Arihant ≻ Publication, 2018.

Course No: (3	Course Name:	Physical Educat	ion and Yoga			Cou	irse	e Code:	BEDO 000	1		
Batch:		Programme:		Semester:	L	T	Р	J	Credits	Contact Hi Per Week	:s :NA		
2024-2028		B. Sc. Math	ematics-DS	III	0	0	0	0	2	Total Hou	rs: NA		
Total Evalua	tion N	Marks: 100	Examination	Duration: E	nd 🛛	Feri	m (3	ho	urs)				
Theory Asse	ssmen	t: 100 Marks	Pre-requisite	of course: Ni	1								
Course Objective	Studer manag Yoga of the aligne	nanagement and the lifestyle of an individual. The student will also learn about the relationship of oga with mental health and value education. In this course, students will also learn about the aspect of the Traditional games of India. This course focuses on employability and skill development development with all CO's.											
Course Outcomes	After CO1: CO2: CO3: CO4:	studying these top To understand the Physical health. Acquaint them w importance. Create interest in Sensitize students movement.	pics, the students e concept of holis ith the Fitness, W the practice of yo s towards Traditic	will be able to tic health and v cellness and We oga asanas and onal games of I	o: vario eigh mec ndia	ous t M lita a, re	dim lanag tion. ecrea	ens gem	ions and c nent progr n and fit I	leterminants ammed & its ndia	of		
			COURSE	SYLLABUS	5								
Module No.				Content							Hours		
Ι	[Cou Phys in the Conc Welli Weig BMI: and if Lifes throu impo Prana Bhuja Dhan Trad Recre of Rec	ContentHeCourse Outcome(s) No.: 1, 2, 3 and 4]Physical Education: Meaning, Aim, Need, Importance and Scope of Physical Education in the Modern Society. Physical Education in India before and after Independence.Concept of Fitness and Wellness: Meaning, Importance, and Factors affecting Fitness and Wellness. Components and fitness equipment.Weight Management: Meaning, Factor affecting weight management.BMI: (Body mass index) Meaning, charts, range and category. Obesity: Meaning, Causes and its types, Solutions for Overcoming Obesity.Lifestyle: Meaning, Definition, Importance, Factor affecting Lifestyle. Healthy Lifestyle through Diet. Relationship between Diet and Fitness. Yoga and Meditation: Definition, importance of Yoga. Yoga relation with mental health and sports. Definition of Asana and Pranayama, differences between Asana and physical exercise. Asana-SurayaNamaskar, Bhujang Asana, Naukasana, Halasana, Vajrasan, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam - Anulom, Vilom, Bhramary.Traditional Games of India: Meaning, types and benefits of Traditional Games.									20		
Text Books: > A. Sin > S. K. > M. L. > B.K.S > B. B. Reference Boo > I. Dev > J. Peto	ngh, an Patel a Kaml I. Iyeng Nigar ooks: vi and l er, Yog	nd Jagdish, Physica and M. Prajapati, P lesh, Physical Edu- gar, Light On Yog n, Yoga Power: Th D. Lifszyc, Yoga f ga Master the Yog	al Education and O Physical, Health and cation: Facts and a, Thorsons, 2006 e Path of Persona For You, Gibbs Sm ic Powers, Abhisl	Olympic Move nd Yoga Educa foundations, P 5. 1 Achievement nith, 2002. nek Publicatior	emer atior . B. c, Do	nt, I 1, A Pul omi	Kalay grav blica nant 7.	yan val tior Pu	i Publisher Publisher 1s, 1988. blishers &	ers, 2016 s, 2017. z Distributor:	s, 2001.		

Course No:	Course Name: Differe	ntial Equation and N	Mechanics		C	our	se Code	: BMAC	0004				
Batch:	Programme: B. Sc. M	lathematics	Semester:	L	ΤP	J	Credits	Contact]	Hrs				
	(With specialization	in Data Science)						Per Wee	k: 6				
2024-2028			IV	5	1 0	0	6	Total Ho	ours: 60				
Total Evalua	tion Marks: 100		Examination Duration:										
			Mid Term (2 hours), End Term (3 hours)										
			Pre-requis	ite	of c	cou	rse:						
Theory Asse	sment: 75 Marks		Differential	1 E	quat	ion	s and Ge	ometry					
Internal Ass	essment: 25 Marks		Nature of (Co	urse	e: 1	Major Co	urse as pe	r				
			common mi	inir	num	i syl	llabus						
	This course will develop a	profound understand	ling of solut	ion	of	seco	ond order	linear di	fferential				
Course	equations with variable coe	fficients and Partia	differential	l eq	luati	ons	of first	and highe	r orders.				
Objective	This will make the students	able to prove the re-	sults based o	on v	vork	c en	ergy prin	ciple, virt	ual work				
	and catenary of uniform le	ngth. This course w	vill also pro	vid	e th	e k	nowledge	e of SHM	, motion				
	under resisting medium, ro	ocket motion and K	Lepler's laws	s o	f m	otic	on. This	course fo	cuses on				
	employability and skill deve	elopment aligned wi	th all CO's.										
	After studying these topics	the students will be	able to:										
	CO1 . The objective of this	course is to familia	rize the stud	len	ts w	ith	various n	nethods of	f solving				
	differential equation	s partial differentia	l equations of	of f	irst	ord	er and se	cond ord	er and to				
Course	have qualitative appl	ications.	quations	JI I	nst	010	or and be		or und to				
Outcomes	CO2: A student doing this	course is able to	solve differe	enti	al e	qua	tions and	l is able i	to model				
Outcomes	problems in nature u	using ordinary diffe	rential equat	tior	ns. A	Afte	r comple	ting this o	course, a				
	student will be able	to take more cou	rses on way	ve e	equa	tio	n, heat e	quation,	diffusion				
	equation, gas dynar	nics, non-linear ev	olution equ	ati	on e	etc.	These e	entire cou	irses are				
	important in enginee	ring and industrial a	pplications f	for	solv	ing	boundary	y value pr	oblem.				
	CO3: The object of the pap	per is to give studer	nts knowledg	ge (of b	asic	mechan	ics such a	is simple				
	harmonic motion, mo	otion under other lay	vs and force	s.					_				
	CO4: The student, after con	mpleting the course	can go for h	nigh	ner p	prot	plems in i	mechanic	s such as				
	hydrodynamics. This	will be helpful in g	etting emplo	oyn	ient	1n 1	ndustry.						
Madula Na		COURSE SYLL	ABUS						Hound				
Module No.	Course Outcome(a) No.	Lond 4	ll						Hours				
	[Course Outcome(s) No.: Second order linear differ	1, 2 and 4]	th voriable	000	ffia	ion	ta. Usa at	falmour					
	solution to find another nor	rmal form method	of undetermi	coe	d co	offi	cients vs	riation of					
т	parameters Series solution	s of differential e	quations Po		u cu er se	orie	s method	l Ressel	30				
1	Legendre Hypergeometric	functions with property	erties Recur	ren	n so ice &	οτις δι σε	enerating	relations	50				
	Statics: Virtual work. Stab	le and Unstable equ	ulibrium. Ca	ater	narv.	~ 5. . Ca	atenary o	f uniform					
	strength.	1	,		j	,							
	Kinematics: Velocities and	accelerations along	radial and tr	ans	svers	se d	irections	and along					
	tangential and normal direct	tions.						C C					
	[Course Outcome(s) No.: 1	1, 2 and 3]											
	Partial Differential Equation	ions: Origin of first	order partial	dif	fere	ntia	l equation	ns. Partial					
	differential equations of I o	rder and degree one	e, Lagrange's	s so	oluti	on,	Partial d	ifferential					
II	equation of first order and d	egree greater than o	ne. Charpit's	me	etho	d of	fsolution	, Surfaces					
	Orthogonal to the given sy	stem of surfaces. C	Drigin of sec	con	d or	der	PDE, So	olution of					
	partial differential equation	s of the second and	nigher orde	er v	with	coi	nstant co	efficients,					
	Classification of linear part	al differential equa	tions of seco	ond	ord	er, i	Solution	of second	20				
	order partial differential equ	ations with variable	coefficients	, M	ong	est	nethod of E^{1}	solution.	30				
	Motion in resisting medium	Constrained met	inder other la	aw or	1 10		es. Elasti	ic sumgs,					
	would in resisting medium	of verying mass. Be	oll, MOUON	un C	sm onte	00ti 1 ~	u and rol	ugii piane					
	curves. Motion of particles	or varying mass, RC	induced motion	I, U	entr	ai C	non, kep	nei s laws					

of motion, Motion of particle in three dimensions, Rotating frame of reference, Rotating Earth, Acceleration in terms of different coordinates systems.

Text Books:

- B. Rai, D.P. Choudhary & H. J. Freedman, A Course of Ordinary Differential Equations, Narosa, 2002.
- > G.F. Simmons, Differential Equations with Application and Historical Notes, TMH, 2017.
- > R.C. Hibbeler, Engineering Mechanics-Statics, Pearson, 2015.
- > R.C. Hibbeler, Engineering Mechanics-Dynamics, Prentice-Hall, 2004.
- R. C. Chandel, H. Kishan, S. S. Yadav, M. Sharma & V. Singh, Differential Equations, RP Pub., 2022
- > L.E. Elsgolts, Differential Equation and Calculus of variations, University Press of the Pacific, 2003.
- > H. Kishan, Dynamics, Atlantic Publishers and Distributors Pvt Ltd, 2023.
- Course Books published in Hindi.

- > Ian N. Sneddon, Elements of Partial Differential Equations, Dover Publication, 2006.
- A. Nelson, Engineering Mechanics, Statics and Dynamics, Tata McGraw Hill, 2017.
- R. C. Chandel, H. Kishan, A. K. Sharma, K. M. Agrawal & S. Verma, Mechanics, RP Pub., 2022
- > J.L. Synge & B.A. Griffith, Principles of Mechanics, TMH, 1959.
- Suggested digital plateform: NPTEL/SWAYAM/MOOCs

Course No:	P Course Name: Data VisualizationCourse Code: BCSC 001	8
Batch:	Programme: B. Sc. Mathematics Semester: L T P J Credits Contact Hr	rs
	(With specialization in Data Science) Per Week:	3
2024-2028	IV 3 0 0 0 3 Total Hour	rs: 40
Total Evalua	tion Marks: 100 Examination Duration:	
	Pro requisite of course: Nil	
Theory Asse	ssment: 75 Marks	
Internal Ass	essment: 25 Marks	other
Comme	department of same faculty	dta
Course	The objective of this course to introduce the all kind of graph and chart that might be used analyze the different business moment decision to attain their objective and gatting the growt	d to th in
Objective	the business. This course focuses on employability and skill development aligned with all CC	11 III)'s
	After studying these topics, the students will be able to:	
	CO1: Apply the basic concepts of Data Visualization	
Course	CO2: List various business moment decisions.	
Outcomes	CO3: Apply the concept of data preprocessing.	
	CO4: Differentiate Data types.	
	CO5: Implement Data Preprocessing technique.	
	COURSE SYLLABUS	
Module No.	Content	Iours
	[Course Outcome(s) No.: 2 and 3]	
	1. Introduction to EDA	
	2. Data Analysis vs EDA	
	3. Understanding the Data	
I	4. Univariate Analysis	20
	5. Bivariate Analysis	
	 Multi Confinearity Missing Values Treatment 	
	8 Outliers Treatment	
	9. Working on Imbalanced Dataset	
	10. Case Study	
	[Course Outcome(s) No.: 1, 4 and 5]	
	1. Introduction to Data Visualization Tools	
	a. Introduction to Data Visualization	
	b. Introduction to Matplotlib	
	c. Basic Plotting with Matplotlib	
	2. Different types of Plots	
	a. Lifter fols b. Area Plots	
	c Histograms	
	d. Bar Charts	
	e. Pie Charts	20
11	f. Box Charts	20
	g. Scatter Plots	
	3. Advanced Visualizations and Geospatial Data	
	a. Waffle Carts	
	b. Word Clouds	
	C. Seaborn and Regression Piols	
	4 Creating Dashboards with Plotly and Dash	
	a. Dashboarding Overview	
	b. Introduction to Plotly	
	c. Introduction to Dash	
	d. Make interactive dashboards	
	5. Case Study Project for Data Visualization - COVID19 Data Storytelling	

- C. O. Wilke, Fundamentals of Data Visualization: A Primer on Making Informative and compelling Figures, Paperback.
- > A. Kirk, Data Visualization: A Handbook for Data Driven Design, Paperback.

Reference Book:

▶ K. Black, Business Statistics: For Contemporary Decision Making.

Course No:	10 Co	urse Name: Data Visualizatio	on Lab				Co	ur	se Code	: BCSC	0815		
Batch:	Pro	Ogramme: B. Sc. Mathematics With specialization in Data Sc	s cience)	Semester:	L	Т	Р	J	Credit	Contact Per We	Hrs ek: 2		
2024-2028				IV	0	0	2	0	1	Total H	[ours: 24		
Total Evalu	ation N	Iarks: 100		Examination Duration: End Term (2 hours									
Internal: 50	Marks			Pre-requis	ite	of	cou	rs	e: Nil				
External: 40) Marks	3		Nature of (Coi	irse	: M	in	or course	e offered	by other		
Attendance:	10 Ma	rks		department	of	sam	ne fa	cu	lty				
Course	The o	bjective of this course is that st	udents wi	ll understan	d a	nd	imp	ler	nent all	kind of g	graph and		
Objective	plots f	or visualizing and analyzing diff	ferent kind	l of data to a	ttai	n th	e bu	isii	ness obje	ective. T	his cours		
	focuse	es on employability and skill dev	velopment	aligned wit	h a	11 C	O's	•					
	After	studying these topics, the studen	nts will be	able to:									
Course	CO1:	Demonstrate the plot for conti	nuous dat	a.									
Outcomes	CO2 :	Demonstrate the univariate an	d bivariate	e plot for cat	teg	oric	al d	ata	ι.				
Outcomes	CO3 :	Demonstrate the univariate and	d bivariate	e plot for tin	nes	serie	es da	ata	•				
		COUR	SE SYLI	LABUS									
Module No.			Conte	nt							Hours		
Ι	1. 2. 3. 4. 5. 6. 7. 8. 9.	Basic Data Exploration with n Missing Values Treatment: Ha Understanding the Data: Data Univariate Analysis: Univaria Bivariate Analysis: Exploring Outliers Treatment: Detecting Experiment on different types h. Line Plots i. Area Plots j. Histograms k. Bar Charts l. Pie Charts n. Scatter Plots Introduction to Plotly: Creating Introduction to Dash: Creating	numpy, Par andling M Profiling te Analysi Relations and Hanc of Plots	ndas and Ma issing Data and Initial In is with Visua hips Betwee lling Outlier lots Using P Dashboard U	atpl nsig aliz en T s s	lotli ghts zatic Fwc	b ons o Va Dash	ria	bles		24		
	10	. Interactive Dashboard with M	Iultiple Pl	ots: Combin	nin	g M	lulti	ple	e Plotly	Graphs i	n		
		One Dashboard											
Text Books: → C. O Figur → A. K	. Wilke res, Pap irk, Da	, Fundamentals of Data Visualiz perback. ta Visualization: A Handbook fo	zation: A l or Data Dr	Primer on M iven Design	lak 1, P	ing ape	Info rbac	orn :k.	native an	d compe	lling		

Reference Book:

> K. Black, Business Statistics: For Contemporary Decision Making.

Course No:	11 Course Name: Fundamentals of Research	Methodolo	ogy		C	Cour	se Cod	e: BBA	C 0016
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	L T P J Credits Contac Per W				: Hrs ek: 4	
2024-2028		IV	Δ	0		0	4	Total I	Hours 40
Total Evalua	ntion Marks: 100	Examinati	on	D	ur	atio	n:	100011	
		Mid Term	(21)	hou	urs), E	nd Tern	n (3 hour	s)
		Pre-requis	ite	of	f co	ours	e: Nil		,
Theory Asse	ssment: 75 Marks	Nature of (Coi	ırs	se:	Min	or cours	se offered	l by other
Internal Ass	essment: 25 Marks	department	of	sar	me	facu	ılty		5
Course	To enable the students to gain insights into ho	w research	is c	arr	ried	d ou	t in busi	iness sce	narios and
Objective	how they can benefit from it. This course focu	ses on empl	oya	ıbil	lity	anc	l skill de	evelopme	ent aligned
	with all CO's.								
	After studying these topics, the students will be	able to:							
~	CO1: Describe the meaning and importance of	research m	eth	ode	olo	ov a	nd resea	arch proc	ess.
Course	CO2: Apply the research methods for various c	lata in solvir	ng r	oro	ble	ems		n en proe	• • • • •
Outcomes	CO3: Analyze the research problems for data x	isualization	1 81						
	CO4: Use Plagiarism tools in research	Isualization	•						
	COURSE SVL								
Modulo No	COURSE STL	LADUS							Hours
	Conte	: 11 t							Hours
	Introduction: Meaning of Research, Object	ctives of R	ese	earo	ch,	Ту	pes of	Researc	ch,
т	Nature and Scope of Research : Role of	,• Research in	e	cor	nor	nics	decisio	n makin	1g. 20
-	Applications of Research								-8. 20
	Research Process: Various steps in research	n process R	lese	ear	ch	Pro	blem fo	ormulatio	m
	Formation of hypotheses	i process, i		our	UII	110		Jimanatio	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	Research Design: Features of a good research	arch design;	D	oiff	fere	ent 1	Researcl	h Desigr	ns;
	Measurement in Research; types of data sets; R	esearch desi	gn	in	ca	se o	f differe	nt resear	ch
	studies								
	Sampling Design: Census & Sample Surveys; in Sampling Design; Types of Sample Design	Criteria for s-Probability	а ў У &	goo z N	od : Nor	samj n-Pro	pling de obability	sign; Ste v samplin	ps 1g,
	Error in Sampling design								
	[Course Outcome(s) No.: 5 and 4] Ouestionnaire Design: Guidelines for develop	ing a good a	110	nti -	 ~	nina			
	Data collection: primary and secondary data a	nig a good q	ues sth	odo odo	лШ л fc	ane m da	to oclice	otion	
т	Data conection: primary and secondary data co	Diffection, Me	euno	Jus	s ic	or ua			20
	Visualization Techniques i.e Heatmaps, Tree M	aps, Waterfa	iza 11 C	Cha	n arts	tool etc,	; Advai & Inter	active Da	ita =0
	Report writing: Layout of Research report:	Types of Re	nor	٠te	м	lech	anism o	f writing	· 9
	Research report Precautions	for	por	ι.,	111	writ	ino	reno	rt
	Plagiarism & Ethics in Research: Types of	² Plagiarism	: C	on	ised	Juen	ces of]	Plagiaris	m:
	Tools for Plagiarism Detection; Paraphrasing a	nd Summari	zin	g, (Cit	atio	n and R	eferencin	ıg;
	Responsibility of the Researcher; Informed C	onsent, Con	fid	ent	tial	lity :	and Priv	vacy; No	n-
	Malfeasance; Cultural Sensitivity in Resear	ch; Conten	ipo	rar	y	Issu	es in l	Ethics a	nd
	Plagiarism etc.								
Text Books:				. -		_			
Kotha	rri, C. R. Research Methodology -Methods &	Technique	s.	Ne	ew	De	lhi: Nev	w Age P	ublishers.
> Coop	er, D. R., & Schindler, P. S. Business Research M	ethods. New	De	lhi	: T	ata N	AcGraw	-Hill.	
Reference Bo	ooks:			_					
> Sachd	leva, J. K. Business Research Methodology. New	Delhi: Himal	aya	a Pi	ubl	ishii	ng House	e.	

- > Naresh K Malhotra & Satyabhushan Dash, Marketing Research, Pearson Education
- Srivastava, T. N., & Rego, S. Business Research Methodology. New Delhi: Mc. Graw-Hill.
- > Rajendra Nargundka Marketing Research: Text & Cases, Tata McGraw Hill

Course No: 2	2 Course Name: Product Design and Develop	ment			Cour	se Co	le: BMEE	0402			
Batch:	Programme: B. Sc. Mathematics	Semester:	L	Т	P J	Credi	ts Contact	Hrs			
	(With specialization in Data Science)						Per Wee	ek: 3			
2024-2028		IV	3	0	0 0	3	Total Ho	ours: 40			
Total Evaluation Marks: 100		Examination Duration:									
		Mid Term (2 hours), End Term (3 hours)									
Theory Assessment: 75 Marks		Pre-requisite of course: Nil									
Internal Ass	essment: 25 Marks										
Course	• To study the basic concepts of Product	• To study the basic concepts of Product design and Development.									
Objective	• To study the applicability of product design and development in industrial applications.										
	• To study the key reasons for design or redesign.										
	• This course focuses on employability and skill development aligned with all CO's.										
	After studying these topics, the students will be able to:										
G	CO1: Identify and analyze the product design and development processes in manufacturing										
Course	industry.										
Outcomes	CO2: Define the components and their functions of product design and development processes										
	and their relationships from concept to c	ustomer ove	r wh	nole	e prod	luct life	e cycle.				
	CO3: Analyze, evaluate and apply the methodologies for product design, development and										
	management.										
	CO4: Decision making ability of the students v	vill improve,	, the	y c	an tak	the r	ight decision	ns			
	regarding the product without the proper	· information	1.		1 /	1 1					
	COS: Undertake a methodical approach to the	managemen	it of	pro	oduct	develo	pment to sa	tisfy			
	customer needs.										
		Ign various (JUSU	mo	ueis.						
Module No	Conte	ant						Hours			
	[Course Outcome(s) No : 1.2 and 3]							IIUUIS			
	[Course Outcome(s) No.: 1, 2 and 3] Classification/Spacifications of Products. Dreduct life avals. Dreduct mix. Introduction to										
	product design. The Role and Nature of Design	Old and N	ew I	Des	ion N	lethods	Design hy	7			
т	Evolution, Design by Craft, Need Based Devel	on by Craft Need Based Development Technology Based Developments						20			
-	Economic Feasibility of Design Concepts. Modern product development process										
	Innovative thinking, Morphology of design.	1				I	I	, ,			
	Reliability: Reliability Considerations: Reliability Analysis of Systems, Bath Tub Curve,							,			
	Reliability of Systems in Series and Parallel. Failure Rate, Mean Time to Failure (MTTF)										
	and Mean Time Between Failures (MTBF).										
	[Course Outcome(s) No.: 4, 5 and 6]										
	Decision Theory: Decision Making Under Cor	nditions of C	erta	inty	y, Deo	cision N	Making				
II	ler Conditions of Uncertainty, Decision Making Under Conditions of Risk, Maximum 20										
	Likelihood Criterion, Variation of Expected Va	lue Criterio	n.	c	D						
	Break-Even Analysis: Fixed and Variable Costs, Assumptions of Break-Even Analysis, Utility of Break Even Analysis, Limitation of Break Even Analysis Statistical Ovality Control (SOC): Advantages of Statistical Ovality Control Ovality										
	Statistical Quality Control (SQC): Advantages of Statistical Quality Control, Quality Control Charts, Types of Control Charts Such as V(Par) and P. Chart, P. Chart and C.										
	Control Charts, Types of Control Charts Such as X(Bar) and R Chart, P Chart and C Chart. Technological Forecasting: Characteristics and Importance of Technological Forecasting, Different Forecasting Methods, Patents & IP Acts-Overview, Disclosure										
	preparation.										
	propuration.										

- > A. K. Chitab and R. C. Gupta, Product Design & Manufacturing, PHI, 2011.
- K. T. Ulrich, S. D. Eppinger and M. C. Yang, Product Design and Development, McGraw Hill, 2020.

- M. K. Starr, Product Design & Decision Theory, Prentice Hall, 1963.
- > W. D. Cain, Engineering Product Design, Business Books, 1969.
- ▶ W. H. Mayall, Industrial Design for Engineers, Imprint unknown, 1967.
- ▶ J. C. Jones, Design Methods Seeds of human futures, Wiley-Interscience, 1970.
- > J. Boyle and J. Jenkins, Intellectual Property: Law & the Information Society- Cases & Materials,
- Independently published, 2024.

Course No: 4	4 Course Name: Workplace Communication			1	Co	ur	se Cod	e: BELA	0012		
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	Т	Р	J	Credit	s Contact Per Wee	Hrs ek: 2		
2024-2028		IV	2	0	0	0	2	Total H	ours: 28		
Total Evalua	tion Marks: 100	Examinati	on	Du	rat	io	n:	1			
		Mid Term	(21)	nou	rs),	Eı	nd Tern	n (3 hours))		
Theory Asse	ssment: 75 Marks	Pre-requis	ite	of	cou	rs	e: Nil				
Internal Ass	essment: 25 Marks										
Course	1. Develop an understanding of the distinction b	between gen	era	l an	d b	ısi	ness co	mmunicati	on, and		
Objective	explore how effective communication strategies differ in various professional contexts.										
	 Identify and address barriers to communication, and acquire practical tools and techniques to overcome challenges in business communication. Learn to apply the "You" perspective and optimistic discourse in business settings to enhance 										
	 4. Master key forms of business correspondence, including the crafting of letters, notices, agendas, minutes, and professional emails, with a focus on clarity, conciseness, and professionalism. 										
	p. Enhance critical reading and speaking skills by analyzing business news, articles, and reports,										
	while also practicing negotiation, persuasion, and effective presentation techniques in various professional settings.										
	After studying these topics, the students will be able to										
	CO1: Differentiate between general and busine	ss communi	cat	ion	and	at	oply the	appropria	te		
Course	communication strategies for diverse bus	iness scenar	ios	. en	sur	ng	g clear a	nd profess	ional		
Outcomes	interactions.			, -		6		. I			
	CO2: Recognize and overcome communication	barriers, en	npl	oyir	ıg e	ffe	ective st	rategies to			
	facilitate smooth and efficient communic	ation in bot	h ir	ndiv	idu	al a	and gro	up settings			
	CO3: Demonstrate proficiency in crafting varie	ous business	coi	rres	pon	de	nce (let	ters, notice	es,		
	agendas, minutes, and emails), tailoring t	heir writing	to	suit	spe	eci	fic busi	ness needs	while		
	maintaining clarity and professionalism. CO4: Enhance their ability to read and analyze business-related texts (news, articles, reports) and										
	apply negotiation, persuasion, and presentation techniques to effectively communicate and influence stakeholders in business contexts										
	CO5: Create a compelling CV/resume and job application documents, using precise vocabulary and industry-specific terminology, and practice presenting themselves confidently in interviews and business proposals.										
	COURSE SYLI	LABUS									
Module No.	Conte	nt							Hours		
	[Course Outcome(s) No.: 1, 2, 3 and 4]										
	The Art of Communication 1. General Vs Business Communication 2. Barriers to Communication, and ways to overcome										
	3. Effective Communication: 'You' perspective	and Optim	1sti	C C	lisc	ou	rse				
	Business Correspondence										
	1 Letters										
.	2. Notice, Agenda, and Minutes								14		
1	3. Emails								14		
	Reading and Speaking 1. Decoding Business News and Articles 2. Negotiation and Persuasion Techniques										
	V /										
	Vocabulary										
	1. Concerning e-mails and Meetings										
П	[Course Outcome(s) No.: 3 and 5] The Art of Writing 1. CV / Resume and Job Application cum Cover Letters	14									
------------	--	----									
	Reading and Speaking										
	1. Reading and Interpreting Reports										
	2. Group and Individual Presentations										
	3. Presenting Business Proposals										
	Vocabulary										
	1. Highlights in a CV/Resume										
	2. Interviews' Terminology										
Text Books											

- R. E. Burnett, Technical Communication, Cengage Learning, 2004.
- C. Glenn and L. Grey. The Writer's Harbrace Handbook, Cengage Learning, 2012.
- > M. A. Rizvi, Effective Technical Communication, McGraw Hill Education, 2017.

- > M. Raman and S. Sharma, Technical Communication: Principles and Practice, OUP, 2005.
- E. H. Weiss, The Elements of International English Style, Routledge, 2005.
- https://www2.latech.edu/~bmagee/303/eng303.html

Course No:	2	Course Name: Soft Skills-II				Coι	irse	Code:	BSDH 03	02		
Batch:		Programme: B. Sc. Mathematics-DS and	Semester: IV/II	L	Т	Р	J	Credits	Contact H Per Wee	Irs k: 3		
2024-2028		M.Sc. Mathematics		3	0	0	0	3	Total Ho	urs: 40		
Total Evalu	ation I	Marks: 100	Examinatio	on E	Jura	atio	n: E	nd Term	(3 hours)			
Theory Ass	essmer	nt : 100 Marks	Pre-requisi	ite o	f co	ours	e: N	ïl				
11001 y 1105	Hone	critical thinking skills by analyz	ing the argur	nent	S W	ith e	vnli	cit and i	mnlicit nre	mises to		
Course	valida	ate the author's point of view. Incl	ilcate probler	n so	lvin	g an	d de	cision m	aking skills	through		
Objective	case	studies on work ethics and organ	izational beh	avic	or. E	beve	lop	and evaluation	uate inferen	nces and		
J	predi	ctions that are based on data; and	select and us	se a	ppro	pria	te st	atistical	methods to	analyze		
	data;	formulate questions that can be	addressed w	vith	data	and	d co	llect, org	ganize, and	l display		
	releva	ant data to answer all types of que	estion in any	com	ipet	itive	exa	ms. Thi	s course fo	cuses of		
	emple	oyability and skill development al	igned with all	CO	's.							
	After	studying these topics, the students	s will be able	to:								
Course	CO1 :	: Convert a student from a proble	em solver inte	o a 1	thin	ker,	who	o embark	s on the jo	urney o		
Outcomos		interpreting the data to come to	a cogent conc	lusio	on b	ased	on t	he right a	ssumptions	s derived		
Outcomes		from an argument										
	CO ₂ :	: Converge the several quantitati	Converge the several quantitative skills of a student so that she collects, compare and									
		conquers the complex data and	uers the complex data and conclude crisp inferences and interpretations from the									
		same.										
	CO3	O3: Juggernaut the students to the mastery of a myriad of mathematical modules, majorly										
		algebra, geometry, and statistic	s.									
		COURSE	E SYLLABU	JS								
Module No	•		Content							Hours		
I	QUA GEO I, Trig DED Unde VER PARA CRIT Reaso an Ar	[Course Outcome(s) No.: 1 and 2] QUANTITATIVE APTITUDE AND LOGICAL REASONING GEOMETRY: Geometry –I Geometry-II, Mensuration –I, Mensuration II, Trigonometry-I, Trigonometry-II DEDUCTIVE REASONING: Introduction to Primary Statements of logical deduction. Understanding of different premises (like ALL, SOME, SOME NOT, NO). 20 VERBAL ABILITY: PARA JUMBLE: Logical Rearrangement of Sentences CRITICAL REASONING-I CRITICAL REASONING-I Introduction to Different Parts of an Argument in Reasoning, Assumption of an Argument, Strengthening of an Argument, Weakening of										
	[Cou	rse Outcome(s) No.: 1 and 2]	LOGICAL									
	QUA	NTITATIVE APTITUDE AND		KEA		DNIC	NG					
		<u>PERN MATHEMATICS</u> : Data Suff ta Interpretation II. Data Interpre	iciency I, Dai tation III	ta Si	іјпс	ienc	у <i>П</i> ,	Data Int	erpretation	20		
11	I, Du	BAL ARILITY •								20		
	CRIT	CRITICAL REASONING-II: Recap of Critical Reasoning Strategies Drawing										
	concl	usion of an Argument. Inference	erence of an Argument, Summarizing and Evaluation of									
	an Ar	gument.	U	,				0				
Text Books:	:											
\succ	A. Sha	arma, How to prepare for Quantita	tive Aptitude	for	CA	Г, Т	MH	publicati	on, 2024.			
\succ	Jaikisł	nan and Premkishan, How to Cra	ick Test of R	easo	onin	g in	All	Compet	itive Exam	inations		
	Arihar	nt Publication, 2018										
	M. K.	Pandey, Analytical Reasoning, BS	Sc Publishing	Co.	Pvt	. Lto	1, 20	009.				
Reference B	Books:											
\checkmark	R. S. <i>A</i>	Aggarwal, Quantitative Aptitude, S	S. Chand Pub	lishi	ng,	2022	2.					
\checkmark	A. Cho	oudhary and B. Patodi, Verbal Ab	ility & Comp	rehe	nsic	on, E	Disha	a Publica	tion, 2020.			
	V. Sax	ena and V. Bhatia, Crack WAT/C	D/PI for MB	ΑA	dmi	issio	ns, I	Disha Pul	olication, 20	016.		

SYLLABI OF SUBJECTS

Third Year Courses

Course No:	8	C ourse Name: Group at	nd Ring Theory & I	Linear Algebr	a	Cou	rse Cod	e: BMAC	0005
Batch:		Programme: B. Sc. Ma (With specialization i	thematics n Data Science)	Semester: I	T	P J	Credits	Contact I Per Wee	Hrs k: 5
2024-2028			,	V Z	. 1	0 0	5	Total Ho	ours: 50
Total Evalua	ation	Marks: 100		Examinatio	n D	ura	tion:		
				Mid Term (2	2 ho	urs).	End Ter	rm (3 hou	rs)
				Pre-requisi	te o	f coi	irse: Alg	gebra, Ma	trices
Theory Asse	ssm	ent: 75 Marks		Nature of C	our	se:	Maior C	ourse as p	er
Internal Ass	essn	ent: 25 Marks		common mir	imu	im sv	vllabus	F	
	This	course will develop a p	profound understand	ding of grou	the	eory,	, ring the	ory, vecto	or space,
C	sub	pace, linear transformati	ons and rank-nullit	ty theorem. T	his	will	make th	e student	s able to
Course	prov	e the results based on p	rincipal ideal doma	, in and Eucli	dian	ı dor	nain. Thi	is course	will also
Objective	prov	ide the knowledge of inn	er product space an	d Gram-Schr	nidt	orth	ogonaliza	ation proc	ess This
	cour	se focuses on employabil	lity and skill develo	nment aligne	d wi	ith al	l CO's	ation proc	055. 1115
	Δ ftc	r studying these topics the	ne students will be s	ble to:	u w	i i i u	ii ee s.		
		r studying these topics, the	accuracing almost al	luic tu.			The obj	active of t	hia
	co	course is to introduce a	student to the basic	of linear al	SCI(a an	d some of	f its appli	nns cations
Course	CO	CO2: Students will be able to know the concepts of group, ring and other related properties.							
Outcomes		which will prepare the students to take up further applications in the relevant fields.							
	CO	3: The student will use th	is knowledge in cor	nputer science	e, fi	nanc	ial mathe	ematics, in	ndustrial
		mathematics and biomathematics.							
	CO4: After completion of this course, students will appreciate its interdisciplinary nature.								
			COURSE SYLLA	ABUS					-
Module No.			Content	t					Hours
	[Co	urse Outcome(s) No.: 1	1, 2, 3 and 4]						
	Intr	duction to Indian ancient	t Mathematics and I	Mathematicia	ns				
	Gro	up Theory: Automor	phism, inner au	tomorphism,	Α	uton	orphism	groups,	
	Aut	omorphism groups of fin	nite and infinite c	yclic groups,	Ch	arac	teristic s	ubgroups,	
	Con	imutator subgroup and its	s properties; Applic	ations of fact	or g	roup	s to auto	morphism	
I	grou	ps. Conjugacy classes,	The class equation	n, p-groups,	1 ne	e Syl	low theo	rems and	25
	test	· Generalized Cavley'	of Sylow theorem. s theorem. Index	theorem	pie Emł	grou veddi	ips, nom	simplicity	
	ann	ications	s meorem, maex	theorem,		Jeau	ing theo	and	
	Lin	ear Algebra I: Vector st	paces. Subspaces. I	inear indepe	nde	nce a	and depe	ndence of	
	vect	ors, Basis and Dimensio	n, Quotient space.	Linear transf	orm	atior	is, The A	lgebra of	
	line	ar transformations, rank n	ullity theorem, thei	r representati	on a	is ma	trices.	0	
	[Co	urse Outcome(s) No.: 1	1, 2, 3 and 4]	•					
	Rin	g theory: Polynomial	rings over commu	utative rings,	D	ivisi	on algor	ithm and	
	con	equences, Principal ideal	l domains, Factoriz	ation of poly	nom	ials,	Reducib	ility tests,	
	Irre	lucibility tests, Eisenstei	n criterion, Unique	e factorizatio	n ir	nZ	[x]. Divi	sibility in	25
II	inte	gral domains, Irreducibles	, Primes, Unique fa	ctorization do	mai	ins, E	Euclidean	domains.	
	Linear Algebra II: Linear functionals, Dual space, Characteristic values, Cayley								
	Han Ortl	iliton I neorem. Inner	product spaces and	a norms, Ca	aucr	1y-50	chwarz 1	nequality,	
	dim	ensional spaces Gram-S	chmidt orthogonali	vases, bess	51 S 86]	IIIC Rilin	quanty ear and	Ouadratic	
	forms								
Text Books:	- • • •								1
> N. He	erstei	n. Topics in Algebra. Wile	v. 2006.						
> K He	offm	n and R. Kunze. Linear Al	gebra. Pearson 201	8.					
Reference Bo	ooks	It Italizo, Elifoul I l							
	se Ro	oks published in Hindi							
	ested	digital plateform: NPTEL	/SWAYAM/MOOC	s					
~~55		G F		-					

Course No:	9 Course Name: Multivariate Statistics			Co	urse Coo	le: BMA	C 0103	
Batch:	Programme: B. Sc. Mathematics	Semester:	LT	ΡJ	Credits	Contact	Hrs	
	(With specialization in Data Science)					Per Wee	ek: 4	
2024-2028		V	31	00	4	Total H	ours: 40	
Total Evalua	ation Marks: 100	Examinatio	on l	Dur	ation:			
		Mid Term (2 h	our	s), End T	'erm (3 h	ours)	
		Pre-requisi	ite	of c	ourse:			
Theory Asse	ssment: 75 Marks	Statistics fo	$\frac{r D}{2}$	ata	Science	2.0		
Internal Ass	essment: 25 Marks	Nature of C	Jou	irse	: Major	- 2 Cours	se	
Course	This course will develop a profound understandi	ng of univaria	te a	nd	bivariate	random v	ariables	
Objective	Multivariate normal distribution, maximum likeli	hood estimatio	n (I	ML	E), Wisha	rt distrib	ution and	
	types of correlation. This course will also provide	the knowledge	eof	Pri	ncipal Co	mponent	Analysis	
	and cluster analysis. This course focuses on empl	loyability and	skil	l de	velopme	nt aligned	d with all	
	CO's.							
	After studying these topics, the students will be a	ble to						
Course	CO1: Know types of random variable and correlation matrices.							
Outcomos	CO2: Apply multivariate normal distribution and Wishart distribution.							
Outcomes	CO3: Understand multiple, Partial and Canonical correlations.							
	CO4: Perform principal component analysis and	cluster analys	is.					
	COURSE SYLLA	BUS					_	
Module No.	Content						Hours	
	[Course Outcome(s) No.: 1 and 2]							
	Univariate and bivariate random variables, mea	an vectors and	l co	ovar	iance ma	trices for	r	
	random vectors and correlation matrices. Multiv	ariate normal	dis	trib	ution, me	an vecto	r	
I	and covariance matrix, properties of multivaria	te normal vec	ctor	s, n	noment g	generating	g 20	
	Wishart distribution and its properties) of mean vect	01 2	ma	covarian		,	
	[Course Outcome(s) No.: 3 and 4]							
	Simple, Multiple, Partial and Canonical correlation	ons alongwith	the	ir p	roperties.			
	Principal Component Analysis: Deriving principal	al components	(P	Ċs),	propertie	es of PCs	,	
II	PCs as projections and rotation of axes, me	thods for disc	carc	ling	compoi	nents and	1 20	
	interpretation of PCs.							
	Cluster Analysis: Similarity and distance meas	sures, hierarch	lica	l cl	ustering,	K-mean	S	
Torrt Doolras	clustering and their interpretation.							
Text Books:	A state of the state of the state of the state of the Gradient	· · · 1 A · · · 1 · · ·	***	•1	2002			
▶ 1. W. ▶ ₽ Λ	Anderson, An introduction to Multivariate Statis	Analysis, Wil	, W	11ey 200	, 2003.)2			
• N. A.	Johnson & D. W. Wichell, Applieu Multivallate	Analysis, will	Cy,	200	12.			
Reference bo	ooks:							
> M C	Srivestave & C. G. Khatri Introduction to multiv	variata statistic		Jort	h Uollan	d 1070		

M. S. Srivastava & C. G. Khatri, Introduction to multivariate statistics, North-Holland, 1979.
 A. C. Rencher, Multivariate Statistical Inference and its Applications, Wiley and Sons, 1998.

Course No:	1 Course Name: Number Theory and Game T	heory C	ourse Code: BMAE	0001					
Batch:	Programme: B. Sc. Mathematics	Semester: LTP	J Credits Contact H	Irs					
	(With specialization in Data Science)		Per Week	k: 5					
2024-2028		V 410	0 5 Total Ho u	urs: 50					
Total Evalua	ation Marks: 100	Examination D	iration:						
		Mid Term (2 hou	urs), End Term (3 ho	urs)					
Theory Acco	semant: 75 Marks	Pre-requisite of	Course:						
Internal Ass	essment: 25 Marks	Nature of Cour	Flogramming Proble	:111					
Course	This course will develop a protound understanding	ng of theory of nu	nbers and game theor	ry. This					
Objective	course will provide the knowledge of Congruence	es, Diophantine E	quations, pay off mat	rix, and					
	generating functions. This course focuses on empl	loyability and skill	development aligned	with all					
	CO's.								
	After studying these topics, the students will be al	ole to:							
	CO1: Upon successful completion, students will l	have the knowledge	e and skills to solve p	roblems					
~	in elementary number theory and also appl	y elementary numb	ber theory to cryptogra	aphy.					
Course	CO2: This course provides an introduction to C	2: This course provides an introduction to Game Theory. Game Theory is a mathematical former which makes possible the analysis of the decision making measure of							
Outcomes	interdependent subjects. It is aimed at expl	interdependent subjects. It is aimed at explaining and predicting how individuals behave in							
	a specific strategic situation, and therefore	help improve decis	sion making.						
	CO3: A situation is strategic if the outcome of a d	ecision problem de	pends on the choices	of more					
	than one person. Most decision problems in	n real life are strate	gic.						
	204: To illustrate the concepts, real-world examples, case studies, and classroom experiments								
	might be used.	DUG							
	COURSE SYLLA	BUS							
Madula Na	Contont			Hanna					
Module No.	Content			Hours					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3]	· ·	E d	Hours					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg	orithm; primes; co	ngruences; Fermat's	Hours					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences: solutions of congruences: Chin	orithm; primes; co Fermat's quotients	ngruences; Fermat's and their elementary	Hours					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chin- function.	orithm; primes; co Fermat's quotients ese remainder the	ngruences; Fermat's and their elementary corem; Euler's phi-	Hours					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence;	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol.	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legenda acobi symbol. of game theory, so	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, observatoristic of	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game. Pure and Mixed strategies. Saddle point and	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legenda acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4]	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence.	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of ax	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence.	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum = z^n ; properties of	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of an Pythagorean triples; sums of 2, 4, 5 squares; assor	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c,x^n + y^n =$ ted examples of di	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum = z^n ; properties of ophantine equations.	Hours 25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of ax Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c, x^n + y^n =$ ted examples of di ations: Generating	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum = z^n ;properties of ophantine equations. g Function Models,	25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chin- function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of an Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela Calculating coefficient of generating functions	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendra about Legendra about Legendra about Legendra form, payoffs, stra game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c,x^n + y^n =$ ted examples of di ations: Generating s, Partitions, Exp	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum = z^n ;properties of ophantine equations. g Function Models, onential Generating	25					
Module No.	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of and Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela Calculating coefficient of generating functions Functions, A Summation Method. Recurrence R	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c, x^n + y^n =$ ted examples of di ations: Generating s, Partitions, Exp elations: Recurren	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum = z^n ;properties of ophantine equations. g Function Models, onential Generating ce Relation Models,	25					
I I I	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' len- reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of an Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela Calculating coefficient of generating functions Functions, A Summation Method. Recurrence R Divide and conquer Relations, Solution of Line Inhomogeneous Recurrence Relations	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c,x^n + y^n =$ ted examples of di ations: Generating s, Partitions, Exp elations: Recurrence ear Recurrence Re- with Generating Fu	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum = z^n ;properties of ophantine equations. g Function Models, onential Generating ce Relation Models, elations, Solution of unctions	Hours 25 25					
I I II	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of an Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela Calculating coefficient of generating functions Functions, A Summation Method. Recurrence R Divide and conquer Relations, Solution of Line Inhomogeneous Recurrence Relations, Solutions of Game Theory II: Fundamental Theorem of Rect	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendr acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c, x^n + y^n =$ ted examples of di ations: Generating s, Partitions, Exp elations: Recurrence ear Recurrence Re with Generating Fu	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum $= z^n$; properties of ophantine equations. g Function Models, onential Generating ce Relation Models, elations, Solution of unctions.	25 25					
I I I	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; China function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' len- reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of an Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela Calculating coefficient of generating functions Functions, A Summation Method. Recurrence R Divide and conquer Relations, Solution of Line Inhomogeneous Recurrence Relations, Solutions of Bame Theory II: Fundamental Theorem of Recta Dominance and Graphical method of solving Recurrence	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendra about Legendra about Legendra acobi symbol. of game theory, so form, payoffs, stra game theory, Tw d its existence. $x+by=c,x^n + y^n =$ ted examples of di ations: Generating s, Partitions, Exp elations: Recurrence ear Recurrence Recurrence with Generating Fu angular games, Con- ctangular games, Recurrence constant of the second s	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum $= z^n$;properties of ophantine equations. g Function Models, onential Generating ce Relation Models, elations, Solution of inctions. neept of Dominance, celationship between	25 25					
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I I I	Content [Course Outcome(s) No.: 1, 2 and 3] Theory of Numbers: Divisibility; Euclidean alg theorem, Euler's theorem and Wilson's theorem; I consequences; solutions of congruences; Chine function. Congruences: Congruence modulo powers of pri quadratic residues; Legendre symbol, Gauss' lem reciprocity law; proofs of various formulations; Ja Game Theory I: Introduction, overview, uses of examples, and formal definitions of: the normal Nash equilibrium. Introduction, characteristic of game, Pure and Mixed strategies, Saddle point and [Course Outcome(s) No.: 1, 2 and 4] Diophantine Equations: Solutions of an Pythagorean triples; sums of 2, 4, 5 squares; assor Generating Functions and Recurrence Rela Calculating coefficient of generating functions Functions, A Summation Method. Recurrence R Divide and conquer Relations, Solution of Line Inhomogeneous Recurrence Relations, Solutions of Game Theory II: Fundamental Theorem of Recta Dominance and Graphical method of solving Rec rectangular game and Linear Programming Pr Simplex method, reduction of m x n game and so	orithm; primes; co Fermat's quotients ese remainder the me; primitive roots ma about Legendra acobi symbol. of game theory, so form, payoffs, stra game theory, Tw dits existence. $x+by=c,x^n + y^n =$ ted examples of di ations: Generating s, Partitions, Exp elations: Recurrence ear Recurrence Recurrence with Generating Fu angular games, Con ctangular games. R oblem, Solving re- olution of 2x2, 2 x	ngruences; Fermat's and their elementary corem; Euler's phi- s and their existence; re symbol; quadratic me applications and tegies, pure strategy ro- person zero-sum z^{n} ;properties of ophantine equations. g Function Models, onential Generating ce Relation Models, elations, Solution of inctions. neept of Dominance, celationship between extangular game by s, and r x 2 cases by	25 25					

Text Books:

- > D. M. Burton, Elementary Number Theory, Universal Book Stall, New Delhi, 2002.
- I. Niven, H. S. Zuckerman and H. L. Montegomery, An Int. to the Theory of Numbers (6th edition) John Wiley and sons, Inc., New York, 2003.
- > Prajit Dutta, Strategies and Games, MIT Press, http://www.ece.stevens-ch.edu/~ccomanic/ee800c.html
- V. K. Balakrishnan, Introductory Discrete Mathematics, Dover Publications, 1996.

- Martin Osborne, An Introduction to Game Theory, Oxford University Press, 2003
- V. K. Balakrishnan, Schaum's Outline of Theory and Problems of Combinatorics Including Concepts of Graph Theory, Schaum's Outline, 1994.
- > Allan MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006.
- Suggested digital plateform: NPTEL/SWAYAM/MOOCS
- Course Books published in Hindi.

Course No: 2	2 Course Name: Graph Theory & Discrete Ma	athematics	Cou	rse Code: BMA	E 0002			
Batch:	Programme: B. Sc. Mathematics	Semester: L	TPJ.	Credits Contact	Hrs			
	(With specialization in Data Science)			Per Wee	ek: 5			
2024-2028		V 4	100	5 Total Ho	ours: 50			
Total Evalua	tion Marks: 100	Examinatio	n Dura	ation:				
		Mid Term (2	2 hours)), End Term (3 h	ours)			
Theory Asses	ssment: 75 Marks	Pre-requisit	te of co	ourse: Algebra				
Internal Asso	essment: 25 Marks	Nature of C	ourse:	Elective Course				
Course	This course will develop a profound understand	ding of graph	theory	, propositional le	ogic and			
Objective	boolean algebra. This course will provide the know	vledge of comb	binatori	cs and theory of a	utomata.			
	This course focuses on employability and skill dev	velopment alig	gned wi	th all CO's.				
	After studying these topics, the students will be ab	ole to:						
	CO1: Upon successful completion, the students	will have the	e know	ledge of various	types of			
	graphs, their terminology and applications.			U	71			
Course	CO2: After Successful completion of this cou	rse, students	will be	e able to unders	tand the			
Outcomes	isomorphism and homomorphism of graphs. This course covers the basic concepts of							
outcomes	graphs used in computer science and other disciplines. The topics include path, circuits,							
	adjacency matrix, tree, coloring. After successful completion of this course, the student will							
	have the knowledge graph coloring, color p	oroblem, vertez	x colori	ng.				
	CO3: After successful completion, students will	have the know	wledge	of Logic gates, K	Larnaugh			
	maps and skills to proof by using truth tables. Students will also be able to apply the basics							
	of the automation theory, transition functio	n and table.						
	CO4: This course covers the basic concepts of disc	crete mathema	tics use	d in computer sci	ence and			
	other disciplines that involve formal rea	asoning. The	topics	include logic, c	counting,			
	relations, hasse diagram and Boolean algeb	ora. After succ	cessful o	completion of this	s course,			
	the student will have the knowledge in Mathematical reasoning, combinatorial analysis,							
	discrete structures and Applications.							
	COURSE SYLLA	BUS			T==			
Module No.	Content				Hours			
	[Course Outcome(s) No.: 1, 2, 3 and 4]							
	Graph Theory I: Introduction to graphs, basic pr	operties of gra	iphs, Si	mple graph, mult	L			
	graph, graph terminology, representation of g	raphs, Bipart	ite, reg	gular, planar and	1			
	connected graphs, connected components in a grap	ph, Euler grap	hs, Dire	ected, Undirected	,			
	multi-graph, mixed graph. Walk and unilateral con	nponents, unic	cursal gi	raph, Hamiltonian				
	path and circuits, Graph colouring, chromatic nun	nber, isomorpr	nism an	a nomomorphism	1			
I	of graphs, incluence relation and degree of the gra	apn.		·····	25			
	propositional Logic: Proposition logic, basic lo	ogic, logical c	connection of the second	ives, truth tables.	,			
	modus tollans, validity, prodicate logic, universal	and avistantial	l quanti	fightion proof by	I			
	implication converse inverse contrapositive cont	radiation dira	i quallu	fusing truth table				
	Boolean Algebra: Basic definitions. Sum of prod	liauction, une	ucts of	sums I originates	•			
	and Karnaugh mans	acts and produ		sums, Logic gates				
	$[Course Outcome(s) No \cdot 1 2 3 and 4]$							
	Granh Theory II. Operation of granh circuit	Path and cir	renits	Fulerian circuits				
	Hamiltonian path and cycles Adjacency matrix	Weighted org	anh Tr	avelling salesmar	'n			
т	problem. Shortest nath Diikstra's algorithm Tree	Binary and S	Spannin	g trees Coloring	2.5			
11	Color problems. Vertex coloring and important pr	operties	Puillin		, 25			
	Combinatories: Inclusion- exclusion recurrence	relations (n th	order re	ecurrence relation				
	with constant coefficients Homogeneous re	ecurrence rel	lations	Inhomogeneous				
	recurrence relations) generating function (closed	form expres	sion n	roperties of G F				
	solution of recurrence relations using G.F. solution	n of combinate	orial pro	oblem using G.F.)			
	Finite Automata: Basic concepts of automation t	theory, Detern	inistic F	Finite Automation				
	recurrence relations), generating function (closed solution of recurrence relations using G.F. solution Finite Automata: Basic concepts of automation t	d form expres n of combinate theory, Determ	sion, province of the second s	roperties of G.F. oblem using G.F.) Finite Automation				

(DFA), transition function, transition table, Non Deterministic Finite Automata (NDFA), Mealy and Moore machine, Minimization of finite automation.

Text Books:

- > N. Deo, Graph Theory with Applications to Engineering and Computer Science, PHI, 2016.
- C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill, 1985.
- J. P. Trembley & R. Manohar, Discrete Mathematics Structures with Applications to Computer Science, TMH, 2008.
- S. S. Ray, Graph Theory with Algorithms and Its Applications: In Applied Science and Technology, Springer, 2013.

- > D. B. West, Introduction to Graph Theory, Pearson, 2000.
- ≻ K. H. Rosen Discrete Mathematics and Its Applications, McGraw-Hill, 2017.
- Suggested digital plateform: NPTEL/SWAYAM/MOOCs.
- Course Books published in Hindi.

Course No:	3 Course Name: Differential Geometry & Te	ensor Analysis Course Code: BMAB	E 0003					
Batch:	Programme: B. Sc. Mathematics	Semester: L T P J Credits Contact I	Hrs					
	(With specialization in Data Science)	Per Wee	k: 5					
2024-2028		V 4 1 0 0 5 Total Ho	ours: 50					
Total Evalua	ation Marks: 100	Examination Duration:						
		Mid Term (2 hours), End Term (3 hou	urs)					
		Pre-requisite of course:						
Theory Asse	ssment: 75 Marks	Coordinate Geometry, Vector Calcula	us					
Internal Ass	essment: 25 Marks	Nature of Course: Elective Course	6					
Course	This course will develop a protound understa	inding of local theory of curves and s	surfaces,					
Objective	Geodesics, Gaussian and normal curvature. This	course will also provide the knowledge of	f Tensor					
	algebra and analysis. This course focuses on emp	bloyability and skill development aligned	with all					
	CO's.							
	After studying these topics, the students will be a	able to:						
	CO1: After Successful completion of this cou	urse, students should be able to determ	ine and					
	calculate curvature of curves in different of	coordinate systems.						
Course	CO2: This course covers the Local theory of	Curves, Local theory of surfaces, Ge	odesics,					
Outcomes	Geodesics curvature, Geodesic polars, Cu	rvature of curves on surfaces, Gaussian cu	irvature,					
	Normal curvature etc.		£ 4					
	cos: After Successful completion of this cours	e, students should have the knowledge of	or tensor					
	algebra, different types of tensors, Riemannian space, Ricci tensor, Einstein space and Einstein tensor etc.							
	COURSE SYLLA	ABUS						
Module No.	Content	t	Hours					
	[Course Outcome(s) No.: 1, 2 and 3]	-						
Ι	Local theory of curves: Space curves, Example binormal, Osculating Plane, normal plane an osculating sphere, Helices, Serret-Frenet appara- tangent surfaces, involutes and evolutes of curv fundamental existence theorem for space curves. Local Theory of Surfaces: Parametric patches surfaces (one parameter), edge of regression, developable surfaces, surfaces of revolution, Hel Tensor Algebra: Vector spaces, the dual spa- transformation formulae, contraction, special te associated tensor with examples. Tensor Analysis I: Contravariant and covaria Symmetric and skew-symmetric tensors, Alge product, Quotient theorem, Reciprocal tens transformation of Christoffel's symbols, Covaria Covariant derivative.	es, Plane Curves, tangent and normal and nd rectifying plane, osculating circle, tus, contact between curve and surfaces, es, Bertrand curves, Intrinsic equations, on surface curve of a surface, family of rues surfaces, skew ruled surfaces and licoids. aces, tensor product of vector spaces, ensors, symmetric tensor, inner product, ant vectors and tensors, Mixed tensors, ebra of tensors, Contraction and inner sors, Christoffel's symbols, Law of nt differentiation, non- commutativity of	25					
II	Metric: first fundamental form and arc length, I intrinsic properties, geodesics, canonical geo geodesics, geodesics curvature, Geodesic polar curves on surfaces, Gaussian curvature, norma curvature, Gaussian curvature, umbilic points, Euler's theorem. Tensor Analysis II: Gradient of scalars, Diverg	Direction coefficients, families of curves, desic equations, normal properties of rs. Gauss-Bonnet theorem, curvature of l curvature, Meusneir's theorem, mean lines of curvature, Rodrigue's formula, ence of a contravariant vector, covariant	25					

properties, geodesics, geodesic curvature, geometrical interpretation of curvature tensor, Ricci tensor, scalar curvature, Einstein space and Einstein tensor.

Text Books:

- > T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
- > B. O'Neill, Elementary Differential Geometry, Academic Press, 2006.
- > Z. Ahsan, Tensors- Mathematics of Differential Geometry, PHI, 2015.
- ▶ B. Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003.
- > D. C. Kay, Tensor Analysis, Schaum's Outline Series, McGraw Hill, 1988.
- R. S. Mishra, A Course in Tensors with Applications to Reimannian Geometry, Pothishala Pvt. Ltd, Allahabad.

- > C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003.
- > D. J. Struik, Lectures on Classical Differential Geometry, Dover Publications, 1988.
- S. Lang, Fundamentals of Differential Geometry, Springer, 1999.
- L. P. Eisenhart, An Introduction to Differential Geometry (with the use of tensor Calculus), Princeton University Press, 1940.
- I. S. Sokolnikoff, Tensor Analysis, Theory and Applications to Geometry and Mechanics of Continua, John Wiley and Sons, 1964.
- Suggested digital plateform: NPTEL/SWAYAM/MOOCs
- Course Books published in Hindi.

Course No: 4	ourse No: 4Course Name: Data Mining and WarehousingCourse Code: BCSE 0152					52					
Batch:		Programme: B. Sc. Mathematics	Semester:	L	Т	Р	J	Credits	Contact Per We	Hrs ek: 3	
2024-2028		(With specialization in Data Science)	V	3	0	0	0	3	Total H	ours: 30	
Total Evalua	ntior	Marks: 100	Examinat Mid Term	ior (2	D hou	ura urs)	tion En	: d Term (3 hours)		
Theory Asse	essn	nent: 75 Marks	Pre-requi	<u> </u>	e of	cοι	ırse	: DBMS	<u>5 110415)</u>		
Internal Ass	The	Chiesting of this course is to introduce th	a hasia aan		ta a	fDa	to V	Vorahous	a and Dat	. Minin a	
Course Objective	tech	iniques. This course focuses on employal	bility and sk	cill	dev	veloj	na v pme	nt aligned	d with all	CO's.	
Course	Afte CO	er studying these topics, the students will 1: Understand and apply the concept of c	be able to: lata wareho	ouse	e an	d m	inin	g in real-	life appli	cations.	
Course	CO	2: Apply the principle algorithms used in	n modern m	acł	nine	lear	rnin	g.			
Outcomes	CO	3: Apply the information theory and prob Data Mining.	bability the	ory	to	get t	he t	basic theo	oretical re	sults in	
	CO	O4: Apply Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.									
	CO	5: Implement clustering using various cl	ustering me	the	ods	on d	lata	set.			
		COURSE SY	LLABUS								
Module No.		Con	tent							Hours	
	[Co	urse Outcome(s) No.: 1, 2 and 3]									
I	Da Wa Ar Se Da	[Course Outcome(s) No.: 1, 2 and 3] Data Warehousing: Overview, Difference between Database System and Data Warehouse, Multi-dimensional Data Model: Concept Hierarchy, Three-Tier Architecture, Meta Repository, Data Warehouse & OLAP Technology, Types of OLAP Servers. Data Cubes Computations & Data Generalization. Data Pre Processing: Data Cleaning, Data Integration and Data Transformation, Data 1						15			
	 Reduction Mapping the Data Warehouse to a Multiprocessor Architecture, Multi-Dimensional Data Model. Introduction: Basics of Data Mining, Issues and Applications of Data Mining Techniques. Mining frequent Patterns: Basic Concepts of Association Rules Mining, Apriori Algorithm, FP-Growth. Multilevel Association Rules, Multi-Dimensional Association Rules. 								L 5 L		
	[Co	ourse Outcome(s) No.: 4 and 5]									
п	 II Classification and Predictions: Classification & Prediction, Issues Regarding Classification and Prediction, Decision Tree, Bayesian Classification, Back Propagation, Neural Network, Nearest Neighbour Classifiers, Support Vector Machines, Prediction. 							15			
	Da Cl Hi Da Da Da	 Machines, Prediction. Data Mining Cluster Analysis: Data Types in Cluster Analysis, Categories of Clustering Methods, Partitioning Methods. Hierarchical Clustering: CURE and Chameleon. Density Based Methods: DBSCAN, OPTICS. Grid Based Methods STING, CLIQUE. Model Based Method: Statistical Approach, Outlier Analysis, Mining Multimedia Data, Text Mining, Web Data Mining, Spatial Data Mining, Temporal Data Mining, Data Visualization. 									

Text Book:

J. Han, M. Kamber & J. Pei, Data Mining Concepts and Techniques, Morgan Kauffmann, 2011.

- > M. H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education, 2006.
- S. Anahory & D. Murray, Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems, Addison-Wesley, 1997.
- > P. N. Tan, M. Steinbach & V. Kumar, Introduction to Data Mining, Pearson Education, 2016.
- > C. C. Aggarwal, Data Mining: The Textbook, Springer, 2015.

Course No: :	course Name: Data Mining and Warehousing Lab Course Code: BCSE 0181							181			
Rotah.		Programma	Somester	T	т	D	Т	Credit	Contact	Urc	
Daten:		B Sc Mathematics	Semester:	L	T	I	J	Creun	Per We	ek: 2	
2024-2028		(With specialization in Data Science)	V	0	0	2	0	1	Total Ho	ours: 24	
Total Evalua	tion	Marks: 100	Examinati End Term	$\frac{1}{(2)}$	Du	rat	tio	n:			
Internal: 50	Mar	ks		(21	IOui	.5)					
External: 40) Ma	rks	Pre-requis	site	of e	cou	irs	e: DBM	S Lab		
Attendance:	10 N	Marks									
Course	The	Objective of this course is to implem	nent and ru	n tl	he p	oro	gra	mme ba	used on th	ne basic	
Objective	cond	cepts of Data Warehouse and Data Minir	ng techniqu	es. '	This	sco	ours	se focuse	s on emplo	oyability	
	and	skill development aligned with all CO's.									
Course	Afte	r studying these topics, the students will be able to:									
Outcomes	CO1	1: Implement the clustering technique like	e DBSCAN,	K-	NN	, K	M	ean.			
	CO2	2: Implement SVM on two dimensional d	ata set.								
	1	COURSE SYL	LABUS								
Module No.		Cont	ent							Hours	
	[Coı	urse Outcome(s) No.: 1 and 2]									
	• I	• Demonstration of pre-processing on different dataset									
	• I	Demonstration of Association rule process	s on differen	t da	itase	et u	sin	g apriori	algorithm		
	• I	Demonstration of classification rule pro	ocess on di	ffeı	ent	da	itas	et using	FP Tree		
	a	lgorithm									
	• I	Demonstration of classification rule proce	ess on differ	ent	data	aset	t us	sing id3 a	algorithm		
	• I	Demonstration of classification rule proc	cess on diffe	erer	nt da	atas	set	using na	iive bayes		
	8	lgorithm									
-	• I	Demonstration of clustering rule process of	on different	dat	aset	usi	ing	simple l	k-means	24	
1	• I	Demonstration of clustering rule process of	on different	dat	aset	us	ing	simple l	k-mediods	27	
	• 1	Demonstration of clustering rule process of	on different	dat	aset	usi	ing	simple l	k-mode.		
	• I	Demonstration of clustering rule process of	on different	dat	aset	usi	ing	DBSCA	N.		
	• 1	Demonstration of clustering rule process	on different	da	tase	t us	sing	g simple	Hieratical		
	t t	based algorithm.	1.00 1								
	• Implementation of K-NN Algorithms on different data sets.										
	• 1	mplementation of Sequential pattern SPA	ADE algorith	ım	on s	equ	uen	ice data s	set.		
	• 1	mplementation of Sequential pattern GSI	P algorithm	on	sequ	ien	ce	data set.			
		mplementation of SVM on a two dimens	ional data se	et.							
Toyt Dools	• 1	Demonstration of Decision Tree on Weka	1001.								
	rarar	Programming Collective Intelligence R	uilding Smg	rt V	Noh	21	<u>م</u>	nnlicatio	one O'Rai	11.v	
2007	5ai al	i, i rogramming Concerve intempetite D	unung Sille	սւ		∠.(JA	ppication	$m_{0}, \cup \mathrm{Rel}$	пу,	
2007.											
Reference Bo	ooks	:									

- M. Hall, E. Frank, G. Holmes, B. Pfahringer, P. Reutemann, & I. H. Witten, The WEKA Data Mining Software: An Update, ACM SIGKDD Explorations Newsletter, Vol. 11 (1), 10–18, 2009.
- https://www.cs.waikato.ac.nz/ml/weka/Witten_et_al_2016_appendix

Course No: 1	3	Course Name: Soft S	Skills-III	III Course Code: BSDH 0303						
Batch:		Programme: B.Sc.	Semester:	L	Т	Р	J	Credits	Contact H Per Wee	Irs k: 3
2024-2028		Mathematics-DS	V	3	0	0	0	3	Total Ho	urs: 40
Total Evalua	ntion I	Marks: 100	Examinatio	on Du	ration	: End	Term	(3 hours)		
Theory Asse	ssmen	t : 100 Marks	Pre-requisi	te of (course	: Nil				
Course	Focus	on the English gramn	har error corr	rection	algori	thm v	vhich i	s an impor	tant task o	f natura
Objective	langu lexica To ea have in ma prelin devel	exical, grammatical, and punctuation errors often committed by a non-native language learner or ease the complexity of grammar rules, ambiguity of semantics and ambiguity of grammar. The ave the ability to use a wide range of algebraic, geometric, and statistical tools that are required a many fields of postsecondary education so that students gain appropriate skills to succeed is reliminary selection process for recruitment. This course focuses on employability and ski evelopment aligned with all CO's.								
	After	ter studying these topics, the students will be able to:								
Course Outcomes	CO1:	CO1: Juxtapose the previously-learned basics of the grammar with the recently acquired intermediate skills of a student, specifically at a sentence level, to augment the know-how of the usage of the language in a variety of structures.CO2: Jettison the confusion and complexity from the minds of the students as far as the rules of								
	CO3:	constrained complexity from the minds of the students as far as the fulles of the language are concerned.co3: Juggernaut the students to the mastery of a myriad of mathematical modules, majorly algebra, geometry, and statistics.								
		argeora, geometry, and	COUDSE S	VII	ADIS					
	1		COURSE S		ADUS					I
Module No.			С	onten	ıt					Hours
I	[Cou QUA PUR] Progr COM VER VOC Phras Sente	rse Outcome(s) No.: 1 NTITATIVE APTITU E ARITHMETIC-II: ession, Functions. ERCIAL ARITHME BAL ABILITY ABULARY ENRICH al Verbs. Same Words BAL REASONING: nce Equivalence.	1 and 2] J DE AND L Arithmetic P <u>TIC-II</u>: Cloc <u>IMENT</u>: Syr –Different Pa Word Analo	OGIC Progress ks, Ca nonym urts of gy, S	AL R ssion, d llendar s, Ant Speecl entenc	EASO Geomo , Ratio tonym h e Cor	DNING etric P D Propos, Odd	rogression, ortion-I d Words. I n &Text C	Harmonic dioms and completion	20
Π	II [Course Outcome(s) No.: 1 and 2] QUANTITATIVE APTITUDE AND LOGICAL REASONING OUANTITATIVE APTITUDE AND LOGICAL REASONING Average 20 DIRECTION SENSE: Cardinal directions, inter cardinal directions, compass based problems, shadow based problems COMMERCIAL ARITHMETIC-III: Time speed and Distance, Races, Problems on Trains, Boat and Stream, Time and Work, Pipe and cistern VERBAL ABILITY: ERROR ANALYSIS:									
Text Books: ≻ A. S ≻ M. k	harma K. Pano	, How to prepare for Q dey, Analytical Reason	uantitative Ap	ptitude lishing	e for C g Co. P	AT, T Vvt. Lto	MH pu d, 2009	ublication, 2	2024.	1
Reference B	ooks:	muel Quantitative Art	tudo S. Char	ad Dr-1	liabir	~ 202	2			

- R. S. Aggarwal, Quantitative Aptitude, S. Chand Publishing, 2022.
 Jaikishan and Premkishan, How to Crack Test of Reasoning in All Competitive Examinations, Arihant Publication, 2018

Course No:	10	Course Name: Metric Space and Complex A	Analysis		Co	urse Code: BMA	C 0006		
Batch:		Programme: B. Sc. Mathematics	Semester:	LT	ΡJ	Credits Contact	Hrs		
		(With specialization in Data Science)				Per Wee	ek: 4		
2024-2028			VI	31	00	4 Total Ho	ours: 40		
Total Evalua	atior	Marks: 100	Examinati	on l	Dur	ation:			
			Mid Term	(2 h	ours	s), End Term (3 h	ours)		
			Pre-requis	ite	of c	ourse:			
Theory Asse	ssm	ent: 75 Marks	Algebra, Ti	rign	ono	metry and Calcul	us		
Internal Ass	essn	nent: 25 Marks	Nature of	Cou	irse	: Major Course as	s per		
~			common mi	inim	um	syllabus			
Course	Thi	s course will develop an understanding of met	ric spaces, t	opol	logy	of metric spaces,	unitorm		
Objective	con	tinuity, connectedness and compactness. This c	course will p	rovi	ide t	he knowledge of f	unctions		
	of a	a complex variable, their continuity and differ	entiability a	nd t	heo	rems of complex a	analysis.		
	Thi	s course focuses on employability and skill dev	elopment al	igne	ed w	ith all CO's.			
	Afte	er studying these topics, the students will be ab	le to:						
	CO	1: The course is aimed at exposing the students	to foundatio	ons o	of ar	alysis which will b	be useful		
		in understanding various physical phenom	nena and giv	ves	the	student the found	lation in		
Course		mathematics.							
Outcomes	CO	CO2: After completion of this course, the student will have rigorous and deeper understanding of							
		fundamental concepts in Mathematics. This	will be help	oful	to tł	ne student in under	standing		
	GO	pure mathematics and in research.	, C			1 .	. 1		
	CO	3: Students will be able to know the con-	icepts of m	netri	C Sj	pace, basic conce	epts and		
		applications in the relevant fields							
		applications in the relevant fields.							
Module No		COURSESTELA	005				Hours		
	[Co	$\frac{1}{1}$					liouis		
	Me	tric Spaces I: Definition and examples. S	equences in	n m	etri	c spaces. Cauchy	r		
	sear	uences. Complete metric space. Topology of	Metric Space	es:	Ope	en and closed ball.			
Ι	Nei	ghborhood, Open set, Interior of a set, limit	point of a se	et, d	eriv	red set, closed set,	20		
	clos	sure of a set, diameter of a set, Cantor's theorem	n, Subspace	s, D	ense	e set.			
	Cor	nplex Analysis I: Analytic Functions and Cau	chy-Riemar	n E	qua	tions: Functions of			
	com	plex variable, Mappings; Mappings by the ex	ponential fu	incti	ion,	Limits, Theorems	5		
	on l	limits, Limits involving the point at infinity, C	ontinuity, D)eriv	vativ	es, Differentiation	L		
	forr	nulae, Cauchy-Riemann equations, Sufficient co	onditions for	difi	fere	ntiability; Analytic	:		
	fund	ctions and their examples. Elementary Function	is and integr	rais:	Ex]	ponential function,	,		
	Log	ivatives of functions. Definite integrals of func-	tions Control	S, 11	rigo	nometric function,	, I		
	its e	examples Upper bounds for moduli of contour	integrals	uis,	CO	intour integrais and	L		
		α	integrais.						
	Me	tric Spaces II: Continuous mappings Sequenti	al criterion a	and	othe	er characterizations			
	of c	ontinuity. Uniform continuity. Homeomorphis	m. Contracti	on r	nap	ping. Banach fixed			
п	poir	nt theorem. Connectedness, Connected subse	ts of, Conn	ecte	dne	ss and continuous	20		
	mappings, Compactness, Compactness and boundedness, Continuous functions on								
	con	npact spaces.							
	Complex Analysis II: Antiderivatives, Proof of antiderivative theorem, Cauchy-Goursat								
	theo	orem, Cauchy integral formula; An exter	extension of Cauchy integral formula,						
	Cor	sequences of Cauchy integral formula, Liou	ville's theo	rem	and	d the fundamental			
	theo	orem of algebra. Convergence of sequences and	l series, Tayl	or s	erie	s and its examples;	,		
	Lau	rent series and its examples, Absolute and	unitormconv	/erg	ence	e ot power series,	,		
	Uni	queness of series representations of power series	ies, Isolated	sing	gula	r points, Residues,	,		

	Cauchy's residue theorem, Residue at infinity; Types of isolated singular points, Residues at poles and its examples.
Text B	ooks:
\succ	J. W. Brown & R. V. Churchill, Complex variable and applications, McGraw Hill, 2013.
\succ	S. Narain & P. K. Mittal, Mathematical Analysis, S. Chand, 2005.
\succ	S. Shirali, & H. L. Vasudeva, Metric Spaces, Springer, First Indian Print, 2009.
\succ	S. Narain & P. K. Mittal, Function of Complex Variable, S. Chand, 2005.
Refere	nce Books:
\succ	G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, 2017.
\succ	S. Kumaresan, Topology of Metric Spaces, Narosa Publishing House, 2014.
\succ	Suggested digital plateform: NPTEL/SWAYAM/MOOCS.
\succ	Course Books published in Hindi.

Course No:	1 Course Name: Numerical Analysis & Opera	tions Resear	rch	Co	urse Coo	le: BMA	C 0007						
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	LT	'P J	Credits	Contact I Per Wee	Hrs k: 4						
2024-2028		VI	3 1	00	4	Total Ho	ours: 40						
Total Evalua	tion Marks: 100	Examination Duration:											
		Mid Term ((2 h	our	s), End T	Cerm (3 h	ours)						
		Pre-requis	ite	of c	ourse:								
Theory Asse	sment: 75 Marks	Calculus, D	Diffe	eren	tial Equa	ations and	I LPP						
Internal Ass	essment: 25 Marks	Nature of	Coi	irse	: Major	Course as	per						
G		common mi	nın	um	syllabus	. C . 1 1	1						
Course	This course will develop a protound understar	e will develop a profound understanding of numerical solution of algebraic an											
Objective	transcendental equations, ordinary differential equa	ations, numer	ica	l int	egration a	and differe	entiation,						
	Eigen value problem & solution of simultaneous	linear equati	ions	s. Tl	nis course	e will also	o provide						
	the knowledge of methods for solving LPP, transp	portation and	ass	sign	ment prol	blems. Th	is course						
	focuses on employability and skill development al	ligned with a	11 C	O's	•								
	After studying these topics, the students will be ab	ole to:											
	CO1: The aim of this course is to teach the studen	t the applicat	ion	of	arious nu	umerical t	echnique						
	for variety of problems occurring in daily l	ife. At the en	d o	f th	e course,	the studer	nt will be						
Course	able to understand the basic concept of N	Jumerical Ar	naly	vsis	and to so	olve algeb	oraic and						
Outcomes	differential equation.												
	CO2: The main outcome will be that students	will be able	e to	ha	ndle prob	plems and	l finding						
	approximated solution. Later he can opt for advance course in Numerical Analysis in												
	Mathematics.												
	CO3: The student will be able to solve various problems based on convex sets an												
	programming. The successful completion o	of this paper v	vill	ena	ble the st	udents to a	apply the						
	basic concepts of transportation problems	s and its rela	atec	l pr	oblems to	o apply in	n further						
	concepts and application of operations rese	arch.											
		BUS					TT						
Module No.	Content						Hours						
	[Course Outcome(s) No.: 1, 2 and 3]												
	Numerical Analysis I: Solution of equations: bis	section, Seca	nt,	Reg	ular Fals	i, Newton							
	Raphson's method, Newton's method for multip	ple roots, Int	erp	olat	ion, Lagi	range and							
	Hermite interpolation, Difference schemes, divid	ded difference	ces,	Int	erpolation	n formula							
	using differences. Numerical differentiation.		1		F 1		• •						
I	Numerical Quadrature: Newton Cotes Formulas, C	Jaussian Qua	idra	ture	Formula	lS.	20						
	System of Linear equations: Direct method for sol	ving systems	01 1 [tom	inea	ir equatio	ns (Gauss							
	Gauss Saidal Balayation mathada)	mposition), 1	ltera	auvo	e method	s (Jacobi,							
	The Algebraic Figen value problem: Iacobi's met	hod Given's	me	tha	1 Power	method							
	Onerations Research I: Introduction Convex	sets fundar	ner	ntal	theorem	of linear							
	programming basic solution. Simpley method introduction to artificial variables, two												
	phase method Big-M method and their comparison	n	.0 u		ciui vuiit	10105, 100							
	[Course Outcome(s) No.: 1. 2 and 3]	*											
	Numerical Analysis II: Numerical solution of	Ordinarv dif	fere	entia	al equation	ons: Euler							
	method, single step methods, Runge-Kutta metho	d, Multi-step	me	etho	ds, Milne	-Simpson	L						
п	method, Types of approximation: Least Square	polynomial	ap	proz	ximation.	Uniform	20						
	approximation, Chebyshev polynomial approxim	nation. Differ	enc	e E	quations	and their	•						
	solutions, Shooting method and Difference equat	tion method	for	solv	ing Line	ar second							
	order differential equation with boundary conditio	ons of first, se	cor	nd a	nd third t	ype.							

Operations Research II: Resolution of degeneracy, duality in linear programming	
problems, primal dual relationships, revised simplex method, sensitivity analysis.	
Transportation problems, assignment problems.	

Text Books:

- > H. A. Taha, Opearations Research- An Introduction, Pearson Education, 2019.
- S. S. Sastry, Introductory methods of Numerical Analysis, PHI, 2012.
- > P. K. Gupta & D. S. Hira, Problems in Operations Research: Principles and Solutions, S Chand, 2010.
- M. Goyal, Computer Based Numerical and Statistical Techniques, Laxmi Pub., Delhi, 2017.
- S. Kalavathy, Operations Research, Vikash Publication House, 2012.

- M. K. Jain, S. R. K. Iyengar & R. K. Jain Numerical Methods for Engineering and scientific computation, New Age, 2012.
- ▶ W. L., Winston, Operations Research: Applications and Algorithms, Cengage Learning, 4th Ed., 2003.
- F. S. Hillier, G. J. Lieberman, B. Nag & P. Basu, Introduction to Operations Research, McGraw Hill, 2017.
- K. Swarup, P. K. Gupta & M. Mohan, Operations research, Sultan Chand & Sons, 2014.
- Suggested digital plateform: NPTEL/SWAYAM/MOOCs.
- Course Books published in Hindi.

Course No:	12 Course Name: Practical-I		Course Code: BMA	C 0802				
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester: L	TPJCreditsContact Per Wee	Hrs ek: 2				
2024-2028		VI 0	0 4 0 2 Total H	ours: 24				
Total Evalua	ation Marks: 100	Examinatio End Term (2	n Duration: 2 hours)					
Internal: 50) Marks	Pre-requisit	te of course: Nil					
External: 4	0 Marks	Nature of C	Course: Major Course a	s per				
Attendance	: 10 Marks	common min	nimum svllabus	s p • •				
Course	This lab aims to develop an understanding of num	erical solution	of equations, system of e	quations				
Objective	numerical integration, Interpolation and soluti	on of Eigen	value problems with o	compute				
Ū	programs using programming languages and softw	ware tools. This	s course focuses on empl	oyability				
	and skill development aligned with all CO's.		Ĩ					
Course	After studying these topics, the students will be a	ble to:						
Outcomes	The main objective of the course is to equip the s	tudent to solve	the transcendental and a	lgebraic				
o uteonies	equations, system of linear equations, ordinary di	fferential equa	tions, Interpolation, Nun	nerical				
	Integration. Method of finding Eigenvalue by Poy	wer method (ur	p to 4×4). Fitting a Pol	vnomial				
	function (up to third degree).		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	J				
	COURSE SYLLA	BUS						
Module No.	Content			Hours				
Ι	Io. Course SYLLABUS io. Content Hou List of the practicals to be done using computer algebra software (CAS), for example Mathematica/MATLAB/Maple/ Maxima/Scilab etc, 1. Solution of transcendental and algebraic equations by i) Bisection method ii) Newton Raphson method (Simple root, multiple roots, complex roots). iii) Secant method. iv) Regula Falsi method. 2. Solution of system of linear equations i) LU decomposition method ii) Gaussian elimination method ii) Gauss-Jacobi method 24 ii) Gauss-Seidel method 3. Interpolation i) Lagrange Interpolation ii) Newton's forward, backward and divided difference interpolations 4. Numerical Integration ii) Simpson's one third rule ii) Weddle's Rule iii) Weddle's Rule iv) Gauss Quadrature 5. Method of finding Eigenvalue by Power method (up to 4 × 4) 6. Fitting a Polynomial Function (up to third degree) 7. Solution of ordinary differential equations							
	iii) Runge Kutta method (order 4)							
	(iv) The method of successive approximations (P	icard)						
Text Books:				<u> </u>				
> M. k	K. Jain, S. R. K. Ivengar & R. K. Jain Nume	erical Methods	s for Engineering and	scientifia				
comr	putation, NEW AGE. 2012.							
→ M. G	oyal, Computer Based Numerical and Statistical T	Techniques, La	xmi Publications, Delhi,	2017.				

Course No:	13 Course Name: Time Series and Stochastic P	rocesses	Cour	rse Code: BMA	C 0104			
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester: L'	ГРЈ (Credits Contact 1 Per Wee	Hrs k: 4			
2024-2028		VI 3	100	4 Total Ho	ours: 40			
Total Evalua	tion Marks: 100	Examination	Dura	tion:				
		Mid Term (2	hours)	, End Term (3 ho	ours)			
		Pre-requisite	e of co	urse:				
Theory Asse	ssment: 75 Marks	Multivariate S	Statisti	cs				
Internal Ass	essment: 25 Marks	Nature of Co	ourse:	Major -2 Cours	e			
Course	This course will develop a profound understandi	ng of time ser	ies and	l its components,	growth			
Objective	curves, autocovariance and autocorrelation function	on, Autoregress	ive pro	cess and moving	average			
	process of general order. This course will also prov	vide the knowle	dge of	ARIMA models,	Markov			
	chains, and ergodicity. This course focuses on em	ployability and	l skill d	levelopment align	ned with			
	all CO's.							
	After studying these topics, the students will be ab	ole to						
G	CO1: Use methods of determination of trend and a	analyse seasona	al com	ponents & indices	5.			
Course	CO2: Find autocovariance and autocorrelation fur	nction and use r	nixed 2	ARMA process.				
Outcomes	CO3 : Identify ARIMA models and apply Dickey	Fuller test						
	CO4. Know about Markov chains Chanman-Kol	mogorov equat	tions a	nd ergodicity				
				na ergoaienty.				
Module No	Content	505			Hours			
	Content				nours			
I	[Course Outcome(s) No.: 1 and 2] Time Series, Components of time series, additive and multiplicative models, methods of determination of trend, growth curves, analysis of seasonal component and seasonal indices. Time series as stochastic process, auto covariance function (acvf), autocorrelation function (acf), partial autocorrelation function (pacf), correlogram, Autoregressive (AR) process of general order, moving average (MA) process of general order, mixed ARMA							
п	process. [Course Outcome(s) No.: 3 and 4] Stationarity and invertibility conditions, Autoregressive integrated moving average (ARIMA) models, model identification, AIC, BIC. Unit root test- Dickey Fuller. Discrete and Continuous-time Markov Chains (MCs): Transition probability matrix, classification of states, Chapman-Kolmogorov equations; n-step transition and limiting probabilities area disity stationery distribution							
Text Books:								
➤ A. M 1991.	Goon, M. K. Gupta & B. Dasgupta, Fundamental	s of statistics, (vol. II)	, World Press, Ca	alcutta,			
G. E. John	Box, G. M. Jenkins, G. C. Reinsel, & G. M. Ljung Wiley & Sons, 2015.	, Time series a	nalysis	: forecasting and	control,			
 S. Ka J. Me 	rlin & H. M. Taylor, A First Course in Stochastic I dhi, Stochastic Processes, New Age International,	Processes, Acad 2012.	lemic l	Press, 1995.				
Reference bo	ooks:							
> P G	Hoel, S. C. Port & C. J. Stone Introduction to Stor	chastic Process	es. Wa	veland Pr Inc. 198	36			
\rightarrow S M	Ross Stochastic Processes Wiley 1996		, ma					
> P.I.I	Brockwell & R. A. Davis. Time Series: Theory and	Methods Spri	nger ?	2009.				
	and a second sec	,	-0, 4					

Course No:	3 Course Name: Statistical Computation and S	Simulation Course Code: BMA	K 0101							
Batch:	Programme: B. Sc. Mathematics	Semester: LTPJ Credits Contact	Hrs							
	(With specialization in Data Science)	Per Wee	k: 3							
2024-2028		VI 3000 3 Total Ho	ours: 30							
Total Evalu	ation Marks: 100	Examination Duration:								
		Mid Term (2 nours), End Term (3 no	ours)							
Theory Asse	essment: 75 Marks	Basic knowledge of Statistics								
Internal Ass	sessment: 25 Marks	Nature of Course: SEC								
Course	This course will develop a profound understandin	g of Generating probability distribution	ons in R,							
Objective	central limit theorem and random number generation	on. This course will also provide the kn	owledge							
	of Gaussian integration, Monte Carlo integration,	Bootstrapping and jackknife resampli	ng. This							
	course focuses on employability and skill develop	nent aligned with all CO's.								
	After studying these topics, the students will be ab	le to								
Course	CO1: Generate probability distributions in R and r	andom number by various methods.								
Outcomos	CO2: Apply central limit theorem.									
Outcomes	CO3: Compute integrals using quadrature formula, Gaussian integration and Monte Carlo methods.									
	CO4: Know Bootstrapping for estimation of samp	ling distribution.								
	COURSE SYLLAE	BUS								
Module No.	Content		Hours							
I	[Course Outcome(s) No.: 1 and 2] Generating discrete and continuous probability distributions. Central limit theorem, Concept of M distributions. Random number generation: General transforma	distributions in R, sampling from larkov chains. Simulating multivariate ation methods, Acceptance-Rejection	15							
	method.									
Ш	Methods to compute integrals: quadrature for integration. Monte Carlo Methods: Monte Carlo integration, M and related methods. Bootstrapping, jackknife rest of sampling distribution.	mula, double integration, Gaussian etropolis- Hastings and Gibbs sampler ampling. Bootstrapping for estimation	15							
Text Books:										
≻ G. C	asella & C. P. Roberts, Monte Carlo Statistical meth	nods, Springer, 2004.								
≻ R. Cl	hristensen, W. Johnson, A. Branscum & G. S. Fishn	nan, Monte Carlo: Concepts, Algorithm	ns, and							
Appl	ications, Springer, 1996.									
> A. C	. Davison, & D. V. Hinkley, Bootstrap methods and	their application (No. 1). Cambridge								
Univ	ersity Press, 1997.									
≻ M. L	. Rizzo, Statistical computing with R, CRC Press, 2	019.								
Reference b	ooks:									
➢ W. J.➢ B. D.	Kennedy & J. E. Gentle, Statistical computing, Ma Ripley, Stochastic simulation, John Wiley & Sons	rcel Dekker Ltd, 1980. , 2009.								

Course No:	4	Course Name: S	oft Skills-IV			Cour	se Coo	le: BSDH	1 0304			
Batch:		Programme: B.Sc.	Semester:	L	Т	Р	J	Credits	Contact H Per Wee	Irs k: 3		
2024-2028		Mathematics-DS	VI	3	0	0	0	3	Total Ho	urs: 40		
Total Evalua	ation I	Marks: 100	Examination D	uratio	on: End	d Tern	1 (3 ho	urs)				
Theory Asse	ssmer	nt· 100 Marks	Pre-requisite of	cour	se: Nil							
Course	Hone	critical thinking s	kills by analyzing	the a	argume	ents wi	ith exp	licit and in	nplicit pre	mises to		
Objective	valida	ate the author's poi	nt of view. Inculc	ate pr	oblem :	solving	g and c	lecision ma	aking skills	through		
0	case	studies on work et	hics and organiza	ational	behav	vior. D	evelop	and evalu	ate inferer	nces and		
	predi	ctions that are base	ed on data; and se	elect a	nd use	appro	priate	statistical 1	methods to	analyze		
	data;	formulate question	ns that can be ad	ldress	ed with	h data	and c	collect, org	anize, and	display		
	releva	ant data to answer	all types of quest	ion in	any co	ompeti	tive ex	ams. This	s course fo	cuses on		
	emplo	byability and skill of	levelopment align	$\frac{1}{1}$ ed wi	$\frac{\text{th all C}}{11}$	CO's.						
	After	studying these top	ics, the students w	111 be	able to			1 1				
Course	COI	Convert a studer	it from a problem	solve	er into	a thin	ker, wl	no embarks	s on the jo	urney of		
Outcomes		interpreting the da	ata to come to a cc	ogent o	conclus	sion ba	sed on	the right a	ssumptions	derived		
	000	from an argument										
	002	CO2: Converge the several quantitative skills of a student so that she collects, compare and										
		conquers the co	inplex data and c	conclu	ue cris	p inte	rences	and interp	pretations f	rom the		
	CO2	same.										
	COS	Juggernaut the si	tudents to the ma	istery	oran	nyriad	or ma	itnematical	modules,	majoriy		
		algebra, geometry	y, and statistics.	X7T T								
Madada Na			<u>COURSE S</u>		ABUS					TTarra		
Module No.	[C]			onten	lt					Hours		
I	QUANTITATIVE APTITUDE AND LOGICAL REASONINGGEOMETRY:Geometry –IGeometry-II, Mensuration –I, Mensuration II,Trigonometry-I, Trigonometry-IIDEDUCTIVE REASONING: Introduction to Primary Statements of logical deduction.Understanding of different premises (like ALL, SOME, SOME NOT, NO).20VERBAL ABILITY:PARA JUMBLE: Logical Rearrangement of SentencesCRITICAL REASONING-I: Introduction to Different Parts of an Argument in Reasoning, Assumption of an Argument, Strengthening of an Argument, Weakening of								20			
п	an Argument [Course Outcome(s) No.: 1 and 2] QUANTITATIVE APTITUDE AND LOGICAL REASONING MODERN MATHEMATICS: Data Sufficiency I, Data Sufficiency II, Data Interpretation I, Data Interpretation II, Data Interpretation III VERBAL ABILITY: CRITICAL REASONING-II: Recap of Critical Reasoning Strategies , Drawing conclusion of an Argument, Inference of an Argument, Summarizing and Evaluation of an Argument									20		
Text Books	an Al	guinent.								I		
 A. Sh Jaikis Publi 	arma, shan a cation	How to prepare fo nd Premkishan, Ho , 2018	r Quantitative Ap	titude of Rea	for CA soning	T, TM in All	IH put Comp	blication, 2 betitive Exa	024. minations,	Arihan		
► M. K	. Pand	ey, Analytical Rea	soning, BSc Publi	shing	Co. Pv	vt. Ltd,	, 2009.					
Keterence B	ooks:	mal Anantitation	Antituda C Char	d Dola	iching	ากาา						
$\begin{array}{c c} & \succ & \text{K. S.} \\ & \triangleright & \text{A. Cl} \\ & \triangleright & \text{V. Sa} \end{array}$	Aggai noudha ixena a	ary and B. Patodi, ¹ and V. Bhatia, Crac	Aptitude, S. Chan Verbal Ability & (ck WAT/GD/PI fo	a Pub Comp or MB	rehensi A Adr	, 2022 on, Di iission	Isha Pu Is, Disł	blication, 2 a Publicat	2020. ion, 2016.			

SYLLABI OF SUBJECTS

Fourth Year Courses

Course No:	14 Course Name: Real Analysis				Cou	irse	Code	: BMAC (8000			
Batch:	Programme: B. Sc. Mathematics	Semester:	L	Т	P .	J Cı	redits	Contact 1	Hrs			
	(With specialization in Data Science)							Per Wee	k: 5			
2024-2028		VII	4	1	0 0	0	5	Total Ho	urs: 50			
Total Evalua	ation Marks: 100	Examination Duration:										
		Mid Term (2 hours), End Term (3 hours)										
Theory Asse	ssment: 75 Marks	Pre-requis	site	of	cou	rse:	Metr	ic Space				
internar Ass		Nature of	Co		se: 1	Majo	r - 1	Course				
	I his course will develop a profound understar	aing of cour	nta		and	unc	ountat	ble sets, se	quences			
Course	and series of real numbers. This will also make	te the studer	its	able	e to	prov	e the	results of	uniform			
Objective	continuity and differentiability and test the	uniform coi	nve	rge	nce	of s	sequer	nces of fu	nctions.			
	Further, a deep understanding of measurab	integration will be developed in this course. This course focuses on employability and skill										
	ntegration will be developed in this course. This course focuses on employability and skill											
	development aligned with all CO's.	11.										
	After studying these topics, the students will b	e able to:	1				c					
	CO1: Learn the concept of countability of real	numbers ar	nd c	onv	verg	ence	e of se	quences.				
Course	CO2: Understand uniform continuity and diffe	erentiability,	an	d fi	inct	ions	of sev	eral varia	bles.			
Outcomos	CO3: Recognize difference between pointwise	and uniform	1 CO	nve	erge	nce	of sequ	ience of fu	nctions.			
Outcomes	CO4: Apply tests for uniform convergence.											
	CO5: Learn functions of bounded variation an	d measurabl	le f	unc	tion	s.						
	CO6: Determine the Riemann and Lebesgue i	ntegrability	of a	a fu	ncti	on.						
	COURSE SYL	LABUS										
Module No.	Conte	ent							Hours			
	[Course Outcome(s) No.: 1 and 2]											
	Countable and uncountable sets, Convergence	of sequence	es o	f re	al n	umb	ers.					
	Functions of real variable: Uniform continui	ty and differ	ent	iab	ility	•			25			
I	Functions of several variables: Limit	, Continuit	ty,	D	iffe	renti	ability	y, Partial	25			
	differentiation, Directional derivatives, Taylor	s series, Inv	ers	e fu	ncti	on tł	neoren	n, Implicit				
	function theorem, Jacobians, Fubini's theorem	•										
	[Course Outcome(s) No.: 3, 4, 5 and 6]											
	Sequence and series of functions, Pointwise an	d uniform co	onv	erg	ence	e, Ca	uchy'	s criterion				
	for uniform convergence, Weierstrass M-test	t, Abel's an	d I	Diri	chle	et's t	est fo	r uniform	25			
11	convergence, Riemann integration, Functions	of bounded	d v	aria	tior	ı, Ri	eman	n Stieltjes	25			
	integration, Lebesgue measure, Lebesgue	integral, N	Лea	sur	able	e se	ts, M	leasurable				
	functions.											
Text Books:				_								
\succ W. R	udin, Principles of Mathematical Analysis, Mc	Graw-Hill, 2	201	7.	2							
> 1. M	. Apostol, Mathematical Analysis, Narosa Pub	lishing Hous	se, i	200	2.	(1)	017					
> S. C.	Malik & S. Arora, Mathematical Analysis, Ne	w Age Inter	nat	ion	al L'	td., 2	2017.	1005				
R. Ba	artle, The Elements of Integration and Lebesgue	e Measure, V	V1le	ey (SICS	Librar	y, 1995.				
\succ D. So	omasundaram & B. Chaudhary, A First Cour	rse in Math	em	atic	al A	Analy	ysis, I	Narosa Pu	blishing			
nous	ς, 1770.											
Reference B	ooks:											
				-								

- H. L. Royden, Real Analysis, Macmillan Publishing Company, 2015.
 P. K. Jain & V. P. Gupta, Lebesgue Measure and Integration, New Age International Ltd., 2020.

Course No:	15	Course Name: Ordinary Differential Equations Course Code: BMAC 0009					0009		
Batch:		Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	TF	, 1	Credi	ts Contact I Per Wee	Hrs k: 5
2024-2028			VII	4	10	0	5	Total Ho	ours: 50
Total Evalua	ntior	1 Marks: 100	Examinati Mid Term	on (2 1	Du hou	rat rs),	ion: End Te	erm (3 hour	s)
			Pre-requis	site	of	cou	rse:		
Theory Asse	ssm escu	ent: 75 Marks	Differentia	1 E	qua	tion	IS		
			Nature of	Co	urs	e: 1	Major –	- 1 Course	<u> </u>
Course	Thi	s course will develop a protound understand	ing for findir	ng t	the s	olui	tion of i	th order dif	ferential
Objective	equ	ations. This course will also make the stud	ients able to) [1] TL	nd t	he	solution	1 of bounda	ry value
	pro	blems and analyze the stability of dynamic	al systems.	Ini	is co	ours	e locus	es on emplo	oyability
	and	skill development aligned with all CO's.	11 /						
		er studying these topics, the students will be	e able to:	an	nd f	ind	the sc	lution of r	u th order
Course	co	homogeneous and non-homogeneous dif	ferential equ	an 19ti	ons	mu	the se		
Outcomes	CO	2. Determine the Figen values and Figen fu	inctions and	lea	rn f	heir	annlic	ations	
		3: Construct Green's function for the solution	on of bound	arv	val	ne r	roblem	s	
		4: Find the stability of linear and non-linear	r dynamical	svs	tem	s s	1001011		
	00	COURSE SYLL		595	tem	5.			
Module No.		Conte	nt						Hours
		$\mathbf{A}_{\mathbf{A}} = \mathbf{A}_{\mathbf{A}} + $	-						
	Intr	oduction. Initial and Boundary value problem	ms. Existenc	e ai	nd I	Jnia	lueness	of solutions	
	of o	ordinary differential equation of first orde	r, Lipschitz	co	ndi	tion	, Picar	d's method.	,
I	Exi	stence and Uniqueness theorem for ordina	ary different	ial	equ	atic	n of h	igher order.	25
	Stru	im-Liouville boundary value problem, Orth	ogonal sets	of f	func	tior	n, Eiger	values and	ĺ
	Eig	en functions, Eigen function expansions, Se	paration and	l Co	omp	aris	on the	orems.	
	<u>ا</u> ر	ourse Outcome(s) No.: 3 and 4]	1		1				
	Gre	en's functions, Construction of Green's fu	unction and	its	ap	plic	ation t	o solve the	,
	bou	ndary value problems, Stability of auton	omous syste	em	of	diff	erentia	l equations,	,
II	Crit	tical point of an autonomous system and the	eir classifica	tio	n as	sta	ble, asy	mptotically	, 25
	stał	ble and strictly stable. Stability of linear syste	em with con	stai	nt co	beff	icient, I	Linear plane	,
	auto	onomous system, Perturbed system, Method	l of Lyapuno	v f	or n	on-l	linear s	ystems.	
Text Books									•
\rightarrow M. D.	. Ra	isinghania, Ordinary Differential Equations.	S. Chand &	c C	o., 2	2019).		
≻ J. N.	Shai	rma & R. K. Gupta, Differential Equations,	Krishna Pral	kas	han	Me	dia (P)	Ltd., 2015.	
≻ E.A.	Coc	ldington & N. Levinson, Theory of Ordinar	y Differentia	ıl E	qua	tion	s, McG	raw Hill, 20	017.
Reference B	ook	2.							
G. Bi	rkho	off & G. C. Rota, Ordinary Differential Equa	ations, John	Wi	lev	and	Sons I	nc., 1989.	
➢ S. L.	Ros	s, Differential Equations, John Wilev and So	ons Inc., 198	34.	- 5			.,	
▶ W.E.	Bo	yce & R. C. Di Prima, Elementary Different	ial Equations	s ar	nd B	oun	idarv V	alue Proble	ms, John
Wiley	, and	d Sons Inc., 2009.	1				J		

> P. Hartman, Ordinary Differential Equations, John Wiley & Sons, 1982.

Course No:	11	Course Name: Operational Research-I			Co	urse C	ode: BMA	E 0004					
Batch:		Programme: B. Sc. Mathematics	Semester:	LΤ	'P J	Credi	ts Contact 1	Hrs					
		(With specialization in Data Science)					Per Wee	k: 4					
2024-2028			VII	31	00	4	Total Ho	ours: 40					
Total Evalua	ntior	Marks: 100	Examinati	on	Du	ration:							
			Mid Term	<u>(2 h</u>	our	s), End	Term (3 h	ours)					
Theomy Asso	aam	ont: 75 Marks	Pre-requis	site Do	01 (ourse:							
Internal Asse	ssiii essn	ent: 25 Marks	Nature of		irse	• Flee	tive						
	Thi	s course will develop a profound understand	ling of linea	r ar	nd i	nteger	linear prog	ammino					
	nrol	plems. The students will learn optimal decision	on policy an	nd w	vill	he able	to solve m	ultistage					
Course	deci	lecision problems. Further, a deep understanding of non-linear programming problems											
Objective	dev	eloped in this course. This course focuses on er	nnlovahility	and	ski	ll devel	onment alig	ned with					
	all ($^{\circ}\Omega_{s}^{\circ}$	npioyaointy	anu	SKI		opinent ang						
	Δfte	CO S.											
		1. Solve various linear programming problem											
Course		2. Find solution of integer linear programming	o. T and sequen	cinc	r nr	hleme							
Outcomes		3. Learn the mathematical tools to solve problem	ame on dyna	mic	s property	oromn	ina						
		4: Understand nonlinear programming problem	rs and meth	ode	to c	btoin t	ning. Dair solution	C					
	co			ous	10 0			5.					
		COURSE SYLLA	BUS					TT					
Module No.		Content						Hours					
	[Co	ourse Outcome(s) No.: 1 and 2]		_									
	Linear Programming Problems (LPP): Introduction, Simplex method, Duality, Dual												
Ŧ	sim	plex method, Sensitivity analysis.						20					
1	Inte	eger Linear Programming Problems: Intro	oduction, mi	xed	int	eger p	rogramming	20					
	prol	plems, cutting plane method, Branch and boun	d method.										
	Seq	uencing Problem: Introduction, Assumptions	s, Johnson's _J	proc	cedu	re for r	ijobs on						
	two	machines and n jobs on m machines, 2 jobs th	rough m ma	chir	nes,	Travel	ing						
	sale	sman problem.											
	[Co	ourse Outcome(s) No.: 3 and 4]											
	Dyr	namic Programming: Introduction, Terminology	ogy, Optimal	dec	cisic	n polic	y, Bellmann	L					
	prin	ciple of optimality, Multistage decision pro	blems, Prog	ram	ımiı	ng unde	er certainty,	20					
11	App	broach for solving LPP.						20					
	Nor	n Linear Programming Problems (NLPP):Ir	ntroduction, 1	Form	nul	ation, C	oncave and						
	Cor	vex Functions, Solution of NLPP having one	and more tha	an o	ne i	nequali	ty						
	con	straints using Kuhn-Tucker conditions, Metho	d of Lagrang	ge m	nulti	pliers.							
Text Books:													
➢ P. K.	Gup	ta & D. S. Hira, Operations Research, S. Char	nd & Co., 20	15.									
> J. K. S	Shar	ma, Operations Research Theory and Application	tions, Macmi	illia	n Ir	dia Ltd	., 2017.						
🕨 🕨 K. Sw	varu	p, P. K. Gupta & M. Mohan, Operations Resea	arch, Sultan (Cha	nd d	& Sons,	2014.						
Reference Be	ooks	:											
➤ S. D.	Sha	rma, Operations Research, Kedar Nath Ram N	ath Publicati	ions	, 20	12.							
➢ H. A.	Tah	a. Operations Research: An Introduction, Pear	rson Education	on.	201	4.							

D. C. Sanyal & K. Das, Linear programming and Game Theory, U. N. Dhur & Sons (P) Ltd., 2020.

Course No:	12	Course Name: Mathematical Modeling			Co	urse Co	ode: MMA	E 0019
Batch:		Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	LT	PJ	Credit	ts Contact Per We	Hrs ek: 4
2024-2028			VII	40	000	4	Total He	ours: 40
Total Evalua	ation I	Marks: 100	Examinat	ion	Dui	ration:		
			Mid Term	(2 h	nour	s), End	Term (3 h	ours)
Theory Asso	cemor	t. 75 Marks	Pre-requi	site nd D	Of C Portic	ourse:	contial ague	tions
Internal Ass	essme	nt. 75 Marks	Nature of			• Elect	ive	uions
Course	This	course provides introduction of mathemat	ical modeling	and	anal	lysis in	biological	sciences
Objective	The r	nation content of this course is chosen from	om population	dvr	nami	ics. This	s course co	overs the
o sjeen (e	funda	mentals of deterministic models in both d	iscrete and con	ntinu	lous	time do	omains. Th	is course
	inclu	des both linear and non-linear models with	sufficient amo	ount	of tł	neoretica	al backgrou	und. Thi
	cours	e focuses on employability and skill devel	opment aligne	d wi	ith a	ll CO's.	C C	
	After	studying these topics, the students will be	able to:					
Course	CO1:	: Understand the mathematical model	and explain t	he s	serie	es of st	eps involv	ved in a
Course	~ ~ •	mathematical modeling process.						
Outcomes	CO2 :	: Apply the concept of mathematical mode	ling through d	liffe	renc	e equati	ons in disc	rete time
	con	linear and discrete time nonlinear model	S. 1 1		1		• 1	
	COS	Use applications of mathematical model	ing and make	stuc	lent	s apprec	clate the po	ower and
	CO4	• Apply mathematical modeling in continu	ous time mode	s pro Me	bien	115.		
	COT	COURSESVLL		.15.				
	1	COURSESTEE	B CS					1
Module No.		Conter	nt					Hours
	[Cou	rse Outcome(s) No.: 1 and 2]						
	Overv	view of mathematical modeling, Types of n	nathematical m	node	els ar	nd metho	ods to solve	
_	them,	, Discrete time linear models – Fibonacci	rabbit model,	, Ce	ll-gr	owth m	odel, Prey	
I	diffor	and model, Analytical solution methods a	and stability a	Disc	SIS (roto	time age	e structure	20
	mode	l = L eslie Model Jury's stability test	eo ulagrailis, i	DISC	Iele	time ago		1
	Discr	the time non-linear models-Different cel	l division mo	dels	Pre	ev-preda	ator model	
	Stabi	lity of non-linear discrete time models. Lo	gistic differen	ce ec	, ·	ion		,
		$r_{so} Outcome(s) No : 3 and 41$	gistie anteren		Juur	1011.		
	Intro	duction to continuous time models. Lin	itations and /	Adve	nto	ra of di	corata tim	
	mode	Include to continuous time models – Lin	manons and A	dels	innag L _ n	ge of ui	r growth o	f
п	micro	porganisms Chemostat Stability and line	arization meth	ods	for	system	of ordinary	20
	differ	rential equations.		040	101	system	or orannary	
	Conti	nuous time single species model – Allee	effect, Qualita	tive	solu	tion of	differentia	1
	equat	ions using phase diagrams, Continuous ti	me models – l	Lotk	a-V	olterra c	competition	ı
	mode	el, Prey predator models.					1	
Text Books:	1	• •						1
≻ J. N.	Kapur	, Mathematical Modelling, New Age Inter	national, 2015	5.				
> M. M	l. Mee	rschaert, Mathematical Modelling, Acade	nic Press, 201	3.				
> A. Ru	therfo	ord, Mathematical Modelling Techniques.	Courier Corpo	oratio	on, 2	2012.		
▶ R. J.]	Elliott	& P. E. Kopp, Mathematics of Financial	Markets. Sprin	iger	Ver	lag, 201	8.	
Reference	Books		1					
► L. D.		, Frinciples of Mathematical Modelling, E	isevier, 2004.	~				

E. A. Bender, An Introduction to Mathematical Modelling, Courier Corporation, 2000.

Course No:	13	Course Name: Coding Theory			(Cou	rse Code	: MMAE	0024
Batch:		Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	T	P J	Credits	Contact Per We	Hrs ek: 4
2024-2028			VII	4	0	0 0) 4	Total Ho	ours: 40
Total Evalua	tion 1	Marks: 100	Examinati Mid Term	on (2]	Du hou	rati :s),	i on: End Tern	n (3 hours	5)
Theory Asse	ssmer	nt: 75 Marks	Pre-requis	site	of	cou	rse: Alge	bra	
Internal Ass	essme	nt: 25 Marks	Nature of	Co	urs	e: 1	Elective		
Course	This	course will develop a profound understa	anding of lin	nea	r co	des	, encoding	g and dec	oding of
Objective	linea linea devel all C0	codes and their applications. Further, a codes, and their advantages in finding oped in this course. This course focuses o D's.	deep unders g the solution n employabi	tan on lity	ding of 1 7 and	of natl sk	cyclic, BC nematical ill develop	CH and qu problems oment alig	aternary will be ned with
Course	After CO1:	studying these topics, the students will b Calculate the parameters of given code polynomial operations.	e able to es and their	du	al co	odes	s using sta	andard ma	atrix and
Outcomes	 comes CO2: Encode and decode information by applying algorithms associated with well-known co CO3: State and prove the fundamental theorems about error-correcting codes. CO4: Compare the error-detecting/correcting facilities of given codes for a given bis symmetric channel. CO5: Design simple linear or cyclic codes with required properties. CO6: Solve mathematical problems involving error-correcting codes by linking them to con- from elementary number theory, combinatorics, linear algebra, and elementary calcul 								n codes. n binary concepts lculus.
Module No.		Conte	ent						Hours
I	Content H [Course Outcome(s) No.: 1 and 2] Linear Codes: Brief introduction to coding theory, Linear codes, Hamming weight, Hamming code, Bases for linear codes, Generator matrix and Parity-check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbor decoding for linear codes, Syndrome decoding, Golay code, Dead Selemen and								, 20
п	[Course Outcome(s) No.: 3, 4, 5 and 6] Cyclic codes: Definition of cyclic codes, Generator polynomials, Generator and parity- check matrices, Decoding of cyclic codes, Burst-error-correcting codes, BCH codes, Parameters of BCH codes, Decoding of BCH codes, Quaternary linear codes and their generator matrices.								. 20
Text Books: → S. Lir → D. R. Wall, Reference Bo	ng S. <i>&</i> Hank Codir D ok:	& C. P. Xing: Coding Theory: A First Co terson, D. G. Hoffman, D. A. Leonard, G ng Theory and Cryptography: The Essent	urse, Cambr C. C. Lindne ials, CRC P	idg er, res	ge U K. T s, 2	nive '. Pl 000	ersity Pres nelps, C. 4	s, 2004. A. Rodger	r & J. R.

Z. X. Wan: Quaternary Codes, World Scientific, Publishing Company Pvt. Ltd., 1997.

Course No:	4 Course Name: Regression Analysis and Pre Modelling	dictive Course Code: MMAE	E 0102							
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester: LTPJCreditsContact E Per Weel	Hrs k: 4							
2024-2028		VII 4000 4 Total Ho	urs: 40							
Total Evalua	tion Marks: 100	Examination Duration:								
		Mid Term (2 hours), End Term (3 hou	ırs)							
		Pre-requisite of course: Nil								
Theory Asse Internal Ass	essment: 75 Marks	Nature of Course: Elective								
Course	This course will develop a profound understan	ding of normed linear spaces. This cou	irse also							
Objective	includes bounded, unbounded and closed ope	rators, orthonormal basis and their pro-	operties.							
	Further, a deep understanding of standard theorem	ms and their applications will be develope	ed in this							
	course. This course focuses on employability and	d skill development aligned with all CO's	s.							
	After studying these topics, the students will be a	able to:								
	CO1: Understand the concept of estimation of p	arameters in regression model.								
	CO2: Apply and use Gauss-Markov theorem to	obtain best linear unbiased estimates.								
	CO3: Understand the Difference between R-Squared and Adjusted R-Squared and interpret them									
	as a measure of goodness of fit.									
Course	CO4: Apply tests for linear hyphothesis testing to	b determine the relationship between the r	response							
Outcomes	and predictor variables.									
	CO5: Learn and apply methods for model adequ	lacy checking.	motions							
	of multiple linear regression model fails	proach adopted when the underlying assu	mpuons							
	CO7 . Understand the type of heteroscedastic	vity present in the model and apply a	methods							
	accordingly	try present in the model and apply i	methous							
	CO8: Understand the problem of multicollineari	ty and how to deal with it.								
	COURSE SYLLA	ABUS								
Module No.	Content	t	Hours							
	[Course Outcome(s) No.: 1, 2, 3 and 4]									
	Multiple linear regression model and assumption	ons, estimation of parameters, estimable								
	functions, error and estimation space, Gauss-Ma	rkov theorem, use of g-inverse.	• •							
I	Model in deviation form, ANOVA for linear n	nodel, R^2 , adjusted R^2 and other model	20							
	selection criterion, tests of linear hypothesis, for	ecasting.								
	of residuels, regression veriable bull DDESS resi	duals P student residuals residual plots								
	nartial residual plots detection and treatment of	f outliers Diagnostics for leverage and								
	influence measures of influence	r outliers, Diagnosties for leverage and								
	[Course Outcome(s) No.: 5, 6, 7, and 8]									
	Estimation of parameters by generalized least so	mares (GLS) in linear models with non-								
	spherical disturbances. Gauss Markov theorem	for GLS estimator, estimation under								
II	heteroscedasticity and tests of heteroscedasticity.	tests for autocorrelation, estimation and	20							
	forecasting under autocorrelated disturbances.	,								
	Generalized Linear Models: Logistic Regressio	n, Poisson Regression and Generalized								
	Linear model.									
	Multicollinearity: Introduction, sources of multi	collinearity, effects of multicollinearity,								
	variance Inflation factors (VIF), Methods of	dealing with multicollinearity, Ridge								
	Regression.									

Text Books:

- N. R. Draper & H. Smith, Applied Regression Analysis, Wiley, 1998.
- > J. Johnston, Econometric Methods, McGraw Hill, 1984.
- D. C. Montgomery, E. A. Peck & G.G. Vining, Introduction to Linear Regression Analysis, Wiley, 2006.

- C. R. Rao, H. Toutenburg, Shalabh, C. Heumann & M. Schomaker, Linear Models and Generalizations-Least squares and alternatives, Springer, 2007.
- > J. F. Monahan, A Primer on Linear Models, CRC Press, 2008.
- > A. I. Khuri, Linear Model Methodology, CRC Press, 2010.
- G. A. F. Seber & A. J. Lee, Linear Regression Analysis, Wiley, 2003.

Course No: 1	Course Name: Topology					Course Code: BMAC 0010					
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester:	L	Т	P	J	Credits	Contact I Per Wee	Hrs k: 5		
2024-2028		VIII	4	1	0	0	5	Total Ho	urs: 50		
Total Evalua	tion Marks: 100	Examinati Mid Term (on (2 ł	Du nou	ira irs)	i tio), E	n: Ind Tern	n (3 hours)		
		Pre-requisite of course: Real						eal Analy	sis		
Theory Assessment: 75 Marks Internal Assessment: 25 Marks		Nature of Course: Major – 1 Course									
Course	This course will develop a profound understand	dingof topolo	ogic	cal	spa	ace	s, contin	uous funct	ions and		
Objective	metrizable spaces. Further, a deep understand	metrizable spaces. Further, a deep understanding of connected, compact and countability axioms									
	and separation axioms will be developed in this	is course. The	is c	ou	rse	fo	cuses on	employab	ility and		
	skill development aligned with all CO's.										
	After studying these topics, the students will b	e able to:						1 1			
Course	COI: Understand topology, topological space	s and topolog	gy :	gen	era	ateo	d by basi	s and sub	basis.		
Outcomes	CO2: Determine the nature of different points	of a set.			. 1			1			
Outcomes	CO3: Learn continuous maps and understand	product, quo	otiei	nt a	ina	m	etric topo	ologies.			
	CO4: Characterize the connected, compact an	a countable s	spa	ces	•						
	COS: Know separation axioms and basic prop	A DUG									
	COURSE SYL	LABUS									
Module No.	Conte	ent							Hours		
	[Course Outcome(s) No.: 1, 2 and 3]										
	Topological spaces, Basis and Sub basis, C	Ordered topo	log	y,	Liı	mit	points,	Adherent			
	points, Isolated points, Derived sets, Dense sets, Closure, Interior, Exterior and Boundary								25		
-	points of a set, Subspaces, Continuity and Related results, The Pasting lemma.								25		
1	points of a set, Subspaces, Continuity and Rel	ated results,	Ine	. 10		\mathcal{O}					
1	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc	ated results, ' t of topolog	ical	l sj	pac	es,	Metric	topology,			
I	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology.	ated results, ' t of topolog	ical	l sj	pac	es,	Metric	topology,			
1	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5]	ated results, ' t of topolog	ical	l sj	pac	es,	Metric	topology,			
	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor	ated results, ' t of topolog	l he ical	l sj	on	xes,	Metric	topology,			
	 points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, local 	ated results, ' t of topolog nponents, P lly connected	l he ical		oni es.	nec	Metric	topology, ces, Path			
I	 points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, loca Compact spaces, Limit point compact and 	ated results, ' t of topolog nponents, P lly connected nd sequentia	l he ical ath d sp ally		oni es.	nec	Metric	topology, ces, Path es, Local	25		
I	 points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Con components, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space 	ated results, ' t of topolog nponents, P lly connected nd sequentia es, Separable	ath l sp ally sp		oni es.	nec	Metric ted spa ct space aration a:	topology, ces, Path es, Local xioms: T ₀ ,	25		
п	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space $T_1, T_2, T_3, T_3^{1/2}, T_4$ spaces, Characterizations a	ated results, ' t of topolog nponents, P lly connected nd sequentia es, Separable and basic pro	ath ally spen		onn es. con e, S	nec	Metric ated space of space aration at	topology, ces, Path es, Local xioms: T_0 ,	25		
I II Text Books:	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space $T_1, T_2, T_3, T_3^{1/2}, T_4$ spaces, Characterizations a	ated results, t of topolog nponents, P lly connected nd sequentia es, Separable and basic pro	ath cath d sp ally pper		onn es. com e, S s.	nec	Metric ted spa ct space aration a	topology, ces, Path es, Local xioms: T_0 ,	25		
I II Text Books: > J. R. I	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Concomponents, totally disconnected spaces, loca Compact spaces, Limit point compact and compactness, First and Second countable spaces $T_1, T_2, T_3, T_{3^{1/2}}, T_4$ spaces, Characterizations a Munkres, Topology, A First Course, PHI, 2000	ated results, t of topolog nponents, P lly connected nd sequentia es, Separable and basic pro	ath d sp ally pper		onn es. com e, S s.	nec	Metric eted spa ct space aration at	topology, ces, Path es, Local xioms: T_0 ,	25		
I II Text Books: ≻ J. R. I ≻ G. F.	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space $T_1, T_2, T_3, T_{3^{1/2}}, T_4$ spaces, Characterizations a Munkres, Topology, A First Course, PHI, 2000 Simmons, Introduction to Topology and Mode	ated results, t of topolog nponents, P lly connected and sequentia es, Separable and basic pro). ern Analysis,	ath ally pper	c c c c c ace tie	contended on the second cont	nec npa epa	Metric eted space aration a:	topology, ces, Path es, Local xioms: T ₀ ,	25		
I II Text Books: ▷ J. R. I ▷ G. F. ▷ J. N. S	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space $T_1, T_2, T_3, T_{3^{1/2}}, T_4$ spaces, Characterizations a Munkres, Topology, A First Course, PHI, 2000 Simmons, Introduction to Topology and Mode Sharma & J. P. Chauhan, Topology (General a	ated results, t of topolog nponents, P lly connected and sequentia es, Separable and basic pro). ern Analysis, nd Algebraic	ath ath d sp ally pper TN c), I	c pace cace cace tie	onn es. com e, S s. , 19	nec npa lepa 963	Metric ted space aration a 3. Prakasha	topology, ces, Path es, Local xioms: T_0 , n, 2019.	25		
I II Text Books: > J. R. I > G. F. > J. N. S Reference Be	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Concomponents, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space $T_1, T_2, T_3, T_{3^{1/2}}, T_4$ spaces, Characterizations a Munkres, Topology, A First Course, PHI, 2000 Simmons, Introduction to Topology and Mode Sharma & J. P. Chauhan, Topology (General a	ated results, t of topolog nponents, P lly connected and sequentia es, Separable and basic pro). ern Analysis, nd Algebraic	ath cath d sp pper TN c), H	c coace cace tie	onities. contes. s, S s.	nec npa epa 963 na I	Metric eted space aration a: 3. Prakasha	topology, ces, Path es, Local xioms: T_0 , n, 2019.	25		
I II Text Books:	points of a set, Subspaces, Continuity and Rel Homeomorphism, Product topology, Produc Metrizable space, Quotient topology. [Course Outcome(s) No.: 4 and 5] Connected and Disconnected spaces, Cor components, totally disconnected spaces, loca Compact spaces, Limit point compact an compactness, First and Second countable space $T_1, T_2, T_3, T_{3^{1/2}}, T_4$ spaces, Characterizations a Munkres, Topology, A First Course, PHI, 2000 Simmons, Introduction to Topology and Mode Sharma & J. P. Chauhan, Topology (General a boks: Kelley, General topology, Springer Verlag, 201	ated results, ' t of topolog nponents, P lly connected and sequentia es, Separable and basic pro). ern Analysis, nd Algebraic	ath ath sp ally sp pper TN c), I	c coace cace rtie	onn es. on es. s. s.	nec npa epa 963	Metric ted space aration a: 3. Prakasha	topology, ces, Path es, Local xioms: T_0 , n, 2019.	25		

Course No:	17 Course Name: Functional Analysis	Course Code: BMAC 0	011					
Batch:	Programme: B. Sc. Mathematics (With specialization in Data Science)	Semester: L T P J Credits Contact Hi Per Week:	rs : 5					
2024-2028		II 4 1 0 0 5 Total Hou	rs: 50					
Total Evalua	ation Marks: 100	Examination Duration: Mid Term (2 hours), End Term (3 hours	5)					
Theory Aggessmont: 75 Marks		Pre-requisite of course: Linear Algebra						
Internal Assessment: 25 Marks		Nature of Course: Major – 1 Course						
Course	This course will develop a profound understand	ling of normed linear spaces. This cours	se also					
Objective	includes bounded, unbounded and closed oper	rators, orthonormal basis and their prop	erties.					
	Further, a deep understanding of standard theorems and their applications will be developed							
	in this course. This course focuses on employabi	lity and skill development aligned with all	CO's.					
Course Outcomes	CO1: Understand Banach and Hilbert spaces, an CO2: Differentiate bounded, unbounded and clo CO3: Check convergence of operators by using CO4: Find orthonormal basis and learn its appli CO5: Apply uniform boundedness theorem, oper COURSE SYLLA	able to. Ind standard theorems defined on these space posed operators a suitable norm and compute the dual space cations en mapping theorem and closed graph theo ABUS	ces ces orem					
Module No.	Conten	t F	Hours					
I	[Course Outcome(s) No.: 1, 2 and 3] Normed linear spaces, Banach spaces, Hilbert S theorem, Riesz lemma and best approximation p Theorem, Bounded operators, Space of bounded representation theorem, Convergence of sequence	Spaces and basic properties, Heine Borel roperty, Inner product spaces, Projection d operators, unbounded operators, Riesz ce of operators, Closed operator	25					
п	[Course Outcome(s) No.: 4 and 5] Orthonormal bases, Bassel inequality and Parseval's Formula, Riesz Fischer theorem, Hahn Banach extension theorem, Uniform boundedness principle, Closed graph theorem and Open mapping theorem, Applications.							
Text Book: ▶ M. T. ▶ B. V. ▶ G. F. Reference Book ▶ E. Kr ▶ A. H	Nair, Functional Analysis, A first course, PHI, 2 Limaye, Functional Analysis, New Age Internat Simmons, Introduction to Topology and Modern ooks: eyszig, Introductory Functional Analysis with Ap . Siddiqi, K. Ahmad & P. Manchanda, Introduction paya Publishers, 2007	2001. ional, 2014. Analysis, McGraw-Hill, Inc. 2017. oplications, John Wiley and Sons, 2007. ction to Functional Analysis with Applica	ations,					

- G. Bachman & L. Narici, Functional Analysis, Courier Corporation, 2012.
 J. B. Conway, A Course in Functional Analysis. Springer, 2010.