HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

B.Sc. MATHEMATICS AND DATA SCIENCE

(Duration: 3 Years)

CURRICULUM AND SYLLABUS

(Applicable for Students admitted from Academic Year 2025-26)

DEPARTMENT OF MATHEMATICS

SCHOOL OF BASIC AND APPLIED SCIENCES

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

VISION AND MISSION

MOTTO:

To Make Every Man a Success and No Man a Failure

VISION:

To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.

MISSION:

- To create an ecosystem for learning and world class research.
- To nurture a sense of creativity and innovation.
- To instill highest ethical standards and values with a sense of professionalism.
- To take up activities for the development of Society.
- To develop national and international collaboration and strategic partnership with industry and institutes of excellence.
- To enable graduates to become future leaders and innovators.

VALUE STATEMENT

- Integrity, Innovation, Internationalization

DEPARTMENT OF MATHEMATICS

VISION AND MISSION

VISION

To be a worldwide Centre for Excellence in Mathematics and scientific computing for the growth of Science and Technology

MISSION

M1: Imparting of quality mathematics education and the inculcating of the spirit of research through innovative teaching and research methodologies.

M2: To achieve high standards of excellence in generating and propagating knowledge in Mathematics.

M3: To build a community that champions and promotes the mathematician in everyone.

B.Sc. MATHEMATICS AND DATA SCIENCE

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The Program Educational Objectives (PEOs) for Mathematics and Data Science describe accomplishments that students are expected to attain within three years after graduation.

PEO I: To equip students with foundational knowledge in mathematics and data science to excel as professionals in diverse fields.

PEO II: To prepare them to pursue higher studies and conduct research in mathematics, statistics, and data science.

PEO III: To develop problem-solving and analytical skills to create data-driven models for real-world applications.

PEO IV: To cultivate technical and interpersonal skills for careers in education, IT, business analytics, and related domains.

PROGRAM OUTCOMES (ALIGNED WITH GRADUATE ATTRIBUTES) (PO)

At the end of this program, graduates will be able to:

PO1: Scholarship of Knowledge:

Capable of demonstrating comprehensive knowledge of one or more disciplines of science, ability to analyse, evaluate, design the solution for different kinds of non-familiar problems / real life situations by applying the scientific knowledge.

PO2: Communication:

Ability to express thoughts and ideas effectively in writing and orally, communicate with others using appropriate media; confidently share one's views and express herself/himself, present complex information in a clear and concise manner to different groups.

PO3: Usage of Modern Tools:

Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

PO4: Team work:

Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

PO5: Research Skill:

Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data and report the results of an experiment or investigation

PO6: Ethical Practices and Social Responsibility:

Ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; possess knowledge of the values and beliefs of multiple cultures and a global perspective.

PO7: Life-long Learning:

Ability to acquire knowledge and skills, including 'learning how to learn', that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Apply mathematical and analytical tools to solve interdisciplinary problems.

PSO2: Develop skills in abstract mathematics, data science, and modeling.

PSO3: Analyze and interpret data for decision-making and visualization.

B.Sc. MATHEMATICS AND DATA SCIENCE (CREDIT STRUCTURE)										
SEMESTER – I										
S. No.	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1.	CC	TP	AIM02002	Differential and Integral Calculus	3	0	2	4	1	5
2.	CC	TH	BMA01001	Descriptive Statistics and Probability	3	1	0	4	1	4
3.	CC	TH	BDS01001	Fundamentals of Computer System Design	3	1	0	4	1	4
4.	CC	TP	ACS11001	Python Programming	2	0	2	3	0	4
5.	HS	TP	GLS51001	Communication Skills	2	0	1	2	1	3
6.	HS	TH	GLS11001	Tamil Art and Culture	1	0	1	1	2	1
7.	VA	TH	GGE51003	Environmental Science and Sustainable Development	2	0	0	2	2	2
8.	HS	PR	GGE51401/ GGE51402	Outreach (NCC/NSS) Level-I	0	0	2	1	0	2
				Total	16	2	8	21	8	25
L – Lecture; T – Tutorial; P – Practical; C – Credit; S – Self Study; TCH – Total Contact Hours										

SEMESTER – II										
S. No.	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1.	CC	TP	AIM02004	Differential Equations and Transforms	3	0	2	4	1	5
2.	CC	TP	BMA01002	Regression Techniques and Time Series Analysis using R	3	0	2	4	1	5
3.	CC	TH	BMA01003	Principles of Data Science	3	1	0	4	1	4
4	CC	TP	BDS01002	Data Structures and Algorithms	3	0	2	4	1	5
5	HS	TP	GLS51002	Personality Development and Soft Skills	2	0	1	2	1	3
6	HS	TH	******	Regional Language	2	0	0	2	0	2
7	HS	PR	GGE51403/ GGE51404	Outreach (NCC/NSS) Level-II	0	0	2	1	0	2
				Total	16	1	9	21	5	26

L – Lecture; T – Tutorial; P – Practical; C – Credit; S – Self Study;
TCH – Total Contact Hours

SEMESTER – III										
S. No.	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1.	CC	TH	BMA01004	Combinatorial Analysis	3	1	0	4	1	4
2.	CC	TP	BDS01003	Database Management Systems	3	1	0	4	1	4
3.	CC	TH	BMA01005	Principles of Artificial Intelligence	3	1	0	4	1	4
4	HS	TH	******	Foreign Language	2	0	0	2	0	2
5	HS	PR	GLS51005	Public Speaking	0	0	2	1	0	2
6	DE	TP	*******	Department Elective-I	2	0	2	3	0	4
7	SI	PR	BMA01800	Internship	#			3	#	
				Total	13	3	4	21	3	20

L – Lecture; T – Tutorial; P – Practical; C – Credit; S – Self Study;
TCH – Total Contact Hours
15 days Internship carried out at the end of SEM II and evaluated in the SEM III

SEMESTER – IV										
S. No.	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1.	CC	TH	BMA01006	Computational Mathematics	3	1	0	4	1	4
2.	CC	TP	ADS11002	Tools and Techniques for Data Analysis	1	0	2	2	1	3
3.	CC	TH	BDS01004	Data Mining	3	1	0	4	1	4
4	CC	TH	BDS01005	Machine Learning	3	1	0	4	1	4
5	HS	PR	GLS51006	English for Competitive Examinations	0	0	2	1	1	2
6	DE	TP	*******	Department Elective-II	2	0	2	3	0	4
				Total	12	3	6	18	5	21

L – Lecture; T – Tutorial; P – Practical; C – Credit; S – Self Study;
TCH – Total Contact Hours

SEMESTER – V										
S. No.	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1.	CC	TP	BMA01007	Matrix Theory and Vector Space	3	0	2	4	1	5
2.	CC	TH	BMA01008	Optimization Techniques	3	1	0	4	1	4
3.	CC	TH	AAD11003	Deep Learning	3	1	0	4	0	4
4	CC	TP	BDS01006	Data Visualization using Tableau	3	0	2	4	1	5
5	HS	TH	GLS51007	Verbal Reasoning and Interview Skills	0	0	2	1	0	2
6	DE	TP	*******	Department Elective-III	2	0	2	3	0	4
				Total	14	2	8	20	3	24

L – Lecture; T – Tutorial; P – Practical; C – Credit; S – Self Study;
TCH – Total Contact Hours

SEMESTER – VI										
S. No.	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1.	CC	TH	BMA01009	Analysis for Predictive Models	3	1	0	4	1	4
2.	CC	TH	BDS01007	Big Data Analytics	3	1	0	4	1	4
3	RP	PJ	BMA01801	Project	0	0	16	8	0	16
4	DE	TP	*******	Department Elective-IV	2	0	2	3	0	4
				Total	8	2	18	19	2	28
L – Lecture; T – Tutorial; P – Practical; C – Credit; S – Self Study; TCH – Total Contact Hours										

TOTAL CREDITS – 120

LIST OF DEPARTMENTAL ELECTIVES - OFFERED BY DEPARTMENT OF MATHEMATICS

ELECTIVES									
S.NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	DE	BMA01500	Advanced Calculus	2	0	2	3	1	4
2	DE	BMA01501	Complex Analysis	2	0	2	3	1	4
3	DE	BMA01502	Computational Linear Algebra	2	0	2	3	1	4
4	DE	BMA01503	Number Theory and Cryptography	2	0	2	3	1	4
5	DE	BMA01504	Business Analytics	2	0	2	3	1	4
6	DE	BMA01505	Financial Analytics	2	0	2	3	1	4
7	DE	BMA01506	Statistical Inference	2	0	2	3	1	4
8	DE	BMA01507	Stochastic Process	2	0	2	3	1	4

LIST OF DEPARTMENTAL ELECTIVES -OFFERED BY DEPARTMENT OF DATA SCIENCE

ELECTIVES									
S.NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	DE	BDS01500	Advanced Database Management Systems	2	0	2	3	1	4
2	DE	BDS01501	Data Warehouse	2	0	2	3	1	4
3	DE	BDS01502	Data Governance & Security	2	0	2	3	1	4
4	DE	ADS11501	Data Wrangling Techniques	2	0	2	3	1	4
5	DE	ADS11505	Information Retrieval and Processing	2	0	2	3	2	4
6	DE	BDS01503	Healthcare Analytics	2	0	2	3	1	4
7	DE	AAD11501	Natural Language Processing	2	0	2	3	2	4
8	DE	ADS11507	Digital Image processing	2	0	2	3	0	4
9	DE	ADS11506	Computer Vision Techniques	2	0	2	3	0	4

SEMESTER I

COURSE TITLE	**DIFFERENTIAL AND INTEGRAL CALCULUS**			**CREDITS**	**4**	
COURSE CODE	**AIM02002**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-0-2-1**	
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	To expose the students to the basics of real analysis.					
Course Objective	1. To characterize constants and functions with limitations. 2. To find the derivative using first principle, chain rule and Leibnitz's Theorem. 3. To perform partial differentiation of a function of two variables. 4. To classify definite and indefinite integrals.					

	5. To perceive the knowledge on multiple integrals.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply limit on functions and derive the theorems on limit. 2. Calculate the rate of change and successive derivatives of a function. 3. Obtain partial derivatives and apply Euler's theorem. 4. Evaluate definite and indefinite integrals. 5. Determine the area and volume using multiple integrals and evaluate beta and gamma functions.
Prerequisites: Basics of sets and functions	

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	-	-	3	-	-
CO2	1	1	3	-	-	-	-	3	-	-
CO3	1	1	3	-	-	-	-	3	-	-
CO4	1	1	3	-	1	-	-	3	-	-
CO5	1	1	3	-	1	-	-	3	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: FUNCTION AND LIMITS	**(9L+6P)**
Constants and variables – Function- Absolute value or modulus – Neighborhood of a Number – Limit of a Function - Theorems on limit – List of important results – Continuous Function. **Self Study:** Limit of a Function **Lab:** Basic Representation of MATLAB	**CO-1** **BTL-3**
MODULE 2: DIFFERENTIATION	**(9L+6P)**
Slope and Rate of Change – Derivative [First Principle] – Method for Evaluating the Differential Coefficient using the First Principle and Standard Results – Derivative of Logarithmic function and Exponential Function – Chain rule – Differentiation of an Implicit Function – Logarithmic Differentiation – Successive Differentiation – Definition and Notations – Leibnitz's Theorem on Successive Differentiation. **Self Study:** Chain rule **Lab:** Differentiation of single variable functions.	**CO-2** **BTL-3**
MODULE 3: PARTIAL DIFFERENTIATION	**(9L+6P)**
Derivation of partial derivatives – Successive partial derivative – Homogeneous function- Euler's theorem – Partial derivatives of a function of two functions. (Note: Simple Problems only) **Self Study:** Homogeneous function **Lab:** Partial Differentiation of Multivariable functions.	**CO-3** **BTL-3**
MODULE 4: INTEGRATION TECHNIQUES	**(9L+6P)**
Integration – Methods of integration – Substitution method – Integration by parts – Integration using partial fraction – Bernoulli's formula. **Self Study:** Definite integral **Lab**: Integration of single variable functions.	**CO-4** **BTL-3**
MODULE 5: MULTIPLE INTEGRAL	**(9L+6P)**
Double integral – Triple integral- Change of order of integration - Improper Integral – Gamma function – Beta function. **Self Study:** Improper Integral **Lab**: Integration of Multivariable functions.	**CO-5** **BTL-3**

TEXT BOOK	
1.	S. Narayanan and T. K. Manickavasagam Pillay (2014), *Calculus Volume I*,S. Viswanathan Pvt. Ltd, India.
2.	Bhupander Singh, S. K. Pundir (2021), *Differential Calculus and Integral Calculus*, Pragathi Publications, India.
REFERENCE BOOKS	
1.	Dr. P. Mariappan (2015), *Business Mathematics*, Pearson India Education Service Pvt. Ltd, India.
2.	Dr. P. R. Vittal, V. Malini (2014) *Calculus*, Margham Publication, India.
E BOOKS	
1.	http://www.themathpage.com
2.	http://mathworld.wolfram.com
3.	http://www.analyzemath.com/calculus
MOOC	
1.	https://itemspro.eu/2020/12/15/mooc-differential-and-integral-calculus-2021/
2.	https://openlearning.aalto.fi/course/view.php?id=168

COURSE TITLE	**DESCRIPTIVE STATISTICS AND PROBABILITY**			**CREDIT**	**4**
COURSE CODE	**BMA1001**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	To expose the students to the fundamental concepts in descriptive statistics and probability theory.				
Course Objective	1. To understand the concept of methods of collection and editing of primary and secondary data.				

	2. To identify the measures of dispersion. 3. To provide an exposure on the basic concepts of probability. 4. To know the concepts of Boole's inequality and Baye's theorem. 5. To establish the random variable performance.
Course Outcome	Upon completion of this course, the students will be able to 1. Compute the solutions of measures of central tendency. 2. Determine the central and non-central moments and apply them appropriately in real time problems. 3. Understand the basic concepts of probability. 4. Apply Baye's theorem in real world problems. 5. Develop an understanding of the concept of random variables.
Prerequisites: Basics of Statistics and Probability Theory.	

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	2	-	-	-	-	2	-	-
CO2	1	1	2	-	-	-	-	2	2	2
CO3	1	1	2	-	-	-	-	2	-	-
CO4	1	1	2	-	2	-	-	2	2	2
CO5	1	1	2	-	2	-	-	2	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION TO STATISTICS	**(9L+3T=12)**
Concepts of Primary and Secondary data - Methods of collection and editing of primary data- Secondary data - Designing a questionnaire and a schedule-Measures of Central Tendency - Mean, Median, Mode, Geometric Mean and Harmonic Mean. **Self Study:** Methods of collection and editing of primary data.	**CO-1** **BTL-3**
MODULE 2: MEASURES OF DISPERSION	**(9L+3T=12)**
Range - Quartile Deviation - Mean Deviation and Standard Deviation - Descriptive Statistics - Central and Non-Central moments and their interrelationship - Sheppard's correction for moments - Skewness and kurtosis. **Self Study:** Quartile Deviation, Standard Deviation, Sheppard's correction for moments.	**CO-2** **BTL-3**
MODULE 3: INTRODUCTION TO PROBABILITY	**(9L+3T=12)**

Basic concepts of Probability - random experiments- trial – outcome - sample space – event - mutually exclusive and exhaustive events - equally likely and favourable outcomes – Mathematical, Statistical, Axiomatic definitions of probability - Conditional Probability and independence of events. **Self Study:** Random experiments, Trial, Conditional Probability and Independence of events.	**CO-3** **BTL-3**
MODULE 4: PROBABILITY THEOREMS	**(9L+3T=12)**
Addition and multiplication theorems of probability for 2 and for n events - Boole's inequality – Baye's theorem - problems based on Baye's theorem. **Self Study:** Addition and Multiplication Theorem, Boole's Inequality, Baye's Theorem.	**CO-4** **BTL-3**
MODULE 5: RANDOM VARIABLES	**(9L+3T=12)**
Definition of random variable - discrete and continuous random variables - functions of random variable - Probability mass function - Probability density function - Distribution function and its properties - Bivariate random variable - Definition, joint, marginal and conditional distributions, independence of random variables. **Self Study:** Probability Mass Function, Bivariate Random Variable.	**CO-5** **BTL-3**

TEXT BOOKS

1.	V. K. Kapoor and S. C. Gupta. (2020), *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
2.	Wackerly D. D, Mendenhall W, and Scheaffer R. L. (2008), *Mathematical Statistics with Applications*, California.
3.	Ross S. M. (2014), *Introduction to Probability and Statistics for Engineers and Scientists*, Elsevier, Los Angeles, USA.

REFERENCE BOOKS

1.	Durrett, R. (2010). *Probability: Theory and Examples* (4th ed.). Cambridge University Press.
2.	Goon A. M., Gupta, M. K., and Das Gupta, B. (2017), *Fundamentals of Statistics*, Australia.
3.	Hoel P. G. (1971), *Introduction to Mathematical Statistics*. Asia Publishing House, Robert V. Hogg, University of Iowa.

E BOOKS

1.	https://www.utstat.toronto.edu/mikevans/jeffrosenthal/book.pdf
2.	https://booksite.elsevier.com/samplechapters/9780123748485/Sample_Chapters/02~Chapter_1.pdf

MOOC	
1.	https://www.my-mooc.com/en/categorie/statistics-and-probability
2.	https://www.my-mooc.com/en/mooc/intro-to-descriptive-statistics--ud827

COURSE TITLE	**FUNDAMENTALS OF COMPUTER SYSTEM DESIGN**			**CREDIT**	**4**
COURSE CODE	**BDS01001**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	To expose the students with the core of computer systems — from Boolean logic and digital architecture to assembly language, virtual machines, and compilers — through hands-on design that bridges hardware and software.				
Course Objective	1. To understand the basics of algorithmic problem-solving. 2. To develop proficiency in solving problems using Python conditionals and loops. 3. To explore the definition of Python functions and their usage in problem-solving. 4. To use Python data structures for representing complex data. 5. To gain hands - on experience with input/output operations using files in Python.				

Course Outcome	Upon completion of this course, the students will be able to 1. Develop a solid foundation in Boolean logic and digital circuit design. 2. Achieve proficiency in computer architectures. 3. Develop the ability to design and implement a virtual machine and its interpreter. 4. Acquire hands-on experience in assembly language programming. 5. Build a solid foundation in compiler design.
Prerequisites: Knowledge of Boolean Algebra, Basic Programming Language	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**2**	**-**	**1**	**3**	**1**	**1**	**-**	**-**
CO4	**1**	**1**	**2**	**2**	**1**	**3**	**1**	**1**	**-**	**3**
CO5	**1**	**1**	**2**	**2**	**1**	**3**	**1**	**1**	**-**	**3**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO COMPUTER SYSTEMS AND BOOLEAN LOGIC	**(9L+3T=12)**
Introduction to Boolean Logic - Basic Logic Gates: AND, OR, NOT, XOR, Truth Tables-Logic Gate Implementations - Boolean Expressions - De Morgan's Laws - Applications of Boolean Logic in Computing - Introduction to Boolean Algebra: Boolean Variables and Operations - Properties of Boolean Algebra-Simplification of Boolean Expressions-Minimization of Logic Circuits-Boolean Algebra in Computer Systems. **Self-Study:** Karnaugh Maps for Boolean Expression Simplification, Designing Combinational Logic Circuits	**CO-1** **BTL-3**
MODULE 2: SEQUENTIAL LOGIC AND MACHINE LANGUAGE	**(9L+3T=12)**
Combinational vs. Sequential Circuits-Clock Signals and Flip-Flops-Types of Flip-Flops-Registers and Counters-State Machines-Designing Sequential Circuits-Machine Language Specification: Machine Language Basics-Instruction Set Architecture-Assembly Language Overview-Memory Addressing and Management-The Fetch-Decode-Execute Cycle-Low-	**CO-2** **BTL-3**

Level Programming. **Self-Study:** Designing and Implementing State Machines, Instruction Set Architecture	
MODULE 3: COMPUTER ARCHITECTURE AND ASSEMBLY LANGUAGE (9L+3T=12)	
Overview of the HACK Architecture- Components of the HACK Computer- HACK Instruction Set- Memory Organization in HACK - Control Unit Design- HACK Assembly Language, Assembly Language- Registers and Data Manipulation-Assembly Syntax-Stack Operations - Addressing Modes in Assembly. **Self-Study:** HACK Instruction Set and Assembly Language Programming, Memory Organization and Addressing Modes in Assembly	**CO-3** **BTL-3**
MODULE 4: VIRTUAL MACHINES AND LANGUAGE INTERPRETATION (9L+3T=12)	
Introduction to Stack-Based Virtual Machine- Stack-Based Virtual Machine Model-Execution of Instructions on the Stack-Virtual Machine Design- Memory Management in Virtual Machines-Performance of Stack-Based Machines-Language and Interpreter for Virtual Machines-Design of a Simple Interpreter- Lexical Analysis and Parsing,-Instruction Set for the Virtual Machine-Executing Programs on the Virtual Machine- Error Handling and Debugging. **Self-Study:** Design and Implementation of a Simple Virtual Machine Interpreter, Memory Management and Error Handling in Virtual Machines	**CO-4** **BTL-3**
MODULE 5: HIGH-LEVEL LANGUAGE AND COMPILER DESIGN (9L+3T=12)	
Introduction-Overview of JACK Language-JACK Compiler- Parsing and Syntax Tree Construction-Intermediate Code Generation, Operating System- Basic OS Functions-System Calls and APIs-OS Design-Simple Operating System Implementation. **Self-Study:** Design and Implementation of a JACK Language Compiler, Core Operating System Functions and System Calls	**CO-5** **BTL-3**

TEXT BOOKS

1.	David Money Harris and Sarah L. Harris (2002), *Digital Design and Computer Architecture*, Standford University, Southern California.
2.	David A. Patterson and John L. Hennessy (2013), *Computer Organization and Design: The Hardware/Software Interface,* University of California, Berkeley.

REFERENCE BOOKS

1.	J. M. Radford (2010), *Boolean Algebra and Its Applications*, Bursa University Press, Turkey.

2.	Andrew S. Tanenbaum (2013), *Structured Computer Organization, University of Michigan Ann Arbor*, Michigan, United States.
3.	Keith D. Cooper and Linda Torczon (1999), *Engineering a Compiler*, University of Netherlands press, Netherlands.
E BOOKS	
1.	https://craftinginterpreters.com/
MOOC	
1.	Introduction to Logic (Coursera)
2.	https://www.coursera.org/learn/computer-systems
3.	https://www.coursera.org/learn/assembly-language-programming
4.	https://www.coursera.org/learn/compilers

COURSE TITLE	**PYTHON PROGRAMMING**		**CREDITS**		**3**
COURSE CODE	**ACS11001**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**2-0-2-2**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assign/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	This course introduces the need for data science and relevant python function libraries along with Numpy arrays. Especially, python concepts pertaining to data science is covered in this course.				
Course Objective	1. To gain knowledge the basic concepts of python programming for data science with relevant Python functions and libraries. 2. To acquire the concepts of user defined modules and packages in python. Also, to have knowledge in the object-oriented programming scenario. 3. Accomplish efficient storage and data operations using NumPy arrays. 4. Handle powerful data operations using Pandas. 5. Perform model building and data analysis with visualization.				

Course Outcome	1. Identify the need for data science and solve basic problems using Python built-in data types and their methods. 2. Design an application with user-defined modules and packages using OOP concept 3. Employ efficient storage and data operations using NumPy arrays. 4. Apply powerful data manipulations using Pandas. 5. Do data preprocessing and visualization using Pandas

Prerequisites: Basic Programming Knowledge

Pedagogy: Discussion,Team work,peer-peer learning

CO, PO AND PSO MAPPING

CO	PO - 1	PO – 2	PO-3	PO - 4	PO - 5	PO - 6	PSO-1	PSO - 2	PSO– 3
CO– 1	3	2	1	2	1	2	3	1	2
CO– 2	2	1	2	-	2	1	2	2	1
CO– 3	3	2	1	2	1	2	3	1	2
CO– 4	2	1	2	1	2	1	2	2	1
CO– 5	-	1	1	2	1	2	3	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION TO DATA SCIENCE AND PYTHON PROGRAMMING 12 Hrs

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

CO-1
BTL-2

Practicum:

1. To Work with the List,Tuples,Dictionary

Discussion on various list,tuples,dictionary motivated the students to pursue knowledge.

MODULE 2: FILE, EXCEPTION HANDLING AND OOP 12Hrs

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

CO-2
BTL-2

Practicum:

1. To Work with the function and modules

2. To work with OOPS. Discussion on various OOPS function motivated the students to pursue knowledge.	
MODULE 3: INTRODUCTION TO NUMPY	**12Hrs**
NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting- Unique and Other Set Logic. **Practicum:** 1. To Work with the numpy Discussion on various numpy function motivated the students to purse knowledge.	**CO-3** **BTL-3**
MODULE 4: DATA MANIPULATION WITH PANDAS	**12 Hrs**
Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries- Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format. **Practicum:** 1. To Work with the Data structures 2. To work series and data frame Discussion on various data structures and data frame motivated the students to pursue knowledge.	**CO-4** **BTL-2**
MODULE 5: DATA CLEANING PREPARATION AND VISUALIZATION	**12 Hrs**
Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots. **Practicum:** 1. To Work with the Pandas 2. To work with data cleaning and preparation Discussion on various panda's function motivated the students to pursue knowledge.	**CO-5** **BTL-2**
TEXT BOOKS	
1.	Y. Daniel Liang.(2012).Introduction to Programming using Python. Pearson.

2.	Wes McKinney.(2014).Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed).O'Reilly.
3.	Jake VanderPlas(2017).Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly.
REFERENCE BOOKS	
1.	Wesley J. Chun.(2006).Core Python Programming. Prentice Hall.
2.	Mark Lutz(2009).Learning Python(4th ed).O'Reilly.
E BOOKS	
1.	https://www.programmer-books.com/introducing-data-science-pdf/
2.	https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3.	http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf
MOOC	
1.	https://www.edx.org/course/python-basics-for-data-science
2.	https://www.edx.org/course/analyzing-data-with-python

COURSE TITLE	**COMMUNICATION SKILLS**			**CREDITS**	**2**
COURSE CODE	**GLS51001**	**COURSE CATEGORY**	**HS**	**L - T – P – S**	**2 – 0 – 1 – 1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL 4**

ASSESSMENT SCHEME

CIA					**ESE**	
First Periodical Assessment	**Second Periodical Assessment**	**Weekly assignment/ lab record and viva as approved by the Department Examination Committee "DEC"**	**Surprise Test / Quiz., as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE Theory**	**ESE Practical**
15 %	**15 %**	**10 %**	**5 %**	**5 %**	**25 %**	**25 %**

Course Description	The course has been designed to improve the communication competency of the students. The course builds on students' English language skills by engaging them in listening, speaking and grammar learning activities (LSRW) that are relevant to authentic contexts. This course trains the students how to communicate accurately, appropriately and fluently in professional and social situations. The course is framed so that the students can appear for Cambridge B1 Preliminary exams and also enable them to get a certification.
Course Objective	1. To acquire self-confidence by which the learner can improve upon their informative listening skills by an enhanced acquisition of the English language. 2. To provide an environment to Speak in English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 3. To equip the students to Read, comprehend and answer questions based on literary, scientific and technological texts. 4. To enhance the writing skills of the students via training in instructions, recommendations, checklists, process-description, letter-writing and report writing. 5. To equip the learners in analyzing and applying creative thinking skills and participate in brainstorming, mind-mapping, audiovisual activities and excel in employability skills.
Course Outcome	Upon completion of this course, the students will be able to 1. Acquire the accuracy through the knowledge of Syntax. 2. Demonstrate the skill of using the vocabulary and use it in sentences appropriately. 3. Infer texts and improvise its usage. 4. Illustrate language acquisition skills through formal correspondence. 5. Analyse and transcode the data and interpret it in text format.
Prerequisites: Plus Two English-Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**
CO2	**2**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**
CO3	**2**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**
CO4	**2**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**

CO5	**2**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1 : ENGLISH FOR EMPLOYABILITY	**(6L + 3P)**
Grammar : 1. Parts of Speech – Identification and Transformation 2. Kinds of Sentences – Identification and Transformation 3. Sentence Pattern – Framing Sentences 4. Tenses – Rules & its usage – Present simple and present continuous; time expressions; state verbs – Past simple ; regular and irregular verbs and spelling of past simple forms ; past continuous. **Vocabulary :** 1. Job titles and describing jobs ; names of company departments 2. Computer terms; email and website terms. 3. Headings for CVs Describing application Procedures **Writing :** 1. Writing emails – formal and informal – phrases for emails & letters. 2. Writing a covering letter with a resume for a job application. **Reading :** Reading about Job and Company : 1. Changing places : job swapping at work. 2. The power of word of mouse : an article on the power of online customer options 3. Haier : an article about the history of a Chinese Company. 4. What kind of company Culture would suit you ? reading answering a quiz. **Lab Activities(Speaking) :** 1.Self Introduction. 2. Describing jobs ; asking other people about their jobs. 3. Asking about the history of a company ; past simple questions 4. Asking questions about companies and jobs. **Lab Activities(Listening) :** 1. Being a PA 2. Growing Pains : an interview with a business consultant about company's Growth. 3. Describing changes in a company : a Conversation on the phone.	**CO-1** **BTL-2**
MODULE 2 : ENGLISH FOR MARKETING	**(6L + 3P)**
Grammar: 1. Concord - Understanding Subject Verb agreement – Identifying the error and Correcting 2. Active and Passive Voice – Identifying the voices and Transforming Active to passive and passive to active 3. Modal Verbs – Using to express modalities – in active and passive voices 4. Words to Describe causes and effects. 5. Prepositions **Vocabulary : 1.** Vocabulary to describe objects; component parts, shapes, dimensions, materials Describing problems with equipment 2. Verbs to Describe process 3. Vocabulary to talk about advertising and marketing, Language to describe cause and effect. **Writing :** 1. Topic Sentence 2. Paragraph Writing 3. Developing a story with the hints 4. Promotional letter(Email)	**CO-2** **BTL-3**

Reading : Product Description and Advertisement : 1. Problems with equipment : emails and headings on a form. 2. Waratah : an article on an Australian clothing company. , Short Texts : Notices, Notes and messages 3. Selling your product abroad; an article , Workplace signs and notices 4. Descriptions of advertising media, Singapore airlines; an article on the branding of an airline. **Lab Activities(Speaking) :** 1.Role Play – Telephone call to a supplier, 2. Describing Objects **Lab Activities(Listening) :** 1. Describing dimensions of products : Conversations with colleagues and suppliers. – The Gizmo game : listening to the uses of a gadget. 2. Channel No.5 : an interview about a production process 3. Telephone conversations : information about orders and deliveries. 4. Descriptions of how a product is advertised.	
MODULE 3 : BUSINESS CORRESPONDENCE	**(6L + 3P)**
Grammar : 1. Tenses – Present continuous for future arrangements; will and going to future forms 2. Using discourse markers ; Sentence starters - Contrast & similarity words, 3. Degrees of Comparison – Framing sentences with appropriate adjectives and adverts – transformation from one degree to another degree. 4. Infinitives and gerunds – using infinitives and gerunds in sentences as different elements. 5. Conditionals – Three types of conditionals **Vocabulary :** 1.Vocabulary for travel 2. Synonyms and Antonyms 3. Employment Vocabulary **Writing :** 1. A letter(Email) of invitation – Accepting the invitation and declining the invitation. **Reading :** Transport, Working Holidays and Conferences : Travel Arrangements : notices and short messages : Eurostar : an article on train travel. 2. Netflix : an article about a company's holiday policy; thinking outside the box: an article on offsite meetings 3. Short Texts : Feedback on conferences **Lab Activities(Speaking) :** Discussion: How to make decisions **Lab Activities(Listening) :** 1. Making and changing appointments : Voicemail messages and phone conversations ; Future intentions and predictions : Short Extracts. 2. A travel Anecdote 3. Half Holidays: a conversations between two employees. 4. Discussing possible venues for a conference : a conversation between colleagues; a welcome speech at a conference.	**CO-3** **BTL-3**
MODULE 4 : ENGLISH FOR BUSINESS RELATIONSHIPS	**(6L + 3P)**

Grammar : 1. Writing Instructions and Recommendations – Transforming instruction to recommendation and recommendation to instruction 2. Expressions of quantity – semi-negative words 3. Present Perfect : time expressions : present perfect versus Past simple. 4. Reported Speech – Direct and Indirect Speeches – Identification and Transformation **Vocabulary :** 1. Affixes 2. Countable and Uncountable nouns 3. Global Management **Writing :** 1.Memo 2. Notice with agenda 3. Email : Requesting information **Reading :** Corporate gift-giving, New places, New people, Team Building and Thinking globally : 1. Career Advice : letters to an advice column 2. Promotional gifts : an article 3. Descriptions of team building events; Kaizen : an article 4. Global HR management : an Article. **Lab Activities(Speaking):** Role Play : 1. Interviewing someone about a job change 2. Discussion : Planning a team building event 3. Promoting a city : giving a speech. **Lab Activities(Listening) :** 1. An interview with someone who has changed career 2. An interview about corporate gift giving 3. Creating good teams : a Presentation 4. Working an international Team : short Extracts.	**CO-4** **BTL-3**
MODULE 5 : ENGLISH FOR PRESENTATION	**(6L + 3P)**
Grammar : 1. Adjectives and adverbs 2. Pronouns and Reference Words 3. Types of Sentences – Simple, Compound and complex Sentences – Identification and transformation. **Vocabulary :** 1. Describing Trends 2. Finance Vocabulary 3. Stocks and Shares 4. Collocation - sets and money **Writing** : 1. Transcoding – Converting an image (Linegraph, piechart, bar chart, flowchart tree diagram etc.,) into a paragraph – Converting a paragraph into an image(Linegraph, piechart, bar chart, flowchart tree diagram etc.,) 2. Summary writing **Reading :** Describing Statistics, Company finances, investments and starting up : 1. Interpreting bar charts 2. Café Coffee day : an article on the growth of the Indian coffee shop. 3. Shares and the stock exchange: a web page; short articles from the financial news; men and women investments : an article 4. Teenage entrepreneus : reading and comparing two articles; Kalido: an article on funding. **Lab Activities(Speaking) :** 1. Describing figures and trends 2. Discussing qualities needed in candidates for a job vacancy **Lab Activities(Listening) :** 1. Listening to statistical information : short extracts 2. An interview with the employee of a company that helps failing business 3. An interview with someone who works in investor relations. 4. Radio interview : marketing director of a business support service.	**CO-5** **BTL-4**

TEXT BOOK	
1	Whitby, Norman (2019). Cambridge English Business Benchmark, Pre-intermediate and Intermediate. Cambridge University Press. India (Pages 208)
REFERENCE BOOKS	
1.	Murphy, Raymond (2021). Essential English Grammar, Cambridge University Press. India (Pages 300)
2.	Redman, Stuart (2020). English Vocabulary In Use: Pre - Intermediate And Intermediate. Cambridge University Press. India (Pages 264).
3.	Bikram K. Das. (2019) An Introduction to Professional English and Soft Skills with audio CD, Cambridge University Press. India (Pages 272).
4.	John, Dolly., (2018), English for Life and the Workplace Through LSRW&T Skills, Pearson Publications. India (Pages 263).
E BOOKS	
1.	https://www.cambridge.org/gb/files/9116/4138/4615/A1_Student_Book.pdf
2.	https://www.cambridge.org/gb/files/1416/4138/4681/A1_Workbook.pdf
3.	https://www.cambridge.org/gb/files/7216/4138/1999/A2_Student_Book.pdf
4.	https://www.cambridge.org/gb/files/6816/4138/2072/A2_Workbook.pdf
MOOC	
1.	https://www.edx.org/professional-certificate/tsinghuax-english-communication-skills
2.	https://www.britishcouncil.org.tr/en/english/mooc/english-for-the-workplace

COURSE TITLE	**தமிழர் கலை மற்றும் கலாச்சாரம் - TAMIL ART AND CULTURE**			**CREDITS**	**1**
COURSE CODE	**GLS11001**	**COURSE CATEGORY**	**HS**	**L-T-P-S**	**1-0-1-2**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL- 2**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation/Lab Records as approved by the Department Examination Committee "DEC"	Attendance	ESE	
					Theory	Practical

15%	15%	10%	5%	5%	25%	25 %
பாடவிளக்கம்	இந்த அடித்தளப் பாடதிட்டத்தினைப் படிப்பதன் மூலம் மாணவர்களிடையே தமிழரின் கலை மற்றும் கலாச்சாரமும், மொழி ஆற்றலும் நன்கு வளர்ச்சி அடையும். மேலும் இப் பாடத்திட்டம் தமிழர் வரலாறு, கலை, கலாச்சாரம், இலக்கியம், செய்யுள், மொழிப் பயிற்சி ஆகியனவற்றை அறியும் வகையில் அமைக்கப்பட்டுள்ளன. இப் பாடத்திட்டத்தினைக் கற்றுக் கொள்வதன் மூலம் மாணவர்களிடையே கற்றலில் ஆர்வம் ஏற்படுகிறது. அது மட்டும் அல்லாமல் தமிழ்மொழியைக் கற்றுக்கொண்டு எளிதில் சரளமாக உரையாடவும் முடிகிறது.					
பாடத் திட்டத்தின் நோக்கம்	1. இந்தப் பாடத்திட்டத்தினைக் கற்பதன் மூலம் மாணவர்கள் எந்தச் சூழ்நிலையிலும் தமிழ்மொழியை எளிதாக எழுதவும், பேசவும், அன்றாட உரையாடல்களில் சிறந்து விளங்கவும் வாய்ப்பளிக்கின்றன. 2. மாணவர்களிடம் மொழிப்பற்றினை உருவாக்கி கற்றலில் ஆர்வத்தை ஊக்குவிக்கிறது. 3. சமுதாயத்தில் தங்களுக்குத் தேவையான வாய்ப்புக்களையும் மாணவர்கள் உருவாக்கிக்கொள்ள வழிவகைச் செய்கிறது. 4. மொழித்துறையில் ஆர்வம் ஏற்பட்டுத் தமிழ் இலக்கியங்களையும் மாணவர்கள் கற்றுக்கொள்கின்றனர். 5. இப் பாடத்திட்டத்தில் தமிழர் கலை மற்றும் கலாச்சாரத்தை மாணவர்கள் அறிந்துக்கொள்வதன் மூலம் இம்மாணவச் சமூகம் கலை, கலாச்சாரம், பண்பாடு பற்றி அறிந்துக்கொள்ள பெரிதும் உதவுகிறது.					
பாடத் திட்டத்தின்	1. தமிழரின் கலை மற்றும் கலாச்சாரத்தைக் கற்பதன் மூலமாக மாணவர்களிடையே கலை ஆர்வம் மேம்படவும், கலாச்சாரச் சிந்தனை உயரவும், மொழித்தடை நீங்கி அவர்கள் எளிதில்					

பயன்கள்	எழுதவும், படிக்கவும், பேசவும் கற்றுக்கொண்டு தமிழ் இலக்கியம் கற்பதில் ஆர்வம் காட்டுவார்கள். 2. மாணவர்கள் மொழித்திறனை வளர்த்துக்கொண்டு விரிவான முறையில் கட்டுரை, கவிதை, சிறுகதை போன்றவைகளைப் படிப்பதிலும் படைப்பதிலும் ஆர்வம் செலுத்துவார்கள். 3. தமிழ்மொழியைக் கலை மற்றும் கலாச்சார சிந்தனையோடு கற்பதன் மூலம் இடத்திற்கு ஏற்றார் போல் தங்களின் வாழ்வியல் தேவைகளைப் பூர்த்தி செய்துக்கொள்ள முடியும். 4. தமிழர் கலை மற்றும் கலாச்சாரத்தினைக் கற்பதன் மூலம் தமிழ் இலக்கிய வரலாற்றினையும் வாழ்வியலோடு இணைந்த கலை மற்றும் கலாச்சார பழக்க வழக்கங்களைப் படித்து அறிந்துக் கொண்டு மாணவர்கள் ஒழுக்க நெறியோடு தங்களின் வாழ்க்கைத் தரத்தை மேம்படுத்திக் கொள்ள உதவும். 5. பண்டைய தமிழர்களின் வாழ்கைமுறை, பண்பாடு, கலாச்சாரம், நாகரீக வளர்ச்சி ஆகியவற்றைக் கற்றுக்கொண்டு மாணவர்கள் தங்களின் வாழ்க்கை தரத்தை மேம்படுத்திக் கொள்ள இந்த பாடத்திட்டம் உதவியாக இருக்கும்.
Prerequisites: Plus Two -Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO 3**
CO1	**1**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO2	**1**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO3	**1**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO4	**1**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO5	**1**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

அலகு - 1 தமிழர் வரலாறு	**(6L)**
ஐவகை நிலம் - முதற்பொருள் - கருப்பொருள் - உரிப்பொருள் - நாகரிகம் - பண்பாடுசொல் விளக்கம், பண்டையத் தமிழர்களின் உணவு, உடை, உறைவிடம், அணிகலன் – பண்டைக் காலப்போர்முறை - வணிகம் - தொழில்கள் – பண்டைத் தமிழரின் ஒழுக்கம் - களவு - வரைவு - கற்பு வாழ்க்கை. வகுப்பறை செயல்முறைகள் : 1. **விரிவுரை முறை** 2. **வினா - விடை முறை** 3. **விடுபட்ட எழுத்துகளை நிரப்புக**. 4. **குழுவிவாதம்** 5. **வகுப்பறை தேர்வு**	**CO-1** **BTL-1**
அலகு – 2 கலாச்சாரம் மற்றும் பழக்க வழக்கங்கள்	**(6L)**
நம்பிக்கைகள் – சடங்குகள் - சமயவழிபாடுகள் - விழாக்கள் - சமயம் - சைவம் - வைணவம் - சமணம் - பௌத்தம் - இசுலாம் - கிறித்தவம். வகுப்பறை செயல்முறைகள் : 1. **விரிவுரை முறை** 2. **வினா - விடை முறை** 3. **விடுபட்ட எழுத்துகளை நிரப்புக**. 4. **குழுவிவாதம்**	**CO-2** **BTL-2**

5. **வகுப்பறை தேர்வு**	
அலகு – 3 தமிழர் கலைகள்	**(6 L)**
பண்டைத் தமிழரின் கட்டிடக்கலை (கோவில்கள், கோட்டைகள்), இசைக்கலையும் கருவிகளும் (தோல்கருவிகள், துளைக்கருவிகள், நரம்புக்கருவிகள், கஞ்சக்கருவிகள், மிடற்றுக்கருவிகள்), சிற்பக்கலை (கோவில் சிற்பங்கள்), ஓவியக்கலை (சிற்றன்ன வாசல் ஓவியம்) நாட்டுப்புறக் கலை (சிலம்பாட்டம், மயிலாட்டம், ஒயிலாட்டம், பொய்க்கால், குதிரையாட்டம்) **வகுப்பறை செயல்முறைகள்:** **1. விளக்கவுரை** **2. வினா எழுப்புதல்** **3. கவிதை சொல்லுதல்** **4. கதை சொல்லுதல்** **5. ஒப்படைப்பு கொடுத்தல்**	**CO-2** **BTL-2**
அலகு - 4 **தமிழர் விளையாட்டுகள்**	**(6L)**
தமிழர் விளையாட்டுகள் - கபடி, பல்லாங்குழி, பாண்டி விளையாடுதல், தாயம், ஆடுபுலியாட்டம், சதுரங்கம். **வகுப்பறை செயல்முறைகள்:** **1. குறு நாடகங்கள் நடித்து உரையாடல்கள் கற்பித்தல்.** **2. கதை சொல்லுதல்** **3. ஒப்படைப்பு கொடுத்தல்**	**CO-2** **BTL-2**
அலகு - 5 தமிழர் நூல்கள்	**(6L)**
திருக்குறள் - ஒழுக்கமுடைமை (அதிகாரம் - 14), கல்வி (அதிகாரம் - 40), குறுந்தொகை (பாடல் எண் - 40), ஐங்குறுநூறு (பாடல் எண் - 22), கலித்தொகை (பாடல் எண் - 133), புறநானூறு (பாடல் எண் - 192) **வகுப்பறை செயல் முறைகள்:** 1. **கவிதை வாசித்தல் போட்டிகள்** 2. **வகுப்பறை தேர்வுகள்**	**CO-3** **BTL-3**
TEXT BOOK	

1.	ஞா.தேவநேயபபாவாணர் - பண்டைத் தமிழ் நாகரிகமும் பண்பாடும், தமிழ்மண் பதிப்பகம், சென்னை. 2000.
2.	அ.தட்சிணாமூர்த்தி - தமிழர் நாகரிகமும் பண்பாடும், யாழ்வெளியீடு, மேற்கு அண்ணாநகர், சென்னை- 40, 2014
REFERENCE BOOKS	
1.	மயிலை சீனி வேங்கடசாமி - நுண் கலைகள், பூம்புகார் பதிப்பகம், சென்னை-08, 2014.
2.	க.பலராமன் - பழந்தமிழில் அறிவியல், உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை. 2009.
E-REFERENCES	
1	https://www.tamilvu.org/ta/library-lA417-html-lA417con-147465

COURSE TITLE		**TAMIL ART AND CULTURE**			**CREDITS**	**1**
COURSE CODE		**GLS11001**	**COURSE CATEGORY**	**HS**	**L-T-P-S**	**1-0-1-2**
Version	**0.0**	**Approval Details**			**LEARNING LEVEL**	**BTL-2**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessments**	**Observation/Lab Records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE**	
					Theory	**Practical**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	Tamil arts, culture and language skills will be well known among the students by studying this foundational course. The various aspects of Tamil history, art, culture, literature, poetry and language would be informative and useful. This Course will create interest in learning Tamil art and culture among students.

Course Objective	1. Enables students to listen, speak, read and write in Tamil in better manner. 2. Develops interest in learning Tamil art and culture among students. 3. Enhances students to use Tamil for themselves in any situation. 4. Provides students the opportunity to learn Tamil literature. 5. Learning about Tamil art and culture, the students get connected with the culture and tradition of the community.
Course Outcome	1. The interest in art and culture among the students will improve and they will show interest in learning Tamil literature. 2. Students will develop skills in reading essays, poems, short stories etc. in a comprehensive manner. 3. By learning Tamil language with artistic and cultural thinking, they can fulfill their living needs accordingly to the place they live-in. 4. By studying Tamil art and culture, students learn about the history of Tamil literature and the art and cultural customs associated with Tamil people's life. 5. This course will help the students to improve their quality of life by learning about the life style, culture, civilization and development of ancient Tamils.
Prerequisites: Plus Two -Intermediate Level	

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	-	3	-	-	3	-	-	-
CO2	2	3	-	3	-	-	3	-	-	-
CO3	2	3	-	3	-	-	3	-	-	-
CO4	2	3	-	3	-	-	3	-	-	-
CO5	2	3	-	3	-	-	3	-	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

Module-1 HISTORY OF TAMILIAN	**(6L)**
Five types of land - Prototype - Theme - Adjective - Civilization - Glossary Explanation, Food, dress, shelter, accessories of ancient Tamils - Ancient warfare - Trade - Industries - Morality of ancient Tamil - Theft - Draft - Chaste life. Classroom Procedures: 1. Lecture Method 2. Question-Answer Method 3. Fill in the missing letters. 4. Group discussion 5. Classroom test	**CO-1** **BTL-1**
Module– 2 CULTURE AND CUSTOMS OF TAMILIAN	**(6 L)**
Beliefs – Rituals – Religious Worship – Festivals – Religion – Saivism – Vaishnavism – Jainism – Buddhism – Islam – Christianity. Classroom Procedures: 1. Lecture Method 2. Question-Answer Method 3. Fill in the missing letters. 4. Group discussion 5. Classroom test	**CO-2** **BTL-2**
Module– 3 TAMIL ART FORM	**(6 L)**
Ancient Tamil Architecture (Temples, Forts), Music and Instruments (Leather Instruments, Perforators, String Instruments, Kanjakarui, Mittakarui), Sculpture (Temple Sculptures), Painting (Chitanna Vasal Painting) Folk Art (Silamdance, Myilatam, Violatam, Poikal, Equestrianism,) Processes: 1. Explanation 2. Questioning 3. Recitation of poetry 4. Story telling 5. Delivery	**CO-2** **BTL-2**
Module- 4 **TRADITIONAL SPORTS OF TAMILIAN**	**(6 L)**
Tamil Sp0rts - Kabaddi, Ballanguzhi, Bandi playing, Thalam, Adubuliyatam, Chess. Classroom Procedures: 1. Teaching dialogues by acting out skits.2. Storytelling3. Delivery	CO-2 BTL-2
Module- 5 **TAMIL LITERATURE**	**(6 L)**
Thirukkural - Discipline (Song - 14), Education (Song - 40), Kurunthogai (Song No. - 40),	CO-3

Ingurunuru (Song No. - 22), Kalithogai (Song No. - 133), Poorananuru (Song No. - 192) Classroom Activities: 1. Poetry Recitation Competitions 2. Classroom Tests	BTL-3

TEXT BOOK	
1.	J. DevaneyapaBhavanar - Ancient Tamil Civilization and Culture, Tamilman Publishing House, Chennai. 2000.
2.	A. Dakshinamurthy - Tamil Civilization and Culture, Jaffna Publication, West Anna Nagar, Chennai - 40, 2014.
REFERENCE BOOKS	
1.	MailaiSeeniVenkatasamy - Fine Arts, Phoombukar Publishing House, Chennai-08, 2014.
2.	K. Balaraman - Palanthamil Science, World Tamil Research Institute, Chennai. 2009.
E-REFERENCES	
1	https://www.tamilvu.org/ta/library-lA417-html-lA417con-147465

COURSE TITLE	**ENVIRONMENTAL SCIENCE AND SUSTAINABLE DEVELOPMENT**			**CREDITS**	**2**
COURSE CODE	**GGE51003**	**COURSE CATEGORY**	**VA**	**L-T-P-S**	**2-0-0-2**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	**To expose the students to the basics of environmental science and sustainable development.**				

Course Objective	**1.** To make the students aware of the natural resources and to educate them to understand the need for preserving the resources. **2.** To provide knowledge on the various aspects of environmental pollution and issues. **3.** To provide basic knowledge and concepts of sustainability. **4.** To educate the students about the concepts of sustainable habitat. **5.** To give a broad knowledge on environmental management system.
Course Outcome	Upon completion of this course, the students will be able to 1. Recognise the effects of over exploitation of natural resources and their impact on day-to-day life on earth. 2. Apply the sustainable solutions for environmental pollution and issues. 3. Implement the concepts of sustainability in the product development. 4. Use appropriate methods for designing green house and maintaining sustainable cities, transport system, industries, etc. 5. Manage the environment for sustainable product development.

Prerequisites: Basic knowledge of science and environment.

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	-	3	1	3	2	-	-	1
CO2	1	1	-	3	1	3	2	-	-	1
CO3	1	1	-	3	1	3	2	-	-	1
CO4	1	1	-	3	1	3	2	-	-	1
CO5	1	1	-	3	1	3	2	-	-	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: NATURAL RESOURCES (6L)

Introduction - Forest resources: Use and over-exploitation – Water resources: Use and over-utilization – Mineral resources: Use and exploitation – Food resources: World food problems, effects of modern agriculture – Energy resources: conventional and nonconventional, solar energy, fuel cells, wind energy, hydro plants, bio-fuels, Energy derived from oceans, geothermal energy – Land resources: Use and over-exploitation – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study – Documentation of nearby environmental assets – river / forest / grassland / hill /	**CO-1** **BTL-3**

mountain.	
MODULE 2: ENVIRONMENTAL POLLUTION AND ISSUES	**(6L)**
Air pollution, effects of air pollutions; Water pollution – sources, sustainable waste water treatment; Solid waste – sources, impacts, zero waste concept, 3R concept, Global environmental issues – Resource degradation, climate change, global warming, ozone layer depletion – Regional and local environmental issues – Carbon credits and carbon trading, carbon foot print. Field Study - Observe a pond nearby and analyze the different measures that can be adopted for its conservation	**CO-2** **BTL-3**
MODULE 3: SUSTAINABILITY	**(6L)**
Introduction, need of sustainability – Social, environmental and economic sustainability concepts – sustainable development, Nexus between technology and sustainable development, challenges for sustainable development – multilateral environmental agreements and protocols – clean development mechanism (CDM) – Environmental legislations in India – water act, air act. Field Study - Assessment of sustainability in your neighbourhood in education / housing / water resources / energy resources / food supplies/ land use / environmental protection, etc.	**CO-3** **BTL-3**
MODULE 4: CONCEPTS OF SUSTAINABLE HABITAT	**(6L)**
Green buildings: material for sustainable design, green building certification, methods for increasing energy efficiency of buildings – sustainable urbanization - sustainable transport – Industrialization and poverty reduction – Industrial processes: material selection, pollution prevention, industrial ecology, industrial symbiosis. Assignment – Explore the different methods that can be adopted for maintaining a sustainable transport system in your city.	**CO-4** **BTL-3**
MODULE 5: ENVIRONMENTAL MANAGEMENT	**(6L)**
Environmental management: Principles and strategies, Indicators of environmental quality – economic valuation - environmental cost-benefit analysis – Fiscal incentives in pollution control and management – Environmental management system: ISO 14000, Life Cycle Analysis (LCA) – scope and goal, bio-mimicking – Environmental Impact Assessment (EIA) – Procedures of EIA in India. Assignment – Conducting an EIA study of a small project (example, construction of house, road, bridge, etc.) in your local area.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Basu, M., Savarimuthu, X. (2017). Fundamentals of Environmental Studies , Cambridge University Press, 1st Edition.
2.	Bhavik R. Bakshi (2019). *Sustainable Engineering: Principles and Practice*, Cambridge University Press, 1st Edition.
3.	Mulligan, C. (2020). *Sustainable Engineering: Principles and Implementation*, CRC Press, 1st Edition.
REFERENCE BOOKS	
1.	Wasewar, K. L., Rao, S. N. (2022). *Sustainable Engineering, Energy, and the Environment Challenges and Opportunities*, CRC Press, 1st Edition.
2.	Singh, J.S., Singh, S.P., Gupta, S. R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing Company, New Delhi,
E BOOKS	
1	https://www.hzu.edu.in/bed/E%20V%20S.pdf
2	https://library.oapen.org/handle/20.500.12657/33379
MOOC	
1.	https://www.my-mooc.com/en/categorie/environmental-science
2.	https://www.coursera.org/specializations/sustainable-cities

COURSE TITLE	**OUTREACH (NSS) LEVEL I**			**CREDITS**	**1**
COURSE CODE	**GGE1402**	**COURSE CATEGORY**	**HS**	**L-T-P-S**	**0-0-2-0**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-5**
ASSESSMENT SCHEME					
CIA					**ESE**
Volunteering	**Events attended**	**Awareness Programs attended**		**Attendance***	**Report Submission**
5	**25**	**15**		**5%**	**50**
Course Description	This course is designed to introduce students to the principles and practices of community service, social development, and active citizenship. The course aims to instill a sense of social responsibility and promote civic engagement among the participants. Through a combination of theoretical knowledge and practical experiences, students will				

	develop essential skills and qualities required to make a positive impact on the community and society. Pre requisite: There are no specific prerequisites for enrolling in the NSS Semester 1 course. However, a genuine interest in community service, social development, and willingness to actively engage with diverse communities are essential.
Course Objective	1. To familiarize students with the objectives, history, and importance of the National Service Scheme (NSS) in community development, emphasizing the significance of social responsibility and civic engagement. To develop essential leadership skills, teamwork, and effective project management techniques, preparing students to organize and execute community service projects successfully. 2. To cultivate empathy, compassion, and cultural sensitivity, enabling students to engage respectfully and effectively with diverse communities during their community service activities. 3. To promote environmental awareness and sustainable practices, encouraging students to integrate eco-friendly approaches into their community service initiatives. 4. To enhance students' communication, problem-solving, and decision-making skills, equipping them to engage with community members, stakeholders, and address challenges effectively.
Course Outcome	1. Students will gain a comprehensive understanding of the objectives, history, and significance of the National Service Scheme (NSS) in promoting community development and social responsibility. 2. Participants will demonstrate the ability to identify and assess prevalent social issues and challenges in the community, laying the groundwork for effective community service initiatives. 3. Through practical experiences and workshops, students will develop essential leadership skills, teamwork, and project management techniques necessary for organizing and executing successful community service projects.

	4. By engaging with diverse communities, students will cultivate empathy, compassion, and cultural sensitivity, fostering meaningful and respectful interactions during their service activities. 5. Upon completion of Semester 1, students will have improved their communication, problem-solving, and decision-making skills, empowering them to actively and effectively engage in community development and service projects.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	3	-	3	-	2	2	-	-	-
CO2	1	3	-	3	-	2	2	-	-	-
CO3	1	3	-	3	-	2	2	-	-	-
CO4	1	3	-	3	-	2	2	-	-	-
CO5	1	3	-	3	-	2	2	-	-	-

TOPICS TO BE COVERED	
Introduction to National Service Scheme (NSS) and its Objectives Understanding Social Issues and Needs Assessment in the Community Project Planning and Management for Community Service Leadership Development and Teamwork Cultural Sensitivity and Interacting with Diverse Communities Communication and Problem-Solving Skills for Community Engagement Environmental Conservation and Sustainable Practices Health, Hygiene, and Community Well-being The Role of Arts and Culture in Community Development Reflecting on Community Service Experiences and Personal Growth **Suggest Activities** **Community Cleanliness Drive:** Organize a cleanliness drive in the local community, involving students and residents in cleaning public spaces and creating awareness about cleanliness and waste management.	**BTL-5**

Health Awareness Camp: Conduct a health awareness camp where participants can provide basic health check-ups, distribute health-related information, and promote the importance of hygiene and sanitation. **Environmental Conservation Project:** Initiate an environmental conservation project, such as tree planting, creating green spaces, or implementing recycling programs, to raise awareness about environmental issues. **Teaching Assistance in Local Schools:** Collaborate with local schools to provide teaching assistance, conduct educational workshops, and help students with their studies. **Empowerment Workshops:** Organize workshops for women, youth, or other marginalized groups to empower them with skills and knowledge relevant to their needs, such as vocational training or financial literacy. **Cultural Exchange Program:** Arrange a cultural exchange event where NSS participants and local community members can share their traditions, dances, music, and food, fostering mutual understanding and appreciation. **Blood Donation Camp:** Partner with local healthcare institutions to organize a blood donation camp to address blood shortages and raise awareness about the importance of donating blood. **Community Survey and Needs Assessment:** Conduct a comprehensive community survey to understand the needs and priorities of the local residents, guiding the selection of future service projects. **Awareness Campaigns:** Create awareness campaigns on critical social issues like gender equality, education, or substance abuse through street plays, posters, and interactive sessions. **Disaster Preparedness Workshop:** Conduct workshops on disaster preparedness, including first aid training and emergency response, to equip the community with necessary skills.	

Senior Citizens' Engagement: Plan activities and events to engage and support senior citizens, such as organizing social gatherings or providing assistance with daily chores. **Digital Literacy Initiatives:** Set up digital literacy workshops to help community members, especially elders and underserved individuals, to learn basic computer and internet skills. **Community Sports Event:** Organize a community sports event to promote fitness, teamwork, and community bonding. **Skill Development Sessions:** Arrange skill development workshops in collaboration with local experts to teach practical skills like tailoring, painting, or handicrafts. **Awareness on Government Schemes:** Educate the community about various government schemes and programs that they may be eligible for, to ensure they can avail themselves of the benefits.	

REFERENCE BOOKS

1	National Service Scheme Manual, Government of India.
2	Orientation Courses for N.S.S. Programme officers, TISS.
3	Case material as Training Aid for field workers, Gurmeet Hans.
4	National Service Scheme Manual, Government of India.
5	Training Programme on National Programme scheme, TISS.
6	Social Problems in India, Ram Ahuja
7	Social service opportunities in Hospitals, Kapil K.Krishan,TISS.

SEMESTER II

COURSE TITLE	**DIFFERENTIAL EQUATIONS AND TRANSFORMS**			**CREDITS**	**4**	
COURSE CODE	**AIM02004**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-0-2-1**	
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	To impart knowledge on the method of solving Partial differential equations, and ordinary differential Equations using Laplace Transforms.					
Course Objective	This course includes the study of first order differential equations, higher order linear differential equations, Laplace transforms, numerical methods, boundary value and initial value problems, qualitative analysis of solutions, and applications of differential equations. 1. To study and solve first-order differential equations, equations of higher degree, Clairaut's equations, and simultaneous differential equations with constant coefficients. 2. To understand and solve second and higher-order differential equations with constant coefficients and Euler's homogeneous linear differential equations. 3. To learn the formation, solution techniques, and methods for solving first-order partial differential equations, including Lagrange's linear equations and direct integration.					

	4. To understand Laplace transforms, their properties, and inverse transforms, and apply them to solve first-order and second-order differential equations with constant coefficients. 5. To study Fourier transforms, including sine and cosine transforms, their properties, and applications such as the convolution theorem and Parseval's identity.
Course Outcome	Upon completion of this course, the students will be able to 1. Solve higher order linear differential equations. 2. Demonstrate the solution of higher order using Euler's homogeneous. 3. Demonstrate competency to solve linear PDE by Lagrange's method. 4. Analyze the concepts of Laplace transforms and inverse Laplace transforms. 5. Identify the inverse Laplace transform.
Prerequisites: Knowledge of Ordinary and Partial Derivatives	

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2	PSO3
CO1	1	1	3	-	-	-	-	1	-	-
CO2	1	1	3	-	-	-	-	1	-	-
CO3	1	1	3	-	-	-	-	1	-	-
CO4	1	1	3	-	2	-	-	3	-	-
CO5	1-	1	3	-	2	-	-	3	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE1: LINEAR FIRST ORDER DIFFERENTIAL EQUATION (9L+6P=12)

Ordinary Differential Equations: Equations of First Order and of Degree Higher than one –Solvable for p, x, y– Clairaut's Equation – Simultaneous Differential Equations with constant coefficients of the form (i) $f_1(D)x + g_1(D)y = \emptyset_1(t)$(ii) $f_2(D)x + g_2(D)y = \emptyset_2(t)$where f_1, g_1, f_2 and g_2 are rational functions D=d/dt with constant coefficients and $\emptyset_1$, $\emptyset_2$ explicit functions of t. **Self-Study:** Clairaut's Equation **LAB:** Solution of first order differential equations	**CO-1** **BTL-3**

MODULE 2: HIGHER ORDER LINEAR DIFFERENTIAL EQUATION	**(9L+6P=12)**
Finding the solution of Second and Higher Order with constant coefficients with Right Hand Side is of the form where V is a function of x – Euler's Homogeneous Linear Differential Equation. **LAB:** Solution of first second differential equations	**CO-2** **BTL-3**
MODULE 3: PARTIAL DIFFERENTIAL EQUATIONS	**(9L+6P=12)**
Partial Differential Equations: Formation of equations by eliminating arbitrary constants and arbitrary functions –Solutions of PDE – Solutions of Partial Differential Equations by direct integration – Methods to solve the first order PDE in the standard forms –Lagrange's Linear Equations. **Self-Study:** Solutions of Partial Differential Equations by direct integration **LAB:** Solution of Lagrange's and Standard PDE.	**CO-3** **BTL-3**
MODULE 4: LAPLACE TRANSFORMS	**(9L+6P=12)**
Laplace Transforms: Definition – Laplace Transforms of standard functions – Linearity property –First Shifting Theorem – Transform of $tf(t), \frac{f(t)}{t}, f'(t), f''(t)$, Inverse Laplace Transforms – Applications to solutions of First Order and Second Order Differential Equations with constant coefficients. **Self-Study:** First Shifting Theorem **Lab:** To find Laplace and Inverse Laplace of elementary function	**CO-4** **BTL-3**
MODULE 5: FOURIER TRANSFORMS	**(9L+6P=12)**
Fourier Integral Theorem (without proof) - Fourier transform pair - Sine and Cosine transforms - Properties - Transforms of Simple functions - Convolution theorem - Parseval's identity. **Lab:** To find Fourier Transform of elementary function	**CO-5** **BTL-3**

TEXT BOOKS	
1.	P. Kandasamy and K. Thilagavathi (2004), Mathematics *for B.Sc – Branch* – I *Volume*III , S. Chand and Company Ltd, New Delhi.
2.	Dr. J. K. Goyal and K.P. Gupta (2004), *Laplace and Fourier Transforms*, Pragati Prakashan Publishers, Meerut.
REFERENCE BOOKS	

1.	S. Narayanan and T. K. Manickavasagam Pillai (2009), *Calculus Vol III*, S. Viswanathan Printers and Publishers Pvt. Ltd, Chennai.
2.	N. P. Bali. (2004), *Differential Equations*, Laxmi Publication Ltd, New Delhi.

E BOOKS	
1.	https://www.math.hkust.edu.hk/~machas/differential-equations.pdf
2.	http://www.mmcmodinagar.ac.in/econtent/physics/DifferentialEquationsAndTheirApplications.pdf
MOOC	
1.	https://nptel.ac.in/courses/111105035/
2.	http://www.nptelvideos.in/2012/11/mathematics-iii.html
3.	https://www.digimat.in/nptel/courses/video/111108081/L02.html
4.	https://www.math.ust.hk/~machas/differential_equations.pdf.
5.	https://www.ijsr.net/archive/v2i1/ijsron2013331.pdf
6.	https://www.whitman.edu/mathematics/calculus_online/chapter17.html

COURSE TITLE	**REGRESSION TECHNIQUES AND TIME SERIES ANALYSIS USING R**			**CREDIT**	**4**	
COURSE CODE	**BMA01002**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-0-2-1**	
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**	
ASSESSMENT SCHEME						
First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**

			Committee "DEC			
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	Explore and visualize time series data and apply and interpret time series regression results.
Course Objective	1. To understand the basics of R programming. 2. To understand the basics of regression analysis and time series. 3. To apply various regression models using R. 4. To understand the time series components. 5. To learn and apply time series analysis techniques using R.
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the key techniques and theory behind data visualization. 2. Fit a simple linear regression model in R. 3. Construct the various multiple linear regression models. 4. Visualize and explore time series data using R. 5. Apply various methods to forecast time series data using the ARIMA model.
Prerequisites: 1**.** Basic knowledge of Statistics and Probability. 2. Basics in R programming.	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**-**	**3**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**-**	**3**	**-**	**-**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO R PROGRAMMING	**(9L+6P=12)**
Overview of R Programming: Operators - Printing Values,-Basic Data Types, Control Structures – Functions - Packages, Running R Code- Reading Data - Text Files- Identifying Data Types-Data Visualization**:** Basic Visualizations-Scatterplots- Visualizing Aggregate Values with Bar plots and Pie charts-Common Plotting Tasks - Exploratory Data Analysis: Summary Statistics - Dataset Size-Summarizing the Data Ordering Data by a Variable - Group and Split Data by a Variable - Box Plots -Skewness and Kurtosis. **Self Study:** Basic Visualizations. **Lab:** Scatterplots, Bar Plots, Pie chart, summarizing the Data Ordering Data by a Variable, Group and Split Data by a Variable, Box Plots, Skewness and Kurtosis.	**CO-1** **BTL-3**
MODULE 2: INTRODUCTION TO REGRESSION	**(9L+6P=12)**
Introduction to regression analysis - Type of regression models- Assumptions of regression analysis - Simple linear regression model - Estimation of regression coefficients - Computations using R-Interpretation of Results. **Self Study:** Regression. **Lab:** Regression- Simple linear equations, the scatter plot, coefficient of regression	**CO-2** **BTL-3**
MODULE 3: MULTIPLE LINEAR REGRESSION	**(9L+6P=12)**
Multiple linear regression model - Estimation of regression coefficients - Logistic regression model - Uses of Regression. **Self Study:** Multiple Regression. **Lab:** Logistic Regression using R, plot the ROC curve using roc( ) function from proc( )	**CO-3** **BTL-3**
MODULE 4: TIME SERIES ANALYSIS	**(9L+6P=12)**
Introduction to Time Series analysis - Type of time series data - Application of time series analysis - Simple Time Series Forecasting models (Simple moving average, exponential moving models). **Self Study:** Decomposition of Time Series Data, ARIMA and SARIMA Models for Time Series Forecasting. **Lab:** Plot the time series dataset using ggplot2, Decomposing time series into its trend, seasonal and residue components using decompose ( ) function	**CO-4** **BTL-3**
MODULE 5: TREND ANALYSIS - ARIMA MODEL	**(9L+6P=12)**
Introduction to trend Analysis- Linear trend analysis-Nonlinear trend Analysis (Polynomial, Exponential) - Introduction to ARIMA Model - ARIMA model estimation and forecasting	**CO-5** **BTL-3**

using R-Trend Analysis using R. **Self Study:** ARIMA Model Estimation and Forecasting in R, Trend Analysis Techniques in R. **Lab:** Linear trend analysis - Nonlinear trend Analysis, ARIMA model estimation and forecasting using R.	

TEXT BOOKS	
1.	Samprit Chatterjee and Ali S Hadi (2006), *Regression Analysis by Example*, Department of Health Policy Mount Sinai School of Medicine New York and Department of Mathematics, The American University in Cairo, Egypt.
2.	George E.P. Box Gwilym M. Jenkins and Gregory C Reinsel. (2016), *Time series Analysis: Forecasting and control*, Published by John Wily and Sons Hoboken, New Jersey.
3.	Manas A. Pathak (2014), *Beginning Data Science with R*, Springer Cham Heidelberg New York, Dordrecht London.
REFERENCE BOOKS	
1.	Michael H. Kutner, Christopher J. Nachtsheim, John Neter, William Li (2005), *Applied Linear Regression Models*, Published by McGraw-Hill! Irwin, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY.
2.	Roger D. Peng (2015), *R Programming for Data Science*, Leanpub book, China.
E BOOKS	
1.	Regression Analysis by National Institute of Standards and Technology
2.	Applied Linear Regression by Sanford Weisberg
3.	https://nbisweden.github.io/workshop-r/2011/slide_elements_1.pdf
4.	https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf
MOOC	
1.	https://www.coursera.org/learn/modern-regression-analysis-in-r
2.	https://www.datacamp.com/tracks/time-series-with-r

COURSE TITLE	PRINCIPLES OF DATA SCIENCE			CREDIT	4
COURSE CODE	BMA01003	COURSE CATEGORY	CC	L-T-P-S	3-1-0-1
Version	0.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	To expose the students to the theory of equations and series				
Course Objective	1. Introduce students to key data science principles, including data collection, cleaning, analysis, and interpretation. 2. Equip students with the ability to apply quantitative modeling and data analysis techniques to solve real-world problems. 3. Teach students how to curate, organize, and wrangle data effectively to prepare it for analysis. 4. Provide knowledge of statistical data analysis methods utilized in business decision-making. 5. Highlight the importance of ethical considerations in data science, such as data privacy, security, and the responsible use of data.				
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the fundamental concepts of data science. 2. Evaluate the data analysis techniques for applications handling large data and demonstrate the data science process. 3. Understand concept of machine learning used in the data science process. 4. Visualize and present the inference using various tools. 5. Learn to think through the ethics surrounding privacy, data sharing.				
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establish random variables.					

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**3**
CO2	**1**	**1**	**2**	**-**	**-**	**-**	**3**	**1**	**3**	**3**
CO3	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**3**
CO4	**1**	**1**	**2**	**-**	**2**	**-**	**-**	**1**	**3**	**3**
CO5	**1**	**1**	**2**	**-**	**2**	**-**	**2**	**1**	**3**	**3**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: DATA EVOLUTION	**(9L+3T=12)**
Data to Data Science – Understanding data: Introduction – Type of Data, Data -Evolution – Data Sources. Preparing and gathering data and knowledge - Philosophies of data science - data all around us: the virtual wilderness - Data wrangling: from capture to domestication - Data science in a big data world - Benefits and uses of data science and big data - facets of data. **Self-Study:** Understanding data, Data wrangling: from capture to domestication	**CO-1** **BTL-3**
MODULE 2: DIGITAL DATA-AN IMPRINT	**(9L+3T=12)**
Introduction to Big Data: - Evolution of Big Data - What is Big Data – Sources of Big Data. Characteristics of Big Data 6Vs – Big Data-Challenges of Conventional Systems- Data Processing Models – Limitation of Conventional Data Processing Approaches – Big Data. Big Data Exploration - The Big data Ecosystem and Data science. Overview of the data science process - retrieving data - Cleansing, integrating, and transforming data. **Self-Study:** Evolution of Big Data- Data Processing Models - Limitation of Conventional Data Processing Approaches.	**CO-2** **BTL-3**
MODULE 3: EXPLORATORY DATA ANALYSIS	**(9L+3T=12)**
Modelling Process – Training model – Validating model – Predicting new observations – Supervised learning, Unsupervised learning, Semi-supervised learning- Exploratory data analysis. **Self-Study:** Modelling Process, Semi-supervised learning. Exploratory data analysis.	**CO-3** **BTL-3**
MODULE 4: FIRST STEPS IN BIG DATA	**(9L+3T=12)**

Distributing data storage and processing with frameworks - Case study: Assessing risk when loaning money - Join the NoSQL movement - Introduction to NoSQL - Case Study. The rise of graph databases - Introducing connected data and graph databases. **Self-Study:** Distributing data storage and processing with frameworks, Introducing connected data and graph databases.	**CO-4** **BTL-3**
MODULE 5: ETHICS AND DATA SCIENCE	**(9L+3T=12)**
Doing Good Data Science-Data Ownership-The Five Cs-Implementing the Five Cs-Ethics and Security Training- Developing Guiding Principles-Building Ethics into a Data-Driven Culture- Regulation- Building Our Future- Case Study. **Self-Study:** Doing Good Data Science, Developing Guiding Principles	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Davy Cielen, Arno D. B. Meysman and Mohamed Ali, (2016), *Introducing Data Science*, International Publisher, South Korea.
2.	Brian Godsey, (2017), *Think Like a Data Scientist*, Manning Publications, Iran.
REFERENCE BOOKS	
1	Joel Grus, O'Reilly, (2015), *Data Science from Scratch: First Principles with Python*, Princton publisher, Turkey.
2.	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, (2013), An *Introduction to Statistical Learning: with Applications in R*, Springer Switzerland.
E BOOKS	
1	https://unidel.edu.ng/focelibrary/books/Principles%20of%20Data%20Science%20by%20Sinan%20Ozdemir%20(z-lib.org).pdf
2.	https://www.amazon.in/Principles-Data-Science-Sinan-Ozdemir/dp/1785887912
3.	https://www.oreilly.com/library/view/principles-of-data/9781789804546/
MOOC	

1.	https://cpe.iiitb.ac.in/courses/epgp-data-science?utm_source=GOOGLE&utm_medium=NBSEARCH&utm_campaign=IND_ACQ_WEB_GOOGLE_NBSEARCH_D
2.	https://www.harvardonline.harvard.edu/course/data-science-principles#:~:text=Data%20Science%20Principles%20is%20a,wrangling%2C%20privacy%2C%20and%20ethics.

COURSE TITLE	**DATA STRUCTURES AND ALGORITHMS**			**CREDIT**		**4**
COURSE CODE	**BDS01002**	**COURSE CATEGORY**	**CC**	**L-T-P-S**		**3-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**		**BTL-4**
ASSESSMENT SCHEME						
First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	This course provides an in-depth exploration of fundamental data structures and algorithms, emphasizing their design, implementation, and analysis. Students will gain proficiency in organizing and manipulating data efficiently, which is essential for solving complex computational problems.					
Course Objective	1. To understand the concepts of ADTs. 2. To design linear data structures – lists, stacks, and queues. 3. To understand sorting, searching, and hashing algorithms. 4. To apply Tree and Graph structures.					

Course Outcome	Upon completion of this course, the students will be able to 1. Explain abstract data types. 2. Design, implement, and analyze linear data structures, such as lists, queues, and stacks, according to the needs of different applications. 3. Design, implement, and analyze efficient tree structures to meet requirements such as searching, indexing, and sorting. 4. Model problems as graph problems and implement efficient graph algorithms to solve them.
Prerequisites: Basic Programming Knowledge, Discrete Mathematics	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**--**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**-**	**1**	**-**	**3**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**-**	**1**	**-**	**2**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: ABSTRACT DATA TYPES	**(9L+6P=12)**
Abstract Data Types (ADTs) – ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations – divide & conquer – recursion – analyzing recursive algorithms **Self-Study:** Algorithm Analysis and Recursion, Algorithm Design and Analysis **Lab:** 1. Implement simple ADTs as Python classes 2. Implement recursive algorithms in Python 3. Implement List ADT using Python arrays	**CO-1** **BTL-3**
MODULE 2: LINEAR STRUCTURES	**(9L+6P=12)**

List ADT – array-based implementations – linked list implementations – singly linked lists – circularly linked lists – doubly linked lists – Stack ADT – Queue ADT – double ended queues – applications**.** **Self-Study:** Linked List Implementations and Variants, Stack and Queue ADT Implementations and Applications. **Lab:** 1. Linked list implementations of List 2. Implementation of Stack and Queue ADTs 3. Applications of List, Stack and Queue ADTs	**CO-2** **BTL-3**
MODULE 3: SORTING AND SEARCHING	**(9L+6T=12)**
Bubble sort – selection sort – insertion sort – merge sort – quick sort – analysis of sorting algorithms – linear search – binary search – hashing – hash functions – collision handling – load factors, rehashing, and efficiency. **Self-Study:** Sorting Algorithms and Their Analysis, Searching and Hashing Techniques **Lab:** 1. Implementation of sorting and searching algorithms 2. Implementation of Hash tables 3. Tree representation and traversal algorithms	**CO-3** **BTL-3**
MODULE 4: TREE STRUCTURES	**(9L+6P=12)**
Tree ADT – Binary Tree ADT – tree traversals – binary search trees – AVL trees – heaps – multiway search trees. **Self-Study:** Tree Traversals and Binary Search Trees, Balanced Trees and Heaps **Lab:** 1. Implementation of Binary Search Trees 2. Implementation of Heaps 3. Implementation of minimum spanning tree algorithms	**CO-4** **BTL-3**
MODULE 5: GRAPH STRUCTURES	**(9L+6P=12)**
Graph ADT – representations of graph – graph traversals – DAG – topological ordering – greedy algorithms – dynamic programming – shortest paths – minimum spanning trees – introduction to complexity classes and intractability. **Self-Study:** Graph Algorithms and Representations, Greedy Algorithms, Dynamic Programming, and Complexity.	**CO-5** **BTL-3**

Lab: 1. Graph representation and Traversal algorithms 2. Implementation of single source shortest path algorithm	

TEXT BOOKS	
1.	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser (2021), *Data Structures & Algorithms in Python",* An Indian Adaptation, John Wiley & Sons Inc.
2.	Lee, Kent D., Hubbard, Steve (2015), *Data Structures and Algorithms with Python*" Springer Edition, Switzerland.
3.	Mark Allen Weiss (2014), *Data Structures and Algorithm Analysis in C++*, Fourth Edition, Pearson Education.
REFERENCE BOOKS	
1	Rance D. Necaise (2011), *Data Structures and Algorithms Using Python*, John Wiley & Sons.
2	Aho, Hopcroft, and Ullman (1983), *Data Structures and Algorithms*, Pearson Education.
3	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein (2002), *Introduction to Algorithms*, Second Edition, McGraw Hill,
E BOOKS	
1	https://algs4.cs.princeton.edu/home/?utm_source=chatgpt.com
2	https://open.umn.edu/opentextbooks/textbooks/1017?utm_source=chatgpt.com

MOOC	
1.	https://tira.mooc.fi/spring-2025/?utm_source=chatgpt.com
2.	https://www.coursera.org/courses?query=data+structures+and+algorithms&utm_source
3.	https://pe.gatech.edu/courses/data-structures-algorithms-i-arraylists-linkedlists-stacks-and-queues?utm_source=chatgpt.com

COURSE TITLE	PERSONALITY DEVELOPMENT AND SOFT SKILLS			CREDITS	2
COURSE CODE	GLS51002	COURSE CATEGORY	HS	L - T – P – S	2 – 0 – 1 – 1
Version 0.0	Approval Details			LEARNING LEVEL	BTL – 4

ASSESSMENT SCHEME

CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee "DEC"	Surprise Test / Quiz., as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical
15 %	15 %	10 %	5 %	5 %	25 %	25 %

Course Description	This course teaches the learners LSRW Skills which is needed in today's global workplace together with essential business vocabulary & grammar. It equips them to communicate effectively and at professional and social scenario which in turn makes them confident individuals. This course would help them to appear for Cambridge Certification and add value to their profile and validate their language proficiency.
Course Objective	1. To acquire self-confidence by which the learner can improve upon their informative listening skills by an enhanced acquisition of the English language. 2. To provide an environment to Speak in English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 3. To equip the students to Read, comprehend and answer questions based on literary, scientific and technological texts. 4. To enhance the writing skills of the students via training in instructions, recommendations, checklists, process-description, letter-writing and report writing.

	5. To equip the learners in analyzing and applying creative thinking skills and participate in brainstorming, mind-mapping, audiovisual activities and excel in employability skills.
Course Outcome	Upon completion of this course, the students will be able to 1.Demonstrate the ability to construct the grammatically correct sentences with accuracy and syntax structures. 2.Integrating various components of English Language and determining it through reading and listening. 3.Analyze and transcode data, construct different types of written essays, read complex passages and summarize ideas, create personal profiles in the form of a resume. 4.Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written business correspondence, and speaking in formal and informal situations. 5.Infer details about presentation skills and implementing it in various professional situations.
Prerequisites: Plus Two English-Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**-**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO2	**2**	**3**	**-**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO3	**2**	**3**	**-**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO4	**2**	**3**	**-**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO5	**2**	**3**	**-**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1 : ATTITUDE	**(6L)**
Grammar : 1. Countable and uncountable nouns 2. Asking questions 3. Expressing likes 4. Introducing reasons 4. Talking about large and small differences. 5. Expressing Results **Vocabulary:** 1. Recruitment Brochure: ability, certificate, course, etc., 2. Work, job, training course. 3. Job Responsibilities 4. Staff, Employee, member of Staff. 5. Phrases expressing enthusiasm 6. Adjective Forms **Writing :** 1. Report Writing – Staff Training Report 2. A Website entry 3. A short Email and an Email of a job application. **Reading :** Articles on Human Resources **Soft Skills and Employability Skills (LAB) : ATTITUDE :** The power of positive thinking – Positive self-talk – self-esteem and positive attitude who Am I ? Attitude in the workplace – Building a positive attitude – Testing your attitude – Adaptability	**CO-1** **BTL-2**
MODULE 2 : GOAL SETTING	**(6L)**
Grammar: 1. Infinitive or verb + ing, 2. Prepositions in phrases describing trends 3. Formal requests 4. First and Second conditionals. 5. Phrases followed by a Verb + ing. **Vocabulary:** 1. Word related to marketing (Launch, Play, Find out, Learn, Know, etc.,) 2. Revenue outcome 3. Adjective – noun collocations, 3. Last and latest **Writing:** 1. A marketing Report 2. Email giving information – making an enquiry – answering enquiries – correcting information – confirming terms 3 Memo Writing **Reading:** Articles on Marketing **Soft Skills and Employability Skills (LAB): GOAL SETTING:** What is goal ? - What are SMART goals? - How does SMART goal setting work? - Goals as commitment – Useful Guideline for goal setting – Trying personal and professional goals – Goals at the workplace – Cascading goals – Types of goals	**CO-2** **BTL-3**
MODULE 3 : TIME MANAGEMENT	**(6L)**
Grammar : 1. Prepositions in time phrases 2. Making recommendations 3. Phrases signaling parts of a presentation 4. Can and could **Vocabulary :** 1. Financial Terms 2. Rising finance 3. Noun Phrases connected with starting companies 4. Assets, collateral etc., **Writing :** Formal Letter : 1. A letter of enquiry 2. Proposal Writing	**CO-3** **BTL-3**

Reading : Articles on Entrepreneurship **Soft Skills and Employability Skills (LAB): TIME MANAGEMENT** : What is time management? Prioritization – Time stressors – Time stealers – Time management - Eisenhower Matrix– Strategies for effective time management – productivity pyramid – The four Ds of time management	
MODULE 4 : EMOTIONAL INTELLIGENCE	**(6L)**
Grammar : 1. Referencing 2. Using the Passives to express opinions and ideas. 3. Relative Clauses **Vocabulary :** 1. Collocations describing reasons for meetings, 2. Collocations with meeting 3. Crucial, priceless, etc., **Writing :** Arranging to travel; an email agreeing to a request and making suggestions – giving instructions – about a business trip – announcing a job opportunity. 2. A letter informing about a new service – complaint, **Reading :** Articles on Business abroad **Soft Skills and Employability Skills (LAB): EMOTIONAL INTELLIGENCE:** What is Emotional Intelligence? Enhancing your emotional self-awareness, - Emotional intelligence and change management – unfreezing the old, re-freezing the new – change and stress – emotional intelligence and crisis management.	**CO-4** **BTL-3**
MODULE 5 : LEADERSHIP	**(6L)**
Grammar : 1. Using the Definite Article 2. Expressing Causes 3. Reporting verbs and reported speech 4 Third Conditional (Imaginary) **Vocabulary :** 1. Verb – Noun collocations 2. Issues, impact, etc., 3. Way or method 4. Words and phrases expressing numbers. **Writing** : Mail arranging a meeting , introducing a company and asking for information – giving suggestions 2. A memo asking for suggestions 3. A proposal for out sourcing. **Reading :** Articles on Change in Business **Soft Skills and Employability Skills (LAB): LEADERSHIP :** Qualities of a leader – Leadership and assertiveness – problem –solving and decision-making – Approaches to problem – solving and decision-making – Brainstorming – Cause-and-effect analysis	**CO-5** **BTL-4**
TEXT BOOKS	

1	Brook-Hart, Guy (2019). Cambridge English Business Benchmark, Upper Intermediate. Cambridge University Press. India (Pages 208)
2.	Pillai, Sabina. Fernandez, Agna.(2018). Soft Skills and Employability Skills. Cambridge University Press. India. (Pages 208)
REFERENCE BOOKS	
1.	Murphy, Raymond (2019). Intermediate English Grammar. Cambridge University Press. India. (Pages 350)
2.	Barnes, D., (2020). Exploratory talk for learning in Mercer, N. and Hodgkinson, S. (eds) Exploring Talk in School. London: Sage Publications. (Pages 208)
3.	Dhanavel. S P (2018). English and Soft Skills. Orient BlackSwan. India. (Pages 136)
4.	Goldsmith, Marshall & M.S. Rao.(2020) Soft Skills: Enhancing Employability. Dreamtech Press. India (Pages 256)
E Books	
1	https://www.pdfdrive.com/basic-english-grammar-with-exercises-e12486779.html
2	http://dspace.vnbrims.org:13000/jspui/bitstream/123456789/4733/1/Leadership%20The%20Power%20of%20Emotional%20Intellegence.pdf
MOOC Courses	
1	https://www.edx.org/professional-certificate/ritx-communication-skills
2	https://www.coursera.org/specializations/people-and-soft-skills-for-professional-success

COURSE TITLE	**TAMIL**			**CREDITS**	**2**
COURSE CODE	**GLS51008**	**COURSE CATEGORY**	**HS**	**L - T – P – S**	**2 – 0 – 0 – 2**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL- 3**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	End Semester Examination ESE
15%	15%	10%	5%	5%	50%

Course Description	This Tamil course improves Tamil language skills of the students' Tamil letters and Grammar are included. This course provides an opportunity not only to get interest in learning Tamil Language but also they can learn to converse easily.
Course Objective	1. By studying this course, students will be able to write and speak Tamil easily in any situation, daily life and daily conversations. 2. Develops language and interest in learning in students. 3. Facilitates students to create opportunities for themselves in the society. 4. Students also learn Tamil literature by developing interest in language department. 5. This lesson plan helps the students to learn about the culture by learning the Tamil language.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the Letters and basic words of Tamil Language which are in daily use. 2. Develops the listening skills of Tamil language. 3. Utilize the letters and common words of the language for communication 4. Develop the conversational skills. 5.Demonstrate the skill of reading and writing.
Prerequisites: Plus Two -Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO2	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO3	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO4	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO5	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

அலகு - 1 **தமிழ் எழுத்துக்கள்**	**(6L)**
தமிழ் எழுத்துகள் – ஓசைகள் - எண்கள் – வண்ணங்கள் – வடிவங்கள் - ஓர் எழுத்துச் சொற்கள் - பழங்கள் மற்றும் காய்கறிகள் – மலர்கள் – இயற்கை - மாதங்கள் சொற்கள் -	**CO-1** **BTL-2**

பெயர்சொற்கள் – உரிச்சொற்கள் – வினைச்சொற்கள் – காலங்கள் - வாழ்த்துகள். வகுப்பறை செயல்முறைகள் : 1. வார்த்தைகளை வட்டமிடுதல். 2. விடுபட்ட எழுத்துகளை நிரப்புக. 3. வடிவங்களுக்கு வண்ணம் தீட்டுக.	
அலகு – 2 கேட்டல் மற்றும் உச்சரித்தல்	**(6L)**
உயிரெழுத்துகள், மெய்யெழுத்துகள் மற்றும் உயிர்மெய் எழுத்துகளை உச்சரித்தல் - சிறுகதைகள் வாசித்தல் – எதிர்ச்சொற்கள் - பொருள்தருக – வாக்கியத்தில் அமைத்து எழுதுதல் – ஒரு சொல்லில் விடையளித்தல். வகுப்பறை செயல்முறைகள் : 1. சொற்களைக் கேட்டு உச்சரிக்க செய்தல். 2. குழுவிவாதம் செய்தல். 3. கோடிட்ட இடங்களைச் சரியான சொற்களைக் கூறுதல்.	**CO-2** **BTL-2**
அலகு -3 எழுத்துப் பயிற்சி	**(6L)**
தமிழ் எழுத்துகளை எழுத கற்பித்தல் - உயிர் எழுத்துகள் - மெய் எழுத்துகள் - உயிர்மெய் எழுத்துகள் - ஆயுத எழுத்து – சார்பெழுத்துகள் – ஒற்றெழுத்துகள் - ஒரு சொல் - இருசொல் எழுதுதல் – ஒருவரி, இருவரி எழுதுதல். வகுப்பறை செயல்முறைகள்: 1. கோடிட்ட இடங்களை நிரப்புக. 2. சரியான எழுத்துகளை வட்டமிடுதல். 3. ஒருவரி சொற்களை எழுதுதல்.	**CO-3** **BTL-3**
அலகு - 4 உரையாடல்கள் கற்பித்தல்	**(6 L)**
சிறு உரையாடல்கள் கற்பித்தல் – வாழ்த்துக்கள் - வங்கியில் பணம் செலுத்துதல் - சந்தையில் கடைகாரரிடம் உரையாடுதல், பொது இடங்களில் உரையாடுதல். வகுப்பறை செயல்முறைகள்: 1. குறு நாடகங்கள் நடித்து உரையாடல்கள் கற்பித்தல். 2. விண்ணப்ப படிவங்கள் பூர்த்தி செய்தல். 3. மின்னல் அட்டைகள் காண்பித்தல்.	**CO-4** **BTL-2**
அலகு - 5 தமிழ் வாசிக்க மற்றும் எழுத கற்பித்தல்	**(6L)**
கடிதங்கள் வாசித்தல் மற்றும் எழுதுதல் – விண்ணப்ப கடிதம், வங்கிகணக்கு படிவங்கள், இரயில் முன்பதிவு விண்ணப்ப படிவம் பூர்த்திசெய்தல் – கவிதை வாசித்தல் – செய்திதாள் வாசித்தல். வகுப்பறை செயல் முறைகள்: 1. விண்ணப்ப படிவங்கள் பூர்த்திசெய்தல். 2. கவிதை வாசித்தல் போட்டிகள் 3. வகுப்பறை தேர்வுகள்	**CO-5** **BTL-3**
TEXT BOOK	

1.	Saidhai. P. Sundaramurthy (2018). Learn Tamil Through english. Manimekalai Prasuram. Chennai - 17.Pages 1 to 84
2.	Pulavar Kulanthai (2020). Students Basic Tamil. Manimekalai Prasuram. Chennai -17. Pages1 to 84
REFERENCE BOOKS	
1.	Lenatamilvanan. (2017). Easy Tamil Grammar. Manimekalai Prasuram, Chennai -17, Pages 11 to 21.
2.	Tamilnadu Board - NCERT/CBSE-Books Class – 6th TO 9th (2021-2022)
E-REFERENCES	
1.	https://cbsetamil.com/cbse-tamil-book/,https://tamil.examsdaily.in/tnpsc-tamil-ilakkanam-material-pdf-download

COURSE TITLE	**TELUGU**			**CREDITS**	**2**
COURSE CODE	**GLS51010**	**COURSE CATEGORY**	**HS**	**L - T – P – S**	**2 – 0 – 0 – 2**
Version	**0.0**	**Approval Details**		**BTL LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments / Project**	**Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"etc.,**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**

Course Description	This course has been designed to meet students' current and future language and communication needs. It attempts to develop their proficiency in the four language skills and knowledge of grammar and vocabulary. This course teaches students how to communicate accurately, appropriately and fluently in professional and social situations.
Course Objectives	1. This course is aimed to teach the basic Telugu language speaking skills. 2. It will introduce basic skills of the Telugu Language: its alphabets, essential words and simple sentence construction methods. 3. The course intends to facilitate students in acquiring foundational skills of reading, writing and speaking Telugu along with synonyms to expand vocabulary.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the basic skills of Letters and sounds in Telugu. 2. Develop the basic vocabulary for everyday's conversation. 3. Construct simple Telugu sentences with the simple words.

	4. Utilize the words that have conjunct character, and can learn functional, everyday conversation**.** 5. Construct Simple sentences for delivering appropriate meaning.
Prerequisites: Plus Two Telugu-Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO2	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO3	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO4	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
CO5	**-**	**3**	**1**	**2**	**-**	**3**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

భాగము 1 : వినడం, చెప్పడం మరియు రాయడం	**(6L)**
తెలుగు అచ్చులు & హల్లులు శబ్దాలు ధ్వనిచిత్రంతో పాటు తెలుగు హల్లుల సంయోగాల పరిచయం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్‌మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు	**CO-1** **BTL-2**

భాగము 2 : పేర్ల పదాలకు, సంఖ్యలకు, మరియు వాటి గుణాల పరిచయం	**(6L)**
తెలుగు నామవాచకం పరిచయం తెలుగు సర్వనామం & దాని విషయం సంఖ్యలు దాని పరిచయం & తెలుగు విశేషణాలు పరిచయం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్‌మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు	**CO-2** **BTL-3**
భాగము 3 : పదాలను విడదీసి వాక్యాలను రాయడం **(6L)**	
తెలుగు పూర్వ పదాలు – సంయోగాలు మరియు దాని ఉపయోగం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్‌మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు	**CO-3** **BTL-3**
భాగము 4 : పనులు, సమయం, క్రియ మరియు కాల వ్యవధుల పరిచయం	**(6L)**

వివిధ క్రియల యొక్క క్రియ & సమయం / కాల సంయోగాలనికి పరిచయం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్‌మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు	**CO-4** **BTL-3**
భాగము 5 : తెలుగు చదవడం, రాయడం మరియు ప్రశ్నించడం	**(6L)**
తెలుగులో సరళమైన వాక్యాలను రూపొందించడం (ప్రాథమిక వాక్య నిర్మాణ నియామాలు) తెలుగులో ప్రతీకూల వాక్యాలును రూపొందించడం తెలుగు బోధన అభ్యాస ప్రక్రియలో ప్రశ్నార్థకవాక్యాలువాక్యాలను రూపొందించడం సూచించబడిన : కార్య కలాపాలు చర్చలు : 5 గంటలు . అసైన్‌మెంట్లు / ప్రెజెంటేషన్ - 5 గంటలు	**CO-5** **BTL-3**

TEXT BOOK	
1.	Telugu Akademy. (2018). Sampradaya Telugu Vyakaranalu. Telugu Akademy. Vijayawada, Andhra Pradesh. India.
2.	Raghavendra. A. (2019). Telugu Vyakaranam. Prajasakti Book House. Tadepalli.
REFERENCE BOOKS	
1.	Ramarao, Chekuri. (2019). A Reference Grammar of Modern Telugu. Emesco Books. Hyderabad
2.	Vemuri, V. Rao. (2020). Learn Telugu with Its Grammar, Eco Foundation, Vijayawada.
E-References	
1	https://sarkarihelp.com/telugu-grammar-pdf-download/

COURSE TITLE	**HINDI**			**CREDITS**	**2**
COURSE CODE	**GLS51009**	**COURSE CATEGORY**	**HS**	**L - T – P – S**	**2 – 0 – 0 – 2**
VERSION	**0.0**	**APPROVAL DETAILS**		**BTL LEVEL**	**3**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC" etc.,**	**Attendance**	**End Semester Examination ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	This course has been designed to develop the regional language skills of the				

	students. The course includes Hindi language, literature, vocabulary and grammar. This course teaches students how to communicate accurately, appropriately and fluently in regional language.
Course Objective	1. To provide an environment to Speak and write in Hindi at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 2. To equip the students to Read, comprehend and answer questions based on literary texts. 3. To help student to become sensitive to the requirements of the society and respond to it in a constructive way. 4. To provide an environment to students to read and appreciate the literature.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the ability to write the grammatically correct sentences with accuracy. 2. Integrating various components of Hindi Language and determining it through reading and listening. 3. Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written correspondence, and speaking in formal and informal situations. 4. Infer details from after listening and reading and implement it in various professional situations. 5. Develop writing and speaking skills.
Prerequisites: Plus Two -Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO2	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO3	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO4	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO5	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

मॉड्यूल 1: **हिंदी पत्र और लिपि**	**(6 L)**
हिंदी स्वर और व्यंजन अक्षर - आश्रित स्वर सीखें - व्यंजन और व्यंजन समूह - अनुस्वर व्यंजन - संज्ञा - सर्वनाम - क्रिया (भविष्य) - संभावित विशेषण - काल - हिंदी के त्वरित नियम - अभिवादन - 2 अक्षर शब्द बनाना, 3 अक्षर शब्द - हर दिन शब्दावली - संख्याएं - रंग - परिवार - वस्त्र - बगीचा - घर - फल और सब्जियां - प्रकृति **सुझाई गई गतिविधियां:** देशी वक्ताओं द्वारा स्वर और व्यंजन का उच्चारण सुनना स्वर और व्यंजन के वीडियो, 2 अक्षर और 3 अक्षर के शब्द, और प्रतिदिन प्रयोगार्थ शब्दावली	**CO-1** **BTL-2**
मॉड्यूल 2: **सुनने का कौशल**	**(6 L)**
स्वर और व्यंजन का उच्चारण सुनना - लघु कथाएँ सुनना - साक्षात्कार - भाषण - सामाजिक मुद्दों पर पॉड वार्ता - निर्धारित पाठों को सुनना: इकाई 1 सभ्यता का रहस्य, इकाई 2 - युवावों से - वार्तालापों को सुनना - जानकारी सुनना - सम्मेलनों के भाषण **सुझाई गई गतिविधियां**: सुनें और चुनें उम्मीदवार पाठ को सुनते हैं और तीन विकल्पों के साथ बहुविकल्पीय प्रश्न का उत्तर देते हैं। उम्मीदवार टीवी चैनलों में बातचीत - साक्षात्कार- अतिथि व्याख्यान, सम्मेलनों और कार्यशालाओं के दौरान विशेषज्ञों के भाषण सुनते हैं	**CO-2** **BTL-3**
मॉड्यूल 3: बोलने का कौशल	**(6 L)**
औपचारिक संवाद - अनौपचारिक संवाद - लिंग रूपों के साथ बोलना - संख्या - काल - परिवार, शहर, त्योहारों, शौक आदि जैसे सामान्य विषयों पर बोलना - पसंद और नापसंद व्यक्त करना - ज़रूरतें और संपत्ति - भूमिका निभाना। **सुझाई गई गतिविधियां:** प्रस्तुति – कार्यक्रमों का संचालन - भाषण देना	**CO-3** **BTL-3**
मॉड्यूल- 4 : पढ़ने का कौशल	**(6 L)**
नमूना पढ़ना - नकल पढ़ना - अक्षरों और शब्दों का सही उच्चारण करना - पढ़ने में प्रवाह - कहानियाँ पढ़ना- संपादकीय, समाचारपत्र के लेख पढ़ना। **सुझाई गई गतिविधियां** फ्लैशकार्ड का उपयोग - चार्ट - चित्रों की पहचान करना - शब्दों को पढ़ना	**CO-4** **BTL-3**
मॉड्यूल-5 लेखन कौशल	**(6 L)**
सामान्य पत्राचार - पत्र लेखन: छुट्टी लेने पत्र, बैंक खाता खोलना, पुस्तकें मंगवाने के लिए पत्र, शिकायत पत्र - संकेत विकास - ज्ञापन - नोटिस **सुझाई गई गतिविधियां:** निर्धारित पाठ्यपुस्तक के अनुसार अभ्यास पूरा करना	**CO-5** **BTL-3**

पाठ्य पुस्तक

1.	Sashtri. S.R.(2019). Hindi Shikshak, Dakshina Bharat Hindi Prachar Sabha, Chennai (Pages 137)

संदर्भ पुस्तकें

1.	Prathamatic Patya Pushthak. (2022), Dakshina Bharath Hindi Prachar Sabha, Chennai. (Pages 168)
2.	Madhyama Patya Pushthak. (2022) Dakshina Bharath Hindi prachar Sabha, Chennai (Pages 184)

ई-संदर्भ	
1.	https://www.hindipod101.com/

COURSE TITLE	OUTREACH(NSS) LEVEL 2			CREDITS	1
COURSE CODE	GGE51404	COURSE CATEGORY	HS	L-T-P-S	0-0-2-0
Version	0.0	Approval Details		LEARNING LEVEL	BTL-5

ASSESSMENT SCHEME					
CIA					ESE
Volunteering	Events attended	Awareness Programs attended	Special Camp attended	Attendance	Report Submission
5	20	10	10	5%	50

Course Description	This course builds upon the knowledge and experiences gained in Semester 1 and further deepens students' engagement in community service, social development, and leadership. The course emphasizes long-term community development, advocacy for social change, and interdisciplinary collaborations. Through advanced projects and experiential learning, students will develop a deeper understanding of social issues and explore innovative solutions to address them. Pre requisite: Completion of NSS Semester 1 or equivalent community service experience is required to enroll in the NSS Semester 2 course. Students should demonstrate a commitment to community service, leadership potential, and a passion for making a positive impact on society.
Course Objective	1. To apply the concepts learned in Semester 1 to design and execute long-term community development projects that address specific community needs and contribute to sustainable social change. 2. To explore the importance of advocacy and policy awareness in effecting meaningful social change, equipping students with the skills to engage in advocacy efforts for the benefit of the community. 3. To develop advanced leadership skills, including effective project management and community empowerment techniques, enabling students to lead and guide successful community service initiatives.

	4. To promote interdisciplinary collaborations among students to tackle complex community challenges, fostering innovative and comprehensive solutions through the integration of diverse perspectives. 5. To empower students to become active advocates for social issues and promote inclusivity in community development, recognizing the importance of engaging diverse community members in decision-making processes.
Course Outcome	1. Students will demonstrate an advanced understanding of community development principles and apply them to design and implement sustainable, long-term community development projects. 2. Participants will exhibit effective advocacy skills and successfully raise awareness about social issues, mobilizing community support for positive social change. 3. Through interdisciplinary collaborations, students will showcase their ability to work effectively with peers from different academic backgrounds, fostering innovative and comprehensive solutions to complex community challenges. 4. Participants will develop entrepreneurial and creative problem-solving skills, utilizing social entrepreneurship principles to address community needs and promote sustainable development. 5. By the end of Semester 2, students will have acquired advanced leadership qualities and actively demonstrated their commitment to long-term community development and social advocacy, making a significant positive impact on the community.

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	3	-	3	-	2	2	-	-	-
CO2	1	3	-	3	-	2	2	-	-	-
CO3	1	3	-	3	-	2	2	-	-	-
CO4	1	3	-	3	-	2	2	-	-	-
CO5	1	3	-	3	-	2	2	-	-	-

TOPICS TO BE COVERED	
1. Long-term Community Development: Planning and Implementing Sustainable Projects 2. Advocacy and Policy Awareness for Social Change 3. Advanced Leadership and Project Management 4. Interdisciplinary Collaborations for Complex Challenges 5. Inclusivity and Empowerment in Community Development 6. Technology Integration and Digital Literacy for Community Service 7. Disaster Preparedness and Relief Services 8. Impact Assessment and Measuring Project Effectiveness 9. Social Entrepreneurship and Innovation in Community Development 10. Culmination and Reflection on NSS Journey Suggested Activities. 1. **Long-term Community Development Project:** Plan and execute a sustainable, long-term community development project focusing on a specific issue identified during Semester 1. This could include initiatives like setting up a library, vocational training centre, or sustainable agriculture project. 2. **Advocacy and Awareness Campaigns:** Organize advocacy campaigns to raise awareness about social issues and promote community support for change. Use various platforms such as social media, public events, and workshops to reach a broader audience. 3. **Interdisciplinary Collaborations:** Collaborate with students from different academic disciplines to address complex challenges in the community. For example, engineers, social scientists, and artists can work together to design innovative solutions. 4. **Digital Empowerment Initiatives:** Implement digital empowerment projects to bridge the digital divide in the community. This could involve providing computer literacy training, setting up community computer centers, or promoting e-governance initiatives. 5. **Cultural Heritage Preservation:** Undertake projects to preserve and promote the cultural heritage of the community. This could include	**BTL-5**

documenting local traditions, organizing cultural festivals, or restoring historical landmarks.

6. **Community Health and Wellness Programs:** Conduct health and wellness programs focusing on preventive healthcare, nutrition, mental health, and promoting healthy lifestyles within the community.
7. **Social Entrepreneurship Ventures:** Encourage students to develop social entrepreneurship ventures that address specific community needs while promoting sustainable practices and self-reliance.
8. **Disaster Preparedness and Response Plan:** Develop and implement a comprehensive disaster preparedness plan in collaboration with local authorities, focusing on building community resilience and response capabilities.
9. **Impact Assessment and Feedback Mechanisms:** Evaluate the impact of previous community service projects from Semester 1 and collect feedback from the community to improve future initiatives.
10. **Inclusivity and Diversity Workshops:** Organize workshops and events that celebrate diversity, promote inclusivity, and address issues of discrimination and social exclusion.
11. **Community-Based Research:** Undertake research projects focused on identifying root causes of social issues and propose evidence-based solutions for community development.
12. **Sustainable Tourism Initiatives:** Develop sustainable tourism initiatives that benefit the community economically while preserving their cultural and natural heritage.
13. **Youth Empowerment and Leadership Workshops:** Conduct workshops to empower youth in the community with leadership skills and personal development training.

14. **Water Resource Management Projects:** Implement projects to conserve and manage water resources effectively, including rainwater harvesting and watershed management. 15. **Women's Empowerment Programs:** Create programs and workshops that focus on empowering women in the community through skill development, self-defense training, and awareness sessions on gender equality.	

REFERENCE BOOKS

1.	National Service Scheme Manual, Government of India.
2.	Orientation Courses for N.S.S. Programme officers, TISS.
3.	Case material as Training Aid for field workers, Gurmeet Hans.
4.	National Service Scheme Manual, Government of India.
5.	Training Programme on National Programme scheme, TISS.
6.	Social Problems in India, Ram Ahuja
7.	Social service opportunities in Hospitals, Kapil K. Krishan, TISS.

SEMESTER III

COURSE TITLE	**COMBINATORIAL ANALYSIS**			**CREDIT**	**4**
COURSE CODE	**BMA01004**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	Combinatorial problems and methods for their solution. Enumeration, generating functions, recurrence relations, construction of bijections.				
Course Objective	1. To study groups and its properties with an illustration. 2. To identify another counting principle theorem. 3. To identify the relations of graphs. 4. To evaluate the algorithms of recurrence relations. 5. To understand the bipartite graphs, Eulerian and Hamiltonian Graphs, Graph Connectivity.				
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the principle of duality theorems. 2. Apply Euler's phi-function. 3. Classify the types of relations. 4. Solve linear recurrence relations. 5. Compute the Bipartite Graphs, Eulerian and Hamiltonian Graphs, Graph Connectivity.				
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establishing random variables.					

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**3**	**-**	**-**
CO4	**1**	**1**	**2**	**-**	**1**	**-**	**-**	**3**	**-**	**-**
CO5	**1**	**1**	**2**	**-**	**1**	**-**	**-**	**3**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO GROUP	**(9L+3T=12)**
Binary operations, group, semi group, monoid, abelian group, subgroup (simple theorems without proof) , Boolean algebra-definition-principle of duality-theorems. **Self Study:** Groups with examples.	**CO-1** **BTL-3**
MODULE 2: BASIC COUNTING PRINCIPLES	**(9L+3T=12)**
Basic Counting Principles, Generating Functions, Euler's phi-function and its Application to Cryptography. **Self Study:** Application to Cryptography.	**CO-2** **BTL-3**
MODULE 3: RELATIONS OF GRAPHS	**(9L+3T=12)**
Relations and their properties – relation matrix, graph of a relation – types of relations -equivalence relation – n-array relations. **Self Study:** Relations and their properties.	**CO-3** **BTL-3**
MODULE 4: SOLVING LINEAR RECURRENCE RELATIONS	**(9L+3T=12)**
Advanced Counting Techniques: Recurrence Relations, Solving Linear Recurrence relations, Divide and Conquer Algorithms and Recurrence relations, Generating Functions, Inclusion Exclusion principles and their applications. **Self Study:** Inclusion Exclusion principles and their applications.	**CO-4** **BTL-3**
MODULE 5: INTRODUCTION TO GRAPH THEORY	**(9L+3T=12)**
Introduction to Graph Theory: Graphs, Bipartite Graphs, Eulerian and Hamiltonian Graphs, Graph Connectivity. **Self Study:** Eulerian and Hamiltonian Graphs	**CO-5** **BTL-3**
TEXT BOOKS	

1.	Kenneth H. Rosen (2012), *Discrete Mathematics and Its Applications*, 7th Edition, McGraw Hill, USA.
2.	Veerarajan, T. (2006). *Discrete Mathematics*. Tata McGraw-Hill Education, India.
REFERENCE BOOKS	
1	R. P. Grimaldi (2007), *Discrete and Combinatorial Mathematics*, Pearson Education, Fifth Edition.
2.	Thomas Koshy (2005), *Discrete Mathematics with Applications*, Academic Press,Italy.
E BOOKS	
1	https://newsite.kashanu.ac.ir/Files/IntroductoryCombinatorics.pdf
2.	https://ac.cs.princeton.edu/home/AC.pdf

MOOC	
1.	https://www.mooc-list.com/tags/combinatorics#google_vignette
2.	https://www.my-mooc.com/en/mooc/ac
3.	https://onlinecourses.nptel.ac.in/noc21_ma68/preview

COURSE TITLE	**DATABASE MANAGEMENT SYSTEMS**			**CREDIT**	**4**
COURSE CODE	**BDS01003**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	To expose the students to the theory of equations and series.				

Course Objective	1. Introduce students to the fundamental concepts of database systems, including data models, database design, and the role of Database Management Systems 2. Examine various types of data models, such as conceptual, logical, and physical models, and understand their roles in database design and implementation. 3. Develop proficiency in creating ER diagrams to visually represent data entities, their attributes, and relationships, serving as a blueprint for database structure. 4. Demonstrate how the theoretical constructs of relational algebra and calculus form the basis for practical query languages like SQL, enhancing students' ability to write efficient and effective database queries. 5. Explore different isolation levels (e.g., read uncommitted, read committed, repeatable read, serializable) and their trade-offs between data consistency and system performance
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the core principles of database systems, including data models, schemas, and architectures. 2. Develop entity-relationship (ER) diagrams to represent data requirements and transform them into relational schemas. 3. Utilize normalization methods to refine database designs, ensuring minimal redundancy and enhanced data integrity. 4. Grasp the concepts of transactions, including ACID properties, and implement transaction management to maintain database consistency. 5. Apply concurrency control techniques to manage simultaneous data access, ensuring data consistency and isolation.

Prerequisites: Knowledge of collection to editing of primary data, secondary data and establishing random variables.

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	--	1	2	2
CO2	1	1	-	-	-	-	-	1	2	2
CO3	1	1	3	2	2	-	-	1	2	2
CO4	1	1	3	2	2	-	-	1	2	2

CO5	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO DATABASE AND TRANSACTIONS	**(9L+3T=12)**
Basics of database system- purpose of database system-view of data-relational Databases-database architecture-transaction management. **Self-Study:** Database architecture-transaction management.	**CO-1** **BTL-3**
MODULE 2: DATA MODELS	**(9L+3T=12)**
The importance of data models- Basic building blocks- Business rules-The evolution of data models- Degrees of data abstraction. **Self-Study:** The importance of data models, Degrees of data abstraction.	**CO-2** **BTL-3**
MODULE 3: DATABASE DESIGN, ER-DIAGRAM AND UNIFIED MODELING LANGUAGE	**(9L+3T=12)**
Database design and ER Model: overview-ER-Model, Constraints- ER-Diagrams, ERD Issues, weak entity sets-Codd's rules, Relational Schemas-Introduction to UML Relational database model: Logical view of data-keys-integrity rules-Relational Database design: features of good relational database design-atomic domain and Normalization (1NF, 2NF, 3NF, BCNF). **Self-Study:** Relational Schemas, Introduction to UML Relational database model.	**CO-3** **BTL-3**
MODULE 4: RELATIONAL DATABASES	**(9L+3T=12)**
Purpose of Database System – Views of data – Data Models – Database System Architecture –Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL. **Self-Study:** Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	**CO-4** **BTL-3**
MODULE 5: TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL	**(9L+3T=12)**
Transaction management: ACID properties- serializability and concurrency control- Lock based concurrency control (2PL, Deadlocks)- Time stamping methods- optimistic methods-database recovery management. **Self-Study:** ACID properties, serializability and concurrency control, Lock based	**CO-5** **BTL-3**

concurrency control.	
TEXT BOOKS	
1.	A Silberschatz, H Korth, S Sudarshan, (2013), *Database System and Concepts*, fifth Edition McGraw-Hill, Cengage Learning.
2.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan (2020), *Database System Concepts*, Seventh Edition, McGraw Hill.
REFERENCE BOOKS	
1.	Ramez Elmasri, Shamkant B. Navathe (2017*), Fundamentals of Database Systems*, Seventh Edition, Pearson Education, Turkey.
2.	C.J. Date, A. Kannan, Swaminathan (2006), *An Introduction to Database Systems*, Eighth Edition, Pearson Education, Boston, MA, USA.
E BOOKS	
1	https://www.springer.com/in/
2.	https://ocw.mit.edu/
3.	https://www.coursera.org/
MOOC	
1.	https://www.coursera.org/learn/databases
2.	https://www.khanacademy.org/computing/computer-programming/sql

COURSE TITLE	**PRINCIPLES OF ARTIFICIAL INTELLIGENCE**			**CREDIT**	**4**
COURSE CODE	**BMA01005**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course	The course describes a variety of models such as search, logic, Bayes nets, and				

Description	MDPs, which can be used to model a new problem.
Course Objective	1. To observe the concept of Artificial Intelligence and characteristics of Intelligent agents. 2. To identify the knowledge representation and automated planning. 3. To understand the basic concepts of Machine learning & AI Applications 4. To understand the Python Programming Language. 5. To establish the performance of Built-in List functions and methods.
Course Outcome	Upon completion of this course, the students will be able to 1. Formulate the concept of Problem-Solving Approach to Typical AI problems. 2. Identify probabilistic reasoning. 3. Identify the measures of Machine learning basics, Natural Language Processing, Speech Recognition. 4. Differentiate Operator and Operands. 5. Classify the different types of Operators.
Prerequisites: Linear Regression, Gradient Descent, Logistic Regression, K-means Clustering, Random Forest.	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**1**	**-**	**2**	**2**	**2**	**1**	**2**	**2**
CO4	**1**	**1**	**1**	**-**	**-**	**-**	**2**	**1**	**2**	**2**
CO5	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: BASICS IN ARTIFICIAL INTELLIGENCE	**(9L+3T=12)**
Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents –Problem Solving Approach to Typical AI problems. Problem solving by Searching: Uninformed and informed strategies and implementation; Path planning; Constraint Satisfaction Problems (CSP).	**CO-1 BTL-3**

Self Study: Future of Artificial Intelligence, Solving Approach to Typical AI problems	
MODULE 2: KNOWLEDGE REPRESENTATION	**(9L+3T=12)**
Logical Agents– Propositional and first order Predicate logic-–inference– Knowledge representation and Automated Planning– Uncertain Knowledge and Reasoning: Quantifying uncertainty– probabilistic reasoning. **Self Study:** Propositional and first order Predicate logic, Uncertain Knowledge and Reasoning: Quantifying uncertainty.	**CO-2** **BTL-3**
MODULE 3: APPLICATIONS OF ARTIFICIAL INTELLIGENCE	**(9L+3T=12)**
Machine learning basics - Learning from examples - forms of learning (supervised, unsupervised, reinforcement learning) -simple models (linear & logistic regression) - Deep Learning AI applications: Natural Language Processing - Language Models – Machine Translation; Speech Recognition; Computer Vision - Image classification. **Self Study:** Machine learning basics, Natural Language Processing, Speech Recognition.	**CO-3** **BTL-3**
MODULE 4: FIRST ORDER LOGIC	**(9L+3T=12)**
Inference in first order logic-Propositional vs. first order inference-Unification & lifts forward chaining-Backward chaining-Resolution-Learning from observation Inductive learning,Decision Trees-Explanation Based Learning-Statistical Learning methods-Reinforcement Learning. **Self Study:** Inference in first order logic, propositional vs. first order inference, unification.	**CO-4** **BTL-3**
MODULE 5: EXPERT SYSTEMS	**(9L+3T=12)**
Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty. **Self Study:** Function Calls, Type Conversion Functions, Math Functions, Values and Accessing Elements, Lists are mutable, traversing a List.	**CO-5** **BTL-3**
TEXT BOOKS	

1.	S. Russell and P. Norvig (1995), *Artificial Intelligence: A Modern Approach*, Prentice Hall, USA.
2.	M. Tim Jones (2008), *Artificial Intelligence: A Systems Approach (Computer Science)*, Jones and Bartlett Publishers, Inc.; 1st Edition, USA.
3.	Nils J. Nilsson (2009), *The Quest for Artificial Intelligence*, Cambridge University Press, UK.
REFERENCE BOOKS	
1	Burkhard A. Meier (2017), *Python GUI Programming Cookbook*, 2nd Edition, Packt Publishing, UK.
2.	Barry, P. (2016), *Head First Python: A Brain-Friendly Guide*, O'Reilly Media, Inc., USA.
3.	Lutz, M. (2013). *Learning Python: Powerful Object-Oriented Programming*. O'Reilly Media, Inc., USA.
E BOOKS	
1	https://vtda.org/books/Computing/Programming/IntroductionToArtificialIntelligence2ndEd_PhilipCJacksonJr.pdf
2.	https://cdn-dynmedia-1.microsoft.com/is/content/microsoftcorp/microsoft/final/en-us/microsoft-brand/documents/2024-wttc-introduction-to-ai.pdf
3.	https://www.gprec.ac.in/ECS%20Materials/Introduction%20to%20Artificial%20Intelligence(vsuresh).pdf
4.	https://acs.dypvp.edu.in/NAAC/AI.pdf

MOOC	
1.	https://www.my-mooc.com/en/categorie/artificial-intelligence
2.	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3.	https://www.my-mooc.com/en/mooc/a-free-online-introduction-to-artificial-intelligence-for-non-experts

COURSE TITLE		FRENCH			CREDITS	2
COURSE CODE		GLS51011	COURSE CATEGORY	HS	L - T – P - S	2 – 0 – 0 - 2
Version	0.0	Approval Details		LEARNING LEVEL		BTL – 3

ASSESSMENT SCHEME					
CIA					End Semester Examination (ESE) Theory
First Periodical Assessment	Second Periodical Assessment	Weekly assignment/ lab record and viva as approved by the Department Examination Committee "DEC"	Surprise Test / Quiz., as approved by the Department Examination Committee "DEC"	Attendance	
15 %	15 %	10 %	5 %	5 %	50%

Course Description	Introduces students to the culture and language of the French-speaking world. Students develop an ability to communicate in real-life situations by acquiring reading, writing, listening, and speaking skills. The elementary courses prepare students to communicate successfully in some common basic social situations using the four language skills—listening, speaking, reading, and writing—within appropriate cultural contexts. The student will also acquire an understanding of cross-cultural awareness.
Course Objective	1. To discover basic elements of the language, such as the different phonemes, the alphabet and its pronunciation 2. To discover the foundation of the language such as conjugations, auxiliaries, numbers, etc. 3. To learn how to form simple sentences about personal topics such as one's family 4.To start interacting with others by asking and answering simple questions 5. Understand your learning style and be able to check your own progress.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate advanced proficiency in spoken and written French. 2. Demonstrate the ability to read critically, interpret analytically, speak persuasively, and write coherently about visual and literary texts produced in the French-speaking

	world. 3. Demonstrate familiarity with methodological approaches in the study of literary and cultural texts, such as close reading, socio-historical contextualization, and literary and cultural theory. 4. Demonstrate knowledge of literary and cultural traditions, such as major movements, writers, and works of the French-speaking world, focusing on at least one and ideally multiple traditions: European, African, Caribbean, Asian, North American, and other Francophone cultures. 5. Demonstrate the skills necessary for scholarly research and writing in the Humanities.
Prerequisites: Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO2	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO3	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO4	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
CO5	-	**3**	**1**	**2**	-	**3**	**3**	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE – 1: INTRODUCTION FRANÇAISE	**(6L)**
1.1 Introduction au cours de français - 1hr 1.2 La France et ses clichés - 2hr 1.3 Première rencontre (saluer, prendre congé, parler de son humeur) - 1hr 1.4 Qui es-tu? (se présenter, les chiffres 1-20, *être* et *avoir*) - 2hrs 1.5 Activité fiche d'identité	**CO-1** **BTL-2**
MODULE – 2: LE MONDE QUI M'ENTOURE	**(6L)**
2.1 Quel temps fait-il? (la météo, les chiffres 20-49) - 1hr 2.2 Mes couleurs préférées (la possession, le genre des articles) - 2hrs 2.3 Introduction à la Révolution Française - 2hrs 2.4 Me repérer dans le temps 1: la date (mois, jours, années) - 2hr 2.5 Me repérer dans le temps 2: l'heure (chiffres 49-60) - 2hrs	**CO-2** **BTL-3**

MODULE – 3: MES GOÛTS	**(6L)**
3.1 La nourriture en France - 2hrs 3.2 Exprimer ses goûts (verbes du 1er groupe, négation verbale) - 2hrs 3.3 Manger et boire en France - 1hr 3.4 Ma famille extraordinaire - 2hrs 3.5 Activité "qui est qui?" - 2hrs	**CO-3** **BTL-3**
MODULE – 4: MON QUARTIER EST UN MONDE	**(6L)**
4.1 Mon quartier idéal (lieux de la ville, prépositions de lieu, *habiter* et *vivre*) - 2hrs 4.2 C'est par où? (verbe *aller*, les directions, l'impératif, donner des indications) - 2hrs 4.3 Activité "où vont-ils?" trouver l'itinéraire - 1hr 4.4 On y va comment? (les transports, *conduire* et *prendre*, la préposition en/à) - 2hr 4.5 Montmartre, un quartier pas comme les autres. 2hrs	**CO-4** **BTL-3**
MODULE – 5: JOUR APRES JOUR	**(6L)**
5.1 Une journée ordinaire (verbes pronominaux, routine, emploi du temps) - 2hrs 5.2 Mes petites habitudes (la fréquence définie et indéfinie) - 1hr 5.3 Une carte postale de vacances - 2hrs 5.4 La provenance et la destination (prépositions in, from, to, le genre des pays) - 1hr 5.5 Mes vacances idéales (adjectifs démonstratifs) -2hr	**CO-5** **BTL-4**

TEXT BOOKS	
1	*1.Alter Ego 1 Cahier d'Activités*, Annie BERTHET & Co, Hachette 2006 *2. Version Originale Cahier d'Exercices*, Monique DENYER & Co, ED. Maison des Langues, 2011
REFERENCE BOOKS	
1.	*Alter Ego 1*
2.	*Version Originale 1*
E Books	
1.	1. www.lepointdufle.net 2. https://www.podcastfrancaisfacile.com/ 3. https://didierfle.com/ 4. https://lebaobabbleu.com/ 5. https://leszexpertsfle.com/ 6. https://www.ressourcesfle.fr/ 7. https://lecafedufle.fr/

<table>
<tr><td colspan="2">COURSE TITLE</td><td colspan="4">GERMAN</td><td>CREDITS</td><td>2</td></tr>
<tr><td colspan="2">COURSE CODE</td><td>GLS51012</td><td>COURSE CATEGORY</td><td>HS</td><td>L - T – P - S</td><td colspan="2">2 – 0 – 0 - 2</td></tr>
<tr><td>Version</td><td>0.0</td><td>Approval Details</td><td colspan="3"></td><td>LEARNING LEVEL</td><td>BTL – 3</td></tr>
<tr><td colspan="8">ASSESSMENT SCHEME</td></tr>
<tr><td colspan="5">CIA</td><td rowspan="2" colspan="3">End Semester Examination (ESE) Theory</td></tr>
<tr><td>First Periodical Assessment</td><td>Second Periodical Assessment</td><td>Weekly assignment/ lab record and viva as approved by the Department Examination Committee “DEC”</td><td>Surprise Test / Quiz., as approved by the Department Examination Committee “DEC”</td><td>Attendance</td></tr>
<tr><td>15 %</td><td>15 %</td><td>10 %</td><td>5 %</td><td>5 %</td><td colspan="3">50%</td></tr>
<tr><td>Course Description</td><td colspan="7">The students shall understand the basic German Language concepts and cultural difference. They can manage to understand and communicate in German when they travel to Germany.</td></tr>
<tr><td>Course Objective</td><td colspan="7">1) To equip the students with a basic daily communication in German.
2) To enable the students to learn the spoken German required to communicate with native speakers
3) To help the students to understand the 4 different modules (Horen, Schreiben, Sprechen and Lesen) which is required to clear the A1 first level international certificate exam.
4) The understand the concepts which is required for pursuing their PG or Job in Germany.</td></tr>
<tr><td>Course Outcome</td><td colspan="7">Upon completion of this course, the students will be able to
1. Recall and recognize the facts and use familiar, everyday expressions, create</td></tr>
</table>

	very simple sentences, which relate to the satisfying of concrete needs. 2. Build a knowledge on understanding the texts and trying to communicate in a simple manner provided the person they are speaking to speaks slowly and clearly and is willing to help. 3. Apply and recalling the basic German Vocabulary, Verb conjugations with pronouns, expressions and connecting the learned facts to communicate in simple German sentences 4. Applying the above learned facts and trying to create own sentences, E-mails etc. as per the basic level achieved 5. Analyzing the native speaker and apply the knowledge (at basic level) in writing and speaking parts.
Prerequisites: Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	-	3	3	-	-	-
CO2	-	3	1	2	-	3	3	-	-	-
CO3	-	3	1	2	-	3	3	-	-	-
CO4	-	3	1	2	-	3	3	-	-	-
CO5	-	3	1	2	-	3	3	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: SUPER	**(6L)**
Jemanden vorstellen - Eine Hitliste internationaler Wörter schreiben - Nach dem Namen und der Herkunft fragen - Eine kursliste schreiben **Grammatik:** regelmäßge verben – möchten,sprechen,sein - Personalpronomen – ich,du,er,sie. - Definiter Artikel im nominative der,die,das - W -Rragen, Ja/Nein Fragen - Präpositionen – aus, in	**CO-1** **BTL-2**
MODULE 2 : MENSCHEN	**(6L)**
Jemanden nach dem Befinden fragen - Sich verabschieden - **Interview:** Informationen über die Familie erfragen und darüber berichten - Über seine Freunde und die Freunde anderer schreiben und sprechen	**CO-2** **BTL-3**

Grammatik: Indefiniter Artikel – ein/eine - Negativartikel – kein/keine... Possessiveartikel – mein,dein,sein..	
MODULE 3 : ESSEN UND TRINKEN	**(6L)**
Lebensmittel vergliechen - Lieblingfarbe und Lebensmittel zuordnen - Umfrage: mein Lieblingsfrühstück - Eine Einkaufsliste für ein Lieblingsessen schreiben **Grammatik:** Verb Konjugation – sein,haben - Imperative! Verbposition im Satz - W -Rragen, Ja/Nein Fragen	**CO-3** **BTL-3**
MODULE 4 : MEIN LEBEN	**(6L)**
Sich über Leben, Beruf, Herkunft, etc..austauschen - Eine Visitenkarte schreiben **Interview:** sich über den Tagensablauf austauchen - Die zahlen bis 100 **Grammatik:** Trennbaren verbena - "man" und "negation nicht" benutzen - Akkusativ(definite/indefinite/negative Artikel) - Präpositionen – um, als, für,bei	**CO-4** **BTL-3**
MODULE 5 : FREIZEIT	**(6L)**
Ein kursposter mit Hobbys schreiben - Welche Hobbys habe ich,welche nicht - Notieren und sprechen – Was man selbst und die Familie am - Wochenende gerne macht- Über seinen Sonntag schreiben **Grammatik:** Modalverben - Präpositionen – in,am	**CO-5** **BTL-4**

TEXT BOOKS	
1	Rolf Bruseke , Starten Wir! (A1) ,Hueber Verlag,2018
REFERENCE BOOKS	
1.	Stefanie Dengler, "Netzwerk neu A1.1 [Kurs und Übungsbuch]" ,Klett, 2015
2.	Harmut Aufderstrasse,Heiko Bock, "Themen 1 aktuell kursbuch",Hueber,2003
E Books	
1.	https://www.learn-german-online.net/en/learning-german-resources/free-german-lessons-a1.htm

COURSE TITLE		SPANISH			CREDITS	2
COURSE CODE		GLS51013	COURSE CATEGORY	HS	L-T-P-S	2-0-0-2
Version	0.0	Approval Details		LEARNING LEVEL		BTL- 3

ASSESSMENT SCHEME

CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	
15%	15%	10%	5%	5%	50%

Course Description	This Spanish language course has been programmed to meet the grammatical and conversation needs of the student. Its content is very comprehensive and will also assist in the professional and personal language requirement of the student
Course Objective	1. To facilitate the student in reaching out to international clients across the globe. 2. To make an immediate connect by speaking to the prospective client/ company in their native language. 3. To improve the overall personality of the student thereby making him/her more confident to communicate with global clients. 4. To provide survival skills to students relocating In countries where Spanish is spoken. This includes USA, all the Latin American countries and Spain.
Course Outcome	1. Develop an understanding in spoken Spanish and construction of basic sentences. 2. Creating conversations & oral understanding. 3. Make the learners to decode a message and to give a suitable reply in the same manner. 4. Build an overall idea on the perceptions, phrases, and other vocabulary. 5. Evaluate and understanding of the language and also its culture, music, food and other aspects of the language.

Prerequisites: Plus Two -Intermediate Level

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	-	3	3	-	-	-
CO2	-	3	1	2	-	3	3	-	-	-
CO3	-	3	1	2	-	3	3	-	-	-
CO4	-	3	1	2	-	3	3	-	-	-
CO5	-	3	1	2	-	3	3	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO LANGUAGE & COMMUNICATION (PART 1) (6L)	
1. El Alfabeto – The Alphabets 2. Numeros – Numbers 3. Saludos - Salutations 4. La hora – The Time Suggested Readings: USO (Basico) Dele Gramatica Epanola **Author by Francisca Castro**	**CO-1** **BTL-1**
MODULE 2: INTRODUCTION TO LANGUAGE & COMMUNICATION (PART 2) (6L)	
1. Los Meses, La Semana- The Month, The week and the days of the year 2. Los Estaciones Delan'o – the Seasons of the year 3. En el Aeropuerto, Cpger El Taxi – At the Airport, Booking tickets 4. Hola – Salutations and Greetings 5. Durante La Clase – During the class 6. Art'culos – Different Articles **Suggested Reading: USO (Basico)** **Dele Gramatica Epanola** **Author by Francisca Castro**	**CO-2** **BTL-2**
MODULE 3: UNDERSTANDING OF BASIC VERB AND INTRODUCTION TO GRAMMAR (6L)	
1.Verbp ser : Presente – Present tense of Verb "to be" 2. Estar / Hay – Conjucations of the verb "to be" and the verb there is / There are 3. Verbos En Presente: Regulares – Introduction to regular verbs	**CO-3** **BTL-3**

4. Ser / Estar / Tener – Conjucation of Irregular Verbs **Suggested Reading: USO (Basico)** **Dele Gramatica Epanola** **Author by Francisca Castro**	
MODULE 4: GRAMMAR AND INTRODUCTION TO BASIC CONCEPT	**(6L)**
1.Posesivos – Possesive Adjectives and Nouns 2. Colores – Colours and Expressions 3. La Familia – The Family and its members 4. Nombres Y Adjectives – Nouns and Adjectives Literary Readings: **USO (Basico)** **Dele Gramatica Epanola** **Author by Francisca Castro**	**CO-4** **BTL-2**
MODULE 5 :	**(6L)**
1.Los nombres de la famila – Name of the Family Members 2. Relaciones – relations 3. Identificación de la tabla de familia - identification of the family table 4. Repaso del semestre entero - Full semester revision Literary Readings: **USO (Basico)** **Dele Gramatica Epanola** **Author by Francisca Castro**	**CO-5** **BTL-3**
TEXT BOOK	
1.	Módulo Mind your Language Institute
E-REFERENCES	
1.	Open.umn.edu
2.	Pdfdrive.com/francisa-castro

COURSE TITLE	KOREAN			CREDITS	2
COURSE CODE	GLS51014	COURSE CATEGORY	HS	L-T-P-S	2-0-0-2
Version 0.0	Approval Details			LEARNING LEVEL	BTL- 3

ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	
15%	15%	10%	5%	5%	50%

Course Description	Korean language will give you the opportunity to take a deep dive into Korean culture. The students will become more confident with their skills in communicating with their employers and potential customers. This course covers most basic grammatical structure and everyday vocabularies.
Course Objective	1. To make the students get an upper hand in the prime industries of the world and direct access to the Korean speaking community. 2. To enable the students to create a direct connect thereby eliminating the requirement of a translator. 3. To improve the overall personality of the student thereby making them more confident to communicate with global clients. 4. To provide survival skills to students relocating to countries where Korean is spoken.
Course Outcome	1. Develop the spoken Korean and construction of advanced sentences. 2. Enhance conversations & oral understanding of few communication concepts. 3. Create an idea to decode messages and enable a suitable reply in the same manner. 4. Identify and construct phrases, and other vocabulary. 5. Analyse their language, culture, music, food and other aspects of the Korean Language.
Prerequisites: Plus Two -Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	-	3	3	-	-	-
CO2	-	3	1	2	-	3	3	-	-	-
CO3	-	3	1	2	-	3	3	-	-	-
CO4	-	3	1	2	-	3	3	-	-	-
CO5	-	3	1	2	-	3	3	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION : LANGUAGE AND CULTURE	**(6L)**
What kind of language is Korean? Korea, philosophy of the Korean language & GangNam Style! In this module, students will learn Korean culture, philosophy of creating Korean scripts, and the Korean alphabet or Korean writing system called 'Hangeul'. After completing the lessons, students will be able to understand the principles how each letter was invented. Also, students will be able to understand Korean sign languages as well. **Suggested Activities:** Memory game	**CO-1** **BTL-1**
MODULE 2: HANGEUL **(6L)**	
Greetings and Introducing phonics, the character system, Noun, Pronoun Basic Verb and Greetings & Introducing. In this module, Students will learn how to greet, ask someone's nationalities / jobs and answer those questions in Korean. After completing the lessons, students will be able to introduce themselves, greet a person and talk about someone's nationalities and occupations. **Suggested activities**: Introducing, Game with song, Flash cards game	**CO-2** **BTL-2**
MODULE 3: RESTAURANT & SHOPPING	**(6L)**
Reading simple sentence - to be able to comprehend sign board and name, ordering at a restaurant, counting units, Interrogative sentence. In this module, students will learn how to order food and make requests at a restaurant in Korean. After completing the lesson, students will be able to inquire about restaurant menus, order a specific portion of food at a restaurant, and order a drink at a café. After completing the lesson, you will be able to express prices per item, purchase a product from a store, and make a specific request while shopping.	**CO-3** **BTL-3**

Suggested Activities: Playing in the condition of restaurant and Shop, Dictation	
MODULE 4: DAILY LIFE & TIME **(6L)**	
Talking about daily life, expressing movement, memo, simple message, object marker, expression of negation, & writing. In this module, students will learn various Korean vocabulary regarding your daily lives. After completing the lessons, students will be able to utilize informal sentence endings, ask and answer about their everyday life. Students will learn about time and date in Korean. And students will also say the days of the week as well. After completing the lessons, students will be able to ask and respond time & date using Korean numbers. **Suggested activities:** Songs about numbers and family	**CO-4** **BTL-2**
MODULE 5: SPEAKING AND INTERACTION WITH NATIVES	**(6L)**
Self–Introduction, conversations, finding out information about friends, talk with Korean, visit a Korean market or company. K-POP! Students are able to successfully handle a limited number of uncomplicated communicative tasks related to predictable topics for survival in Korea. **Suggested Activities:** Talk with Native Korean	**CO-5** **BTL-3**

TEXT BOOK	
1.	세종한국어 1 The National Institute of The Korean Language
REFERENCE BOOKS	
1.	[Active Korean 1], Language Education Institute Seoul National University, MoonJin Media
2.	[Practical Korean 1] Darakwon, Korea, Korea
3.	[Korean Language for a Good Job], Darakwon (2007), Korea
E-REFERENCES	
1	https://www.amazon.in/Korean-Made-Simple-beginners-learning-ebook/dp/B00JHT4PCE
2	http://www.twoponds.co.kr/en/snu
3	https://www.koreantopik.com/2017/10/1-8-sejong-korean-textbook-pdfaudio69.html

COURSE TITLE		MANDARIN			CREDITS	2
COURSE CODE		GLS51015	COURSE CATEGORY	HS	L-T-P-S	2-0-0-2
Version	0.0	Approval Details		LEARNING LEVEL		BTL - 3

ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	This level of Mandarin language course has been programmed to understand more symbols and grammatical concepts. It simplifies the construction of sentences, making it easy to converse basic sentences. The student will be able to translate texts and also speak relating to weather, climate and self-introduction. An introduction to 'My family' and description using adjectives.
Course Objectives	1. To make the students to understand Mandarin global language , the students get an upper hand in the prime industries of the world and direct access to the Chinese speaking community. 2. To create a direct, connect thereby eliminating the requirement of a translator. 3. To improve the overall personality of the student thereby making him/her more confident to communicate with global clients. 4. To provide survival skills to students relocating to countries where Mandarin is spoken.
Course Outcomes	1. Assimilate the rules of Hanyu pinyin, pronunciation, Mandarin Chinese tones, character-based common vocabulary, fundamental grammar, and oral and writing practices. 2. Differentiate the major tones of Chinese characters and able to identify the similar pronunciation of vocabularies. 3. Practicing basic communicative skills in Mandarin Chinese;

	through repetition practices in class, students are to learn commonly used Chinese vocabulary, sentences structure and oral communicative skills. 4. Create an idea to recognize easy and basic Mandarin characters; in addition, students are to learn the regulation of expressing Mandarin Chinese in PinYin system and understand the specific adoption of borrowing from Alphabetic symbols. 5. Apply a knowledge of Mandarin to practice and draw Mandarin Chinese strokes order and characters
Prerequisites: Plus Two -Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	-	3	3	-	-	-
CO2	-	3	1	2	-	3	3	-	-	-
CO3	-	3	1	2	-	3	3	-	-	-
CO4	-	3	1	2	-	3	3	-	-	-
CO5	-	3	1	2	-	3	3	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE – 1 MANDARIN CHINESE CHARACTER AND TONES	**(6L)**
Basic strokes in Chinese - commonly used radicals - formation of vocabulary - pictograms - ideograms - compound ideographs - phono-semantic compounds - derivative cognates - phonetic loans - 4 tones introduction - consonants - single vowel - double vowels - initial, medial and vowels **Suggested activities:** Direct lecturing, repeated themes lecturing	**CO-1** **BTL-2**
MODULE - 2 LISTENING SKILLS	**(6L)**
Listening to native speaker's pronunciation of scripts, vocabularies. Tones differentiating trainings, one character with different pronunciation or tones, different characters with the same pronunciation or tones **Suggested activities:**	**CO-2** **BTL-3**

Listening to native speaker's pronunciation and translate it into English.	
MODULE - 3 SPEAKING SKILLS	**(6L)**
Imitating native speaker's pronunciations, tones and intonations to speak naturally **Suggested activities:** Reverse teaching, presentation, formal and informal conversations, singing Chinese songs, cultural activities, describing things.	**CO-3** **BTL-3**
MODULE - 4 READING SKILLS	**(6L)**
50 vocabularies - easy to difficult - important and commonly used - **Suggested activities:** Flashcards to practice, word recognition competition	**CO-4** **BTL-3**
MODULE 5 WRITING SKILLS	**(6L)**
15 vocabularies - easy to difficult - important and commonly used - Chinese Calligraphy **Suggested activities:** Only practiced in assignments, not tested in any exams, composition practice (optional)	**CO-5** **BTL-3**
TEXT BOOK	
1.	National Taiwan Normal University Mandarin Training Center (2015). Linking publishing company. A Course in Contemporary Chinese (Textbook) 1
REFERENCE BOOK	
1.	National Taiwan Normal University Mandarin Training Center (2017). Linking publishing company. Practical Audio-Visual Chinese Vol. 1, 3rd Edition
E-REFERENCE	
1.	http://chineseworksheetgenerator.org

COURSE TITLE	JAPANESE			CREDITS	2
COURSE CODE	GLS51016	COURSE CATEGORY	HS	L-T-P-S	2-0-0-2
Version 0.0	Approval Details			LEARNING LEVEL	BTL- 3

ASSESSMENT SCHEME

CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz etc., as approved by the Department Examination Committee "DEC"	Attendance	
15%	15%	10%	5%	5%	50%

Course Description	This course has been designed to acquire grammar and be able to use Japanese to communicate in everyday simple and practical situations. The content of this course includes pronunciations speaking skills, listening practice and reading and writing.
Course Objective	1. To make the students to write and speak Japanese easily in any situation, daily life and daily conversations. 2. To develop language skills and interest in learning. 3. To facilitate students to create opportunities for themselves in the society. 4. To develop the spoken language fluently. 5. To help the students to learn about the uniqueness of the Japanese Language.
Course Outcome	Upon the completion of this course, the students will be able to 1. Demonstrate the letters and basic words of Japanese Language which are in daily use. 2. Develops the listening skills of Japanese language. 3. Utilize the letters and common words of the language for communication. 4. Develop the conversational skills. 5.Demonstrate the skill of reading and writing.

Prerequisites: Plus Two -Intermediate Level

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	-	3	1	2	-	3	3	-	-	-
CO2	-	3	1	2	-	3	3	-	-	-

CO3	-	3	1	2	-	3	3	-	-	-
CO4	-	3	1	2	-	3	3	-	-	-
CO5	-	3	1	2	-	3	3	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1 – LANGUAGE AND CULTURE	**(6L)**
Greetings - -Self-Introduction - Numbers and Alphabets – Names of countries & Continents-Telling the time-Professions-Introduction about the language and country - Context based learning –At the Café, City orientation, Family, Daily routine ,Weather and Clothing 挨拶ーー自己紹介ー数字とアルファベットー国と大陸の名前ー時間を伝えるー職業ー言語と国についての紹介ーコンテキストベースの学習ーカフェで、都市オリエンテーション、家族、日常、天気と服装	**CO-1** **BTL-1**
MODULE 2 : BASIC GRAMMAR	**(6L)**
Definite and indefinite articles - Simple verbs and conjugation – Pronouns-Possessive Pronoun-W Questions-Adjectives –Separable verbs 明確な冠詞と不定冠詞ー単純な動詞と活用ー代名詞ー所有代名詞ーW質問ー形容詞ー分離動詞	**CO-2** **BTL-2**
MODULE 3 : READING & LISTENING SKILLS	**(6L)**
Reading simple passages - to be able to comprehend advertisements and short texts - Listening comprehension of real time situation based dialogues 簡単な文章を読むー広告や短いテキストを理解できるようにするーリアルタイムの状況に基づいた対話の理解を聞く	**CO-3** **BTL-3**
MODULE 4 : WRITING SKILLS **(6L)**	
Small passages – Comprehension – Composition – Letter writing 小さな文章–理解–作文–手紙の書き方	**CO-4** **BTL-2**
MODULE 5 : SPEAKING SKILLS	**(6L)**
Introducing self- describing daily routine – engaging in dialogues about family, city, orientation, ordering food at the café and weather 自己記述的な日常生活の紹介–家族、都市、オリエンテーション、カフェでの食事の注文、天気についての対話に参加する	**CO-5** **BTL-3**

TEXT BOOK	
1.	Minna no Nihongo: main textbook and translation book. (second edition, Elementary level 1-1) Publisher: Goyal Publishers
REFERENCE BOOKS	
1.	Konomi,Emiko.Begginning Japanese for Professionals:Book 1, Portland State University,2015. https://www.academia.edu/81329400/Basic_japanese_A_grammar_and_workbook
E-REFERENCES	
1.	https://www.academia.edu/81329400/Basic_japanese_A_grammar_and_workbook

COURSE TITLE	**PUBLIC SPEAKING**				**CREDITS**	**1**
COURSE CODE	**GLS51005**	**COURSE CATEGORY**	**HS**	**L - T – P – S**	**1 – 0 – 1 – 2**	
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL – 4**	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment	**Second Periodical Assessment**	**Practical**	**Surprise Test / Quiz., as approved by the Department Examination Committee "DEC"**	**Attendance**	**Theory**	**Practical**
15 %	**15 %**	**10 %**	**5 %**	**5 %**	**25%**	**25%**
Course Description	This course is an introduction to speech communication that emphasises the practical skill of public speaking, including techniques to lessen speaker anxiety and the use of visual aids to enhance speaker presentations. Civility and ethical speech-making are the foundations of this course. Its goal is to prepare students for success in typical public speaking situations and to provide them with the basic principles of organisation and research needed for effective speeches.					
Course Objective	By the end of this course, students will be able to: 1. Develop the ability to critically evaluate speeches by assessing both verbal and non-verbal elements to effectively analyse their overall effectiveness. 2. Enhance audience analysis skills to understand the preferences, needs, and characteristics of the target audience and design speeches that align with their expectations and interests. 3. Acquire the capability to organise speeches in a manner that achieves specific objectives, such as providing informative content, persuasive arguments, or fulfilling the unique requirements of special occasions.					

	4. Master the application of presentation aids to complement and amplify the impact of speeches, utilising visual, auditory, or other supportive tools to enhance engagement and comprehension. 5. Develop proficient research skills by critically analysing and interpreting diverse and relevant sources of information on a wide range of topics to bolster the credibility and depth of the speeches.
Course Outcome	Upon completion of this course, the students will be able to 1. Evaluate speeches based on a variety of verbal and non-verbal criteria. 2. Analyse the audience and design speeches to reflect the analysis. 3. Organise the speech that informs, persuades, or fulfils the needs of a special occasion. 4. Apply the presentation aids to enhance the speech. 5. Analyse meaningful research on a variety of topics.
Prerequisites: Plus Two English-Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	2	3	-	2	3	-	-	-
CO2	-	3	2	3	-	2	3	-	-	-
CO3	-	3	2	3	-	2	3	-	-	-
CO4	-	3	2	3	-	2	3	-	-	-
CO5	-	3	2	3	-	2	3	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1 : INTRODUCTION TO PUBLIC SPEAKING AND SPEECH EVALUATION	**(3L+3P)**
Introduction – What is public speaking? – Different kinds of speeches – Mastery of language – Criteria for Evaluating Speeches-Awareness to strategies – Evaluating Verbal Criteria– Adapting Speech to Audience and Context **Speaking Skills (Activities):** Self-Introduction- Speak for 60 seconds	**CO-1** **BTL-2**
MODULE 2 : ANALYZING THE AUDIENCE AND DESIGNING SPEECHES	**(3L+3P)**
Public Speaking and Audience Analysis- Acquire knowledge – Skill in real life presentation – Techniques for Conducting Audience Analysis– Adapting Speech Content-	**CO-2** **BTL-3**

Visual aids – Ethical Considerations in Audience Analysis and Speech Design **Speaking Skills (Activities):** Group Discussions and Team Presentation-Role Plays - Monologues- Recitations	
MODULE 3 : ART OF SPEAKING	**(3L+3P)**
Organizing Speeches for Information, Persuasion, and Special Occasions- Art of speech – Organizational Structures for Informative Speeches– Adapting Speech Organization to Special Occasions - Visual and Verbal Techniques for Speech Organization- To have self-confidence – Humour – Anecdotes – Personal experiences – knowledge on current events **Speaking Skills (Activities)**: Group Debates - Impromptu Speaking	**CO-3** **BTL-3**
MODULE 4 : APPLYING PRESENTATION AIDS TO ENHANCE SPEECHES	**(3L+3P)**
Public Speaking and Presentation Aids- Types of Presentation Aids- Designing and Creating Effective Visual Aids- Incorporating Audio and Physical Aids-Delivering method – Involvement – Organization – Planning and designing meticulously- Presenting with Presentation Aids **Speaking Skills (Activities)**: Master of Ceremony-Group Activities and Open Discussion	**CO-4** **BTL-3**
MODULE 5 : DELIVERY AND EXECUTION	**(3L+3P)**
Preparation – Purpose of the Speech - Selecting the subject – Making an outline – Research Analysis Methods for Informative Speeches -Gathering materials – Critical Thinking and Research Ethics– Time Management – Rehearsing **Speaking Skills (Activities)**: On the spot topic speech for 5 minutes-Mock Interviews – Panel sessions	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Carnegie, Dale and Esenwein, J. Berg. The Art Of Public Speaking. Rupa Publications India, 2018
REFERENCE BOOKS	
1.	Peale, Norman Vincent. The Power of Positive Thinking, Fingerprint Publishing, 2017
2.	Carnegie, Dale. The Art of Public Speaking, Mittal Books Publishing House, 2015
E BOOKS	
1.	https://www.managementhelp.org/public-speaking
2.	https://gtu.ge/Agro-Lib/successful-public-speaking.pdf
MOOC	
1.	https://www.coursera.org/learn/public-speaking
2.	https://onlinecourses.nptel.ac.in/noc22_hs134/preview

COURSE TITLE	INTERNSHIP			CREDITS	1
COURSE CODE	BMA08100	COURSE CATEGORY	SI	L-T-P-S	0-0-6-0
Version	0.0	Approval Details		LEARNING LEVEL	BTL–4
ASSESSMENT SCHEME					
CIA			ESE		
50%			50%		

Course Description	The internship is structured around clear learning objectives and encourages students to engage in reflective practices to evaluate and enhance their professional development. The B.Sc. Mathematics and Data Science Internship immerses students in real-world applications of mathematical theory, data analysis, and machine learning. With guidance from both academic mentors and industry professionals, students apply classroom knowledge to solve complex problems, gaining valuable hands-on experience. Prior approval and concurrent enrollment in internship units are required, ensuring a seamless integration of academic learning with practical skills, preparing students for careers in data science, analytics, finance, and beyond.
Course Objective	1. Gain an understanding of how mathematical and data science concepts are applied in industry settings, and how professional expectations and workplace dynamics influence problem-solving approaches. 2. Build proficiency in key industry skills such as statistical analysis, machine learning, data visualization, and mathematical modeling, relevant to the field of data science. 3. Refine and clarify career goals by critically analyzing the real-world application of mathematics and data science concepts, enhancing professional development and industry readiness.
Course Outcome	Upon completion of this course, the students will be able to: 1. Analyze and interpret complex data sets, identifying key challenges and trends relevant to real-world industry problems in mathematics and data science. 2. Adapt to unfamiliar work environments, developing an understanding of professional cultures, team dynamics, and industry-specific practices. 3. Apply mathematical and data science techniques to solve real-world problems, leveraging prior knowledge and overcoming obstacles encountered in the workplace. 4. Develop a deeper awareness of their technical and analytical skills, and how they

	align with their career aspirations in the fields of data science and mathematics. 5. Gain a comprehensive understanding of their industry, the mathematical and data science tools used, and how their experiences influence their career goals and professional growth.
PREREQUSITE: Programming Skills, Basic Database	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**2**	**2**	**-**	**1**	**2**	**2**	**2**
CO2	**1**	**1**	**3**	**2**	**2**	**-**	**1**	**2**	**2**	**3**
CO3	**1**	**1**	**3**	**2**	**2**	**-**	**1**	**2**	**2**	**3**
CO4	**1**	**1**	**3**	**2**	**2**	**-**	**1**	**2**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**-**	**1**	**2**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

INTERNSHIP

The internship is structured around specific learning objectives and reflective assignments. It is supervised both academically by a faculty member and professionally by an industry supervisor. All academic internships require prior approval, and students must be concurrently enrolled in academic internship units. Students assess the application of mathematical and data science principles in real-world contexts, while supervisors evaluate the student's performance in using analytical and problem-solving skills effectively at the internship.

Procedure for Applying for Internships (B.Sc. Mathematics and Data Science)

To apply for an internship, students should research companies and organizations within the fields of data science, mathematics, and related industries such as technology, finance, and analytics. Explore their websites for internship or training opportunities, and look for links that allow students to submit their details and upload a professional resume. If the company accepts direct applications, students can apply through the provided channels, ensuring they tailor their resume to highlight relevant skills in data analysis, machine learning, and mathematical modeling.

1. **Internal Marks: 50**
2. **External Marks: 100**

Internal Rubrics

S.No	Description	marks
1	Review 0	10
2	Review 1	20
3	Review 2	20
	Total	50

External Rubrics

S.No	Description	Marks
1	Project report	40
2	Task Explanation	20
3	PPT	20
4	Viva	20
	Total	100

SEMESTER IV

COURSE TITLE	**COMPUTATIONAL MATHEMATICS**			**CREDIT**	**4**
COURSE CODE	**BMA01006**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	The study focuses on designing numerical methods for solving scientific problems, including linear/nonlinear systems, data fitting, and ODEs, while analyzing algorithm robustness, accuracy, and convergence speed, along with computer arithmetic and round-off errors.				
Course Objective	1. To understand the role of computers in mathematics and science. 2. To solve system of linear equations by substitution and elimination. 3. To define interpolation and prove the order of the polynomial is unique. 4. To develop own numerical differentiation and experience computational limitation. 5. To identify the suitable methods to solve ordinary differential equations.				
Course Outcome	Upon completion of this course, the students will be able to 1. Apply mathematical modeling on computational methods. 2. Compute the solution of system of equations using direct and indirect numerical methods. 3. Apply method of interpolation and extrapolation for equal and unequal intervals. 4. Differentiate and integrate numerically. 5. Compute the solutions of initial value problems numerically.				
Prerequisites: Knowledge of matrices and Algebra.					

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO4	**2**	**1**	**3**	**1**	**2**	**-**	**1**	**3**	**-**	**-**
CO5	**2**	**1**	**3**	**1**	**2**	**-**	**1**	**3**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO COMPUTATIONAL MATHEMATICS	**(9L+3T=12)**
Mathematical modeling, review of Taylor series, Numerical error- floating-point representation, computer arithmetic, round-off errors, and loss of significance in numerical computations. **Self-Study:** Understanding Numerical Stability and Conditioning, Floating-Point Arithmetic and Error Propagation.	**CO-1** **BTL-3**
MODULE 2: LOCATING ROOTS OF EQUATIONS	**(9L+3T=12)**
Solution of algebraic and transcendental equations: Method of false position – Newton's method –Fixed point iteration method – Solution of linear system of Gaussian elimination and Gauss-Jordan methods – Iterative methods: Gauss Jacobi and Gauss –Seidel methods- Inverse of a matrix by Gauss-Jordan method. Eigenvalue of a matrix by power method. **Self-Study:** Divergence of series	**CO-2** **BTL-3**
MODULE 3: INTERPOLATION AND APPROXIMATION	**(9L+3T=12)**
Lagrange Polynomials – Divided difference – Newton forward and backward difference method – Cubic Spline interpolation. **Self-Study:** Relations and functions	**CO-3** **BTL-3**
MODULE 4: NUMERICAL DIFFERENTIATION AND INTEGRATION	**(9L+3T=12)**
Derivatives from difference table – Divided difference and finite difference – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two- and three-point Gaussian quadrature formula – Double integrals	**CO-4** **BTL-3**

using trapezoidal and Simpson's rules. **Self-Study:** Basic differentiation and integration	
MODULE 5: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS **(9L+3T=12)**	
Single step Methods: Taylor Series method –Euler and Modified Euler method – Fourth order Runge-Kutta method for solving first and second order differential equations -Multistep method: Milne's and Adam's predictor and corrector methods. **Self-Study:** Ordinary Differential Equations.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	K. Gunavathi, P. Kandasamy and K. Thilagavathy (2006), *Numerical Methods*, 3rd Edition, India.
2.	C. F. Gerald and Wheatley, P. O (2002), Applied *Numerical Analysis*, Sixth Edition, Pearson Education Asia, New Delhi.
REFERENCE BOOKS	
1.	S. C. Chapra and R. P Canale (2007), *Numerical Methods for Engineers*, 5th Edition, Tata McGraw Hill, New Delhi.
E BOOKS	
1.	https://www.e-booksdirectory.com/details.php?ebook=12315
2.	https://www.freebookcentre.net/Mathematics/Numerical-Analysis-Books.html
MOOC	
1.	https://www.mooc-list.com/course/numerical-methods-engineers-saylororg
2.	https://archive.nptel.ac.in/courses/111/107/111107105/

COURSE TITLE		TOOLS AND TECHNIQUES FOR DATA ANALYSIS			CREDITS	2
COURSE CODE		ADS11002	COURSE CATEGORY	SE	L-T-P-S	1-0-2-1
Version	0.0	Approval Details			LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test/Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	A concise study of methods and tools used to collect, process, and interpret data for effective analysis and decision-making.
Course Objective	To understand the various concepts in the Data Science process. 1. To study the applications of Data Science. 2. To learn to setup the data science tools environment and implement in Python and R 3. To learn to write programs in Python and R for data science projects. 4. To know the process of data visualization & data manipulation w.r.to data science. 5. To develop proficiency in data manipulation using pandas for indexing, selection, handling missing data, and aggregation, while gaining skills in data visualization using Matplotlib and Seaborn for effective graphical representation.
Course Outcome	Upon completing this course, each student will be able to: 1. Demonstrate the basic knowledge of the data science process. 2. Setup the software environment for python and R Language and apply various techniques to work with data. 3. Manipulate and visualize the data using tools like pandas and matplotlib. 4. Develop simple data science applications. 5. Analyze the various data science related projects.

Prerequisites: NIL

Pedagogy: Case Studies and Presentations

CO,PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO7	PSO-1	PSO-2	PSO-3
CO-1	2	1	3	-	-			1	2	2
CO-2	2	1	3	-	-			1	2	2
CO-3	2	1	3	2	1	-	-	1	2	2
CO-4	2	1	3	-	-	-	-	1	2	2
CO-5	2	1	3	2	1	2	-	1	2	2

1:Weakly Related,2:Moderatelyrelatedand3:Strongly Related

MODULE 1 : INTRODUCTION	**9 Hrs.**
Introduction to Data Sciences – The data science process – Roles in data science project – Stages of Data Science Project – Defining the goal – Data collection and Management – Modelling – Model evaluation – Presentation and documentation – Model deployment and Maintenance-Applying Data science in Industry – Benefits from Business centric Data Science – Data Analytics and Types – Common Challenges in Analytics – Distinguishing between Business Intelligence and Data Science.	**CO-1** **BTL-3**
MODULE2: DATA EXTRACTION	**9 Hrs**
Using Data Science to Extract meaning from Data – Machine learning Modeling with instances Data science tools environment - Python – overview - Setting up Data science toolbox **PRACTICUM:** 1. Python Basic function.	**CO-2** **BTL-3**
MODULE 3: ENVIRONMENT FOR ANALYSIS	**9 Hrs**
Usage of Data science tools environment: Essential concepts and tools-Obtaining – Managing your Data workflow – Drake. Techniques using Python Tools - k – Nearest Neighbours – Naive Bayes **PRACTICUM:** 1. Python analysis function 2. Pandas function	**CO-3** **BTL-3**
MODULE 4: R PROGRAMMING	**9 Hrs**
Techniques using R Tools - R programming overview - Loading data into R – Modeling methods – choosing and evaluating models –Linear and logistic Regression. **PRACTICUM:** 1. Basic functions of R	**CO-4** **BTL-3**

2. Loading data into R 3. Linear regression 4. Logistic regression	
MODULE 5: DATA MANIPULATION AND VISUALIZATION	**9Hrs**
Data Manipulation using pandas: Installing and using Pandas- Introducing pandas objects- Data Indexing and selection – handling missing data, merge and joining sets, Aggregation and grouping. Data Visualization using Matplotlib – Simple Line Plots- Simple Scatter plots, Multiple subplots, Visualization with seaborn. **PRACTICUM:** 1. Exploring pandas functions 2. Exploring matplotlib functions 3. Data indexing and grouping	**CO-5** **BTL-3**

TEXT BOOKS	
1.	J. Janssens (2014), *Data science at the command line*, First edition. Sebastopol, O'Reilly Media, USA.
2.	J. Grus (2015), *Data Science from Scratch: First Principles with Python*, First edition. Sebastopol, Shroff/O'Reilly Media.
3.	N. Zumel and J. Mount (2014), *Practical data science with R*, Manning Publications Co, Shelter Island, NY 11964.
REFERENCE BOOKS	
1.	L. Pierson and J. Porway (2017), *Data science for Dummies*, 2nd edition. Hoboken, NJ: John Wiley and Sons, Inc, Canada.
2.	C. O 'Neil and R. Schutt (2013), *Doing Data Science: Straight Talk from the Frontline*, First edition. Beijing; Sebastopol: O'Reilly Media, India.
3.	J. VanderPlas (2016), *Python Data Science Handbook: Essential Tools for Working with Data*, First edition. Shroff/O'Reilly, India.
EBOOKS	
1.	https://riptutorial.com/ebook/r
2.	https://r4ds.had.co.nz/
3.	https://dokumen.pub/advanced-guide-to-python-3-programming-9783030259433.html
MOOC	
1.	https://www.csbsju.edu/data-analytics/
2.	https://www.simplilearn.com/free-python-online-course-skillup

COURSE TITLE	DATA MINING			CREDIT	4
COURSE CODE	BDS01004	COURSE CATEGORY	DE	L-T-P-S	3-1-0-1
Version	0.0	Approval Details		LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	To expose the students in fundamental data mining techniques through hands-on application to real-world datasets.
Course Objective	1. To understand the basic data mining concepts. 2. To study the various data mining techniques. 3. To evaluate the performance of classification techniques. 4. To explore real-world applications of data mining.
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the types of data to integrate a data mining system. 2. Apply preprocessing methods for any given raw data. 3. Extract interesting patterns from large amount of data. 4. Discover the role played by data mining in various fields. 5. Evaluate the accuracy of supervised and unsupervised models and algorithms.

Prerequisites: Knowledge of Database Management Systems, Probability and Statistics

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	2	-	-	-	-	1	2	2
CO2	1	1	2	1	-	-	1	1	2	2
CO3	1	1	2	-	-	-	-	1	2	2
CO4	1	1	2	1	2	1	-	1	2	2

CO5	**1**	**1**	**2**	**1**	**2**	**1**	**-**	**1**	**2**	**2**

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION TO DATA MINING	**(9L+3T=12)**
Basic Data Mining Tasks – Data Mining Versus Knowledge Discovery in Data Bases – Data Mining Issues – Data Mining Matrices – Social Implications of Data Mining – Data Mining from Data Base Perspective. **Self-Study**: Data Mining vs. Knowledge Discovery in Databases, Social Implications of Data Mining	**CO-1** **BTL-3**
MODULE 2: DATA MINING TECHNIQUES	**(9L+3T=12)**
Data Mining Techniques – a Statistical Perspective on data mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms. **Self-Study:** Similarity Measures in Data Mining, Neural Networks and Genetic Algorithms in Data Mining	**CO-2** **BTL-3**
MODULE 3: CLASSIFICATION TECHNIQUES	**(9L+3T=12)**
Introduction to Classification Models-Bayesian Classification Algorithms, K-Nearest Neighbors (K-NN) Algorithm- Support Vector Machines (SVM)-Random Forest Classifier-Evaluation Metrics for Classification Models- Overfitting and Underfitting in Classification-Feature Selection and Dimensionality Reduction in Classification. **Self-Study:** Evaluation Metrics for Classification Models, Overfitting and Underfitting in Classification Models	**CO-3** **BTL-3**
MODULE 4: CLUSTERING TECHNIQUES AND ADVANCED ALGORITHMS	**(9L+3T=12)**
Clustering Tree – Based Algorithms – Neural Network Based Algorithms – Rule Based Algorithms – Combining Techniques: Introduction – Similarity and Distance Measures – Outliers– Hierarchical Algorithms. Partitioned Algorithms. **Self-Study:** Hierarchical and Partitioned Clustering Algorithms, Outlier Detection in Clustering	**CO-4** **BTL-3**
MODULE 5: ASSOCIATION RULE MINING	**(9L+3T=12)**
Association Rules: Introduction - Large Item Sets – Basic Algorithms – Parallel & Distributed Algorithms – Comparing Approaches – Incremental Rules – Advanced Association Rules Techniques – Measuring the Quality of Rules. **Self-Study:** Parallel and Distributed Algorithms for Association Rule Mining, Measuring the Quality of Association Rules	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Han, Jiawei, and Micheline Kamber (2011), *Data Mining: Concepts and Techniques*, 3rd Edition, Morgan Kaufmann, USA.
2.	Dunham, Margaret H. (2003), *Data Mining: Introductory and Advanced Topics*, Pearson Education, USA.
REFERENCE BOOKS	
1.	Witten, Ian H., and Eibe Frank (2005), *Data Mining: Practical Machine Learning Tools and Techniques (Second Edition)*, Morgan Kaufmann, USA.
E BOOKS	
1	https://link.springer.com/book/10.1007/978-3-319-14142-8
MOOC	
1.	https://nptel.ac.in/courses/106105174
2.	https://www.mooc-list.com/course/data-mining-methods-coursera?utm_source=chatgpt.com
3.	https://archive.nptel.ac.in/courses/106/105/106105174/?utm_source=chatgpt.com

COURSE TITLE	**MACHINE LEARNING**			**CREDIT**	**4**
COURSE CODE	**BDS01005**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	The Machine Learning course provides an introduction to algorithms and techniques for training models to learn patterns and make predictions from data.				
Course Objective	1. To understand the basic concepts of machine learning. 2. To understand and build supervised learning models. 3. To understand and build unsupervised learning models.				

	4. To evaluate the algorithms based on corresponding metrics identified. 5. To understand bootstrapping, measuring classifier performance.
Course Outcome	1. Explain the basic concepts of machine learning. 2. Construct supervised learning models. 3. Construct unsupervised learning algorithms. 4. Evaluate and compare different models. 5. Construct the guidelines for machine learning experiments
Prerequisites: Basic Mathematics, Programming Skills	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**-**
CO2	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**-**
CO3	**1**	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**2**	**-**
CO4	**1**	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**2**	**-**
CO5	**1**	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**2**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: BASICS OF MACHINE LEARNING	**(9L+3T=12)**
Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias. **Self Study:** Generalization, Bias variance trade-off.	**CO-1** **BTL-3**
MODULE 2: SUPERVISED LEARNING	**(9L+3T=12)**
Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier. **Self Study:** Support vector machine, Decision Tree, Random Forests	**CO-2** **BTL-3**
MODULE 3: ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	**(9L+3T=12)**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models. **Self Study:** Expectation maximization.	**CO-3** **BTL-3**
MODULE 4: NEURAL NETWORKS	**(9L+3T=12)**
Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning. **Self Study:** Batch normalization, Regularization, Dropout.	**CO-4** **BTL-3**
MODULE 5: DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS	**(9L+3T=12)**
Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test. **Self Study:**K-fold CV paired t test.	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Ethem Alpaydin (2020), *Introduction to Machine Learning*", MIT Press, 255 Main Street, 9th Floor Cambridge.
2.	Stephen Marsland (2014), *Machine Learning: An Algorithmic Perspective*, "Second Edition", CRC Press, Berlin Germany.
REFERENCE BOOKS	
1.	Christopher M. Bishop (2006), *Pattern Recognition and Machine Learning*", Springer, Switzerland.
2.	Tom Mitchell (1997), Machine Learning, McGraw Hill, 3rd Edition, Cambridge.
5.	Sebastain Raschka, Vahid Mirjalili (2019), *Python Machine Learning*", Packt publishing, Russia.
E BOOKS	

1.	Géron, A. (2020), *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems*, ISP in France.
MOOC	
1.	https://www.coursera.org/learn/machine-learning
2.	https://course.fast.ai/
3.	https://onlinecourses.nptel.ac.in/noc21_cs24/preview

COURSE TITLE		**ENGLISH FOR COMPETITIVE EXAMINATIONS**			**CREDITS**	**1**
COURSE CODE		**GLS51006**	**COURSE CATEGORY**	**HS**	**L-T-P-S**	**1-0-1-2**
VERSION	**0.0**	**APPROVAL DETAILS**			**LEARNING LEVEL**	**BTL-4**

ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment	**Second Periodical Assessment**	**Weekly assignment/ lab record and viva as approved by the Department Examination Committee "DEC"**	**Surprise Test / Quiz., as approved by the Department Examination Committee "DEC"**	**Attendance**	**Practical**	**Theory**
15 %	**15 %**	**10 %**	**5 %**	**5 %**	**25 %**	**25 %**

Course Description	This course provides students with the skills and strategies needed to succeed in competitive exams, such as English grammar, vocabulary, reading and writing skills, listening comprehension, and critical thinking. It also helps them to understand the English language and exam structure better.
Course Objective	1. To provide an environment where people may compete on both a formal and casual level and employ those abilities in regular conversation, presentations, group discussions, and debates. 2. To prepare the students to read literary materials, comprehend them, and respond to questions based on them.

	3. Assisting students in developing social awareness and positive responses to societal demands. 4. To give students a setting in which to take competitive exams.
Course Outcome	Upon completion of this course, the students will be able to; 1. Acquire knowledge of the structure and format of competitive examinations. 2. Develop vocabulary and grammar to increase success in competitive examinations. 3. Create critical thinking and problem-solving skills to answer complex questions. 4. Analyse their vocabulary and communication ability to build the knowledge of idioms, phrasal verbs and commonly used expressions for better productivity, job performance and to develop self-confidence. 5. Learn how to approach and solve comprehension and essay questions with confidence.
Prerequisites:- Intermediate Level	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO2	**2**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO3	**2**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO4	**2**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
CO5	**2**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1 : INTRODUCTION TO COMPETITIVE EXAMS	**(3L+3P)**
Introduction to Competitive Exams - IELTS, TOEFL etc., Precis writing – Types of Letter writing – Business Letters – Letters for employability	**CO-1** **BTL-2**
MODULE 2 : READING COMPREHENSION **(3L+3P)**	
Reading Comprehension- Cloze Test- Passage Completion-Practice Test – Listening Comprehension Exercise (Lab)	**CO-2** **BTL-3**
MODULE 3 : ERROR CORRECTION **(3L+3P)**	
Spotting Errors- Sentence Improvement-Practice Test	**CO-3** **BTL-3**
MODULE 4 : VOCABULARY TEST	**(3L+3P)**
Para Jumbles- Tracing Odd Sentences- Synonyms and Antonyms-Practice Test	**CO-4** **BTL-3**
MODULE 5: GENERAL GRAMMAR	**(3L+3P)**
Idioms and Phrases, One Word Substitution, Active and Passive Voice, Direct-Indirect Speech-Practice Tests	**CO-5** **BTL-3**

	TEXT-BOOK
1.	General English for Competitive Exams, by Dr. Rashmi Singh, 2nd Edition
	REFERENCEBOOKS
1.	TOEFL
	E-REFERENCES
1.	https://www.careers360.com/all-ebooks
2.	https://www.dishapublication.com/ebooks
3.	https://www.visionias.net/p/free-e-books-for-all-competitive.html
4.	https://www.fdaytalk.com/ebooks/
MOOC	
1.	https://www.mooc-list.com/tags/english

SEMESTER V

COURSE TITLE	MATRIX THEORY AND VECTOR SPACE			CREDITS	4	
COURSE CODE	BMA01007	COURSE CATEGORY	CC	L-T-P-S	3-0-2-1	
Version	0.0	Approval Details		LEARNING LEVEL	BTL-4	
ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To make the student understand the basic concepts of functional analysis					
Course Objective	1. To develop understanding in the domain of matrix theory, vector spaces. 2. To understand the properties and applications of Hermitian. 3. To develop a solid understanding in vector spaces. 4. To explore the concepts of dual spaces. 5. To understand linear transformations and analyze matrix properties.					

Course Outcome	Upon completion of this course, the students will be able to 1. Analyze the basic concepts of matrices. 2. Evaluate the types of matrices. 3. Learn the concepts of base and dimension of vector space 4. Apply the Gram-Schmidt process to construct an orthonormal set of vectors in an inner product space. 5. Demonstrate competence with the basic ideas of Matrix theory and linear transformation linear transformation.
Prerequisites: Basics Knowledge of matrices	

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	-	-	2	-	-
CO2	1	1	3	-	-	-	=	2	-	-
CO3	1	1	3	-	-	-	-	2	-	-
CO4	1	1	3	-	-	-	-	2	-	-
CO5	1	1	3	-	-	-	=	2	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: MATRICES	**(9L+6P=12)**
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation **Self-Study:** Inverse of Matrices **Lab:** Diagonalization of matrices by orthogonal transformation	**CO-1** **BTL-3**
MODULE 2: MATRIX TRANSFORMATIONS	**(9L+6P=12)**
Hermitian and Skew-Hermitian Matrices – Orthogonal and Unitary Matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane. **Self Study:** Hermitian and Skew Hermitian Matrices **Lab:** Quadratic form to canonical form	**CO-2** **BTL-3**

MODULE 3: VECTOR SPACE	**(9L+6P=12)**
Elementary Basic Concepts – Subspace of a Vector space - Homomorphism – Isomorphism -Internal and External direct sums - Linear span - Linear Independence and Bases. **Self Study:** Homomorphism **Lab:** Internal and External direct sums	**CO-3** **BTL-3**
MODULE 4: DUAL SPACES	**(9L+6P=12)**
Dual Spaces – Annihilator of a subspace - Inner Product Spaces – Norm of a Vector –Orthogonal Vectors - Orthogonal Complement of a subspace – Orthonormal set. **Self Study:** Orthonormal Sets in Signal Processing and Data Compression **Lab:** Orthogonal Complement.	**CO-4** **BTL-3**
MODULE 5: LINEAR TRANSFORMATIONS	**(9L+6P=12)**
Algebra of Linear Transformations – Regular, Singular Transformations – Range of T – Rank of T - Characteristic Roots – Characteristic Vectors – Matrices. **Self Study:** Linear Transformations and Their Matrix Representations in Computer Graphics **Lab:** Characteristic Roots and Characteristic Vectors	**CO-5** **BTL-3**

TEXT BOOKS

1.	R. Balakrishnan and M. Ramabadran (2005), *Modern Algebra*, Vikas Publishing House Pvt. Ltd, New Delhi.
2.	I. N. Herstein (2006), *Topics in Algebra*, John Wiley and Sons, New York.
3.	Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence (2022), *Linear Algebra*, Fifth Edition, Pearson Education, USA.

REFERENCE BOOKS

1.	Surjeet Singh and Qazi Zameeruddin (2004), *Modern Algebra*, Vikas Publishing house Hill, New Delhi.
2.	A. R. Vasishtha (2015), *Modern Algebra*, Krishna Prakashan Mandir, Meerut.

E BOOKS

1.	https://bookauthority.org/books/best-abstract-algebra-ebooks
MOOC	
1.	https://nptel.ac.in/courses/111/106/111106135/
2.	https://nptel.ac.in/courses/111/101/111101115/
3.	https://nptel.ac.in/courses/111/108/111108066/
4.	https://nptel.ac.in/courses/115/105/115105097/

COURSE TITLE	**OPTIMIZATION TECHNIQUES**			**CREDIT**	**4**
COURSE CODE	**BMA01008**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	Students will learn how to identify optimal solutions for decision-making processes in complex systems, Real life problems, balancing objectives and constraints.				
Course Objective	1. To introduce optimization concepts and techniques. 2. To equip students with problem-solving strategies for various optimization problems. 3. To apply optimization methods to engineering and science applications. 4. To understand the principle of optimality in dynamic programming. 5. To explore advanced optimization techniques.				
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the basic concepts and application of operations research in various fields. 2. Obtain the solution of LPP by various methods. 3. Obtain the solution of Non-LPP by various methods.				

	4. Determine the understanding of Dynamic Programming. 5. Calculate the optimum solution of transportation problems.
Prerequisites: Knowledge of Algebra	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**3**	**-**	**-**
CO3	**1**	**1**	**2**	**-**	**2**	**1**	**1**	**3**	**-**	**-**
CO4	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**-**	**-**
CO5	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO OPTIMIZATION	**(9L+3T=12)**
Definition and Importance of Optimization -Classification of Optimization Problems - Applications in Science, Engineering, and Business-Basic Terminology: Decision Variables, Objective Functions, Constraints - Formulation of Optimization Problems **Self Study:** Classification of Optimization Problems	**CO-1** **BTL-3**
MODULE 2: LINEAR PROGRAMMING	**(9L+3T=12)**
Introduction to Linear Programming (LP) - Formulation of LP Problems - Graphical Solution Method - Simplex Method - Duality in Linear Programming - Sensitivity Analysis **Self Study:** Graphical Solution Method	**CO-2** **BTL-3**
MODULE 3: NONLINEAR PROGRAMMING	**(9L+3T=12)**
Introduction to Nonlinear Programming (NLP) - Types of NLP Problems - Unconstrained Optimization: Gradient Descent, Newton's Method - Constrained Optimization: Lagrange Multipliers, Kuhn-Tucker Conditions **Self Study:** Lagrange Multipliers, Kuhn-Tucker Conditions	**CO-3** **BTL-3**
MODULE 4: DYNAMIC PROGRAMMING	**(9L+3T=12)**

Principle of Optimality - Formulation of Multistage Decision Problems - Forward and Backward Recursion – Dynamic Programming. **Self Study:** Application of Dynamic Programming	**CO-4** **BTL-3**
MODULE 5: APPLICATIONS OF OPTIMIZATION TECHNIQUES	**(9L+3T=12)**
Integer Programming - Genetic Algorithms and Evolutionary Optimization - Optimization in Transportation and Assignment Problems - Network Optimization Problems (Shortest Path, Maximum Flow). **Self Study:** Transportation and Assignment Problems	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Kanti Swarup, P.K. Gupta, and Man Mohan (2010), *Operations Research.* Sultan Chand, New Delhi.
REFERENCE BOOKS	
1.	S. S. Rao (2009), *Engineering Optimization: Theory and Practice,* Published by John Wiley & Sons, Inc., Hoboken, New Jersey in Canada.
2.	Richard Bronson and Govindasami Naadimuthu (1982), *Operations Research,* Fairleigh Dickinson University , London.
3.	David G. Leuenberger (2021), *Introduction to Linear and Nonlinear Programming,* International series in Operation Research and Management Science, Maryland.
E BOOKS	
1.	https://zlib.pub/book/engineering-optimization-theory-and-practice-7aj8fr67mdl0

MOOC	
1.	https://www.mooc-list.com/tags/optimization-methods
2.	https://www.mooc-list.com/tags/nonlinear-optimization
3.	https://www.mooc-list.com/initiative/edx

COURSE TITLE		DEEP LEARNING			CREDITS	4
COURSE CODE		AAD11003	COURSE CATEGORY	CC	L-T-P-S	3-1-0-0
Version	0.0	Approval Details			LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/Project	Surprise Test/Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	In this course, students will learn the fundamental principles, underlying mathematics, and implementation details of deep learning. This includes the concepts and methods used to optimize these highly parameterized models, the modules that make them up, and common neural network architectures (convolutional neural network. Applications ranging from computer vision to natural language processing and decision-making (reinforcement learning) will be demonstrated.
Course Objective	1. To build a strong foundation in linear algebra, probability, statistics, and numerical methods. 2. To provide a comprehensive understanding of machine learning algorithms. 3. To explore advanced topics in neural networks. 4. To develop expertise in applying deep learning techniques such as convolutional networks. 5. To introduce the fundamentals of Generative Adversarial Networks.
Course Outcome	On the successful completion of the course, students will 1. Learn how to modify state-of-the-art deep learning architectures for a new dataset/task. 2. Know the basic model types used in deep learning, e.g., Convolutional Neural Networks (CNNs). 3. Recurrent Neural Networks (RNNs), and Generative Adversarial Networks (GANs). 4. Understand the basic concepts of neural networks and deep learning

	methods. 5. Know the suitability of specific deep learning methods to various real world data domains such as the ones arising from text, images, and videos.

Prerequisites: NIL

Pedagogy: Case Studies and Presentations

CO,PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

1: Weakly Related,2: Moderately related and 3: Strongly Related

MODULE1: MATHEMATICAL PRELIMINARIES	**9 Hrs**
Introduction to Linear Algebra; Principal Component Analysis; Probability and Statistics; Numerical Methods, Gradient and constraint-based optimization.	**CO-1** **BTL-3**
MODULE 2: MACHINE LEARNING BASICS	**9 Hrs**
Learning algorithms; Training, validation and test sets; Neural networks, convolutional and recurrent networks, backpropagation; Performance metrics, hyperparameters and debugging strategies	**CO-2** **BTL-3**
MODULE 3: INTRODUCTION TO DEEP NETWORKS	**9 Hrs**
Problems with backpropagation and modern approaches; Autoencoders, representation learning; Regularization, dropout, optimization strategies. Deep recurrent networks, bidirectional networks and encoder-decoder architectures; Introduction to LSTM, building an LSTM network.	**CO-3** **BTL-3**
MODULE 4: DEEP CONVOLUTIONAL NETWORK	**9 Hrs**
Deep convolutional network for Telugu OCR and performance analysis; LSTM networks for text processing. Generative adversarial networks (GAN), building and training GANs; GAN variants and current results; limitations and weaknesses of deep learning.	**CO-4** **BTL-3**

MODULE 5: GENERATIVE ADVERSARIAL NETWORKS	**9 Hrs**
Introduction to GAN – Encoder/Decoder, Generator/Discriminator architectures. Challenges in NN training – Data Augmentation – Hyper parameter Settings – Transfer Learning– Developing and Deploying ML Models (e.g., Matlab/Tensor Flow/ PyTorch).	**CO-5 BTL-3**

TEXT BOOKS	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville (2015), Deep Learning, MIT Press.
2.	Adam Gibson and Josh Patterson (2017), *Deep Learning, A practitioner's approach*, O'Reilly, First Edition, Russia.
3.	Keras (2018), *Deep Neural Networks*, Jojo Molehill, A press.
REFERENCE BOOKS	
1.	I. Goodfellow, Y. Bengio (2016), *A. Courville*, *Deep Learning*, MIT Press.
2.	K. P. Murphy (2012), *Machine Learning: A Probabilistic Perspective*, MIT Press.
3	Francois Cholett (2017), Deep *Learning with Python*, Manning Shelter Island.
E BOOKS	
1.	https://readyforai.com/download/deep-learning-pdf/
2.	https://d2l.ai/d2l-en.pdf
3.	http://imlab.postech.ac.kr/dkim/class/csed514_2019s/DeepLearningBook.pdf
MOOCS	
1.	https://www.classcentral.com/subject/deep-learning
2.	https://www.mygreatlearning.com/deep-learning/free-courses
3	https://www.coursera.org/courses?query=deep%20learning

COURSE TITLE	**DATA VISUALIZATION USING TABLEAU**			**CREDIT**	**4**
COURSE CODE	**BDS01006**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME						
First Periodical	**Second Periodical**	**Practical Assessments**	**Observation / Lab records as**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**

Assessment	**Assessment**		**approved by the Department Examination Committee "DEC"**			
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	This course explores data visualization techniques, covering design principles, tools, and methods for transforming data into actionable insights. Students will gain hands-on experience with tools like D3.js and Tableau to create interactive and dynamic visualizations.					
Course Objective	1. To understand the fundamentals of data visualization. 2. To know the working principles of various information visualization depth tools. 3. To acquire knowledge about the issues in data representation. 4. To visualize the Data using tools Tableau. 5. To gain skill in designing real time interactive information visualization systems.					
Course Outcome	Upon completion of this course, the students will be able to 1. Apply mathematics and basic science knowledge for designing information visualization systems. 2. Collect data ethically and solve engineering problems in visualizing the information. 3. Implement algorithms and techniques for interactive information visualization. 4. Conduct experiments by applying various modern visualization tools and solve the space layout problem. 5. Analyze and design systems to visualize multidisciplinary multivariate Data individually or in teams.					
Prerequisites: Knowledge of Data analysis, Programming						

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**3**	**3**
CO2	**1**	**1**	**3**	**2**	**1**	**-**	**-**	**1**	**3**	**3**
CO3	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**1**	**3**	**3**
CO4	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**1**	**3**	**3**
CO5	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**1**	**3**	**3**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION	**(9L+6P=12)**
Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools. Mapping - Time Series - Connections and Correlations - Scatter Plot Maps - Trees, Hierarchies. **Self Study:** Recursion - Networks and Graphs **Lab:** 1. Visualize and interpret time series data using various chart types. 2. Explore the concept of connections and correlations in data by creating and interpreting scatter plots. 3. To visualize hierarchical data structures using tree maps, a space-filling visualization method.	**CO-1** **BTL-3**
MODULE 2: VISUALIZATION TECHNIQUES FOR TIME-SERIES, TREES & GRAPHS	**(9L+6P=12)**
Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Infographics. **Self Study:** Time Series Visualizations, Visualizing Complex Networks **LAB :** 1. Explore Visualizing Data with Time Series and Correlations.	**CO-2** **BTL-3**

2. Explore Hierarchical Visualization and Mapping Connections. 3. Visualize Data with Multiple Charts and Interactive Dashboards.	
MODULE 3: TEXT AND DOCUMENT VISUALIZATION	**(9L+6P=12)**
Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Web Techniques, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions, Grammars and BNF Notation, Compressed Data. **Self Study:** Vectors and Geometry, Binary Data Formats, Advanced Detective Work **LAB :** 1. Parsing and Extracting Data from Text Files and HTML Pages 2. Data Parsing-Using BNF Notation and Grammars 3. Web Scraping and Storing Data in Databases	**CO-3** **BTL-3**
MODULE 4: INTERACTIVE DATA VISUALIZATION	**(9L+6P=12)**
Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – D3.js, Tableau Dashboards. **Self Study:** Building Effective Dashboards with Tableau, Interactive Data Visualizations Using D3.js. **LAB :** 1. Interactive Data Visualization with D3.js. 2. Dashboard Creation in Tableau. 3. Geospatial Data Visualization and Mapping. 4. Animated Data Visualizations and Transitions with D3.js.	**CO-4** **BTL-3**
MODULE 5: SECURITY IN DATA VISUALIZATION	**(9L+6P=12)**
Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system. **Self Study:** Visualizing Network Security, Intrusion Detection and Firewall Log Visualization for Security Monitoring. **LAB:** 1. Visualizing Port Scan Data. 2. Firewall Log Visualization. 3. Intrusion Detection Log Visualization.	**CO-5** **BTL-3**

4. Securing Visualization Systems. 5. Attacking and Defending Data Visualization Systems.	

TEXT BOOKS	
1.	Robert Spence (2014), *Information Visualization an Introduction*, Third Edition, Pearson Education, Springer, Heidelberg, Germany.
REFERENCE BOOKS	
1.	Colin Ware (2012), *Information Visualization Perception for Design*, Third edition, Morgan Kaufmann Publishers United Kingdom.
2.	Robert Spence (2006), *Information Visualization Design for Interaction*, Second Edition, Pearson Education, Georgia Institute of Technology, Georgia.
3.	Benjamin Benderson and Ben Shneiderman (2003), *The Craft of Information Visualization*, Morgan Kaufmann Publishers Laboratory at the University of Maryland.
E BOOKS	
1.	https://books.google.co.in/books/about/Data_Visualization.html?id=v7gfEQAAQBAJ&redir_esc=y

MOOC	
1.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/?v=c86ee0d9d7ed.
2.	https://www.coursera.org/learn/datavisualization.
3.	https://www.coursera.org/courses?query=data%20 visualization.

COURSE TITLE	VERBAL REASONING AND INTERVIEW SKILLS			CREDIT	1
COURSE CODE	GLS51007	COURSE CATEGORY	HS	L-T-P-S	1 – 0 – 1 - 1
Version	0.0	Approval Details		LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME						
CIA					ESE	
First Periodical Assessment	Second Periodical Assessment	Practical	Surprise Test / Quiz., as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical
15 %	15%	10 %	5 %	5 %	25 %	25 %

Course Description	This course seeks to enhance their verbal thinking abilities and employment skills. In the course, students learn how to use their newly acquired speaking skills to compete in the outside world. Students who participate in this course will master the speaking techniques necessary to maximize their potential through practice with verbal reasoning.
Course Objective	1. To enhance verbal thinking skills for ordinary public speaking. 2. To assist students in becoming better debaters and verbal analysts by preparing them with verbal analyses. 3. To improve speaking abilities and advance to the right stage using thinking abilities. 4. Gaining the capacity to evaluate one's speaking abilities and put them to use in practice. 5. Making recommendations on how to strengthen your verbal communication skills through regular practice.
Course Outcome	Upon completion of this course, the students will be able to 1. Illustrate verbal ability skill. 2. Develop verbal reasoning ability to improve logical reasoning skills. 3. Analyse language strategies and techniques for speaking in formal and informal professional contexts. 4. Enhance the ability to use linguistic structures and vocabulary in professional contexts. 5. Develop the ability to prepare and present professional skills and knowledge in a convincing manner.

Prerequisites: Intermediate Level

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
CO2	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
CO3	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
CO4	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
CO5	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: VERBAL REASONING SKILLS	**(3L+P)**
Introduction to Verbal Reasoning – Analogy – Classification - Coding-Decoding - Blood Relations - Puzzle Test - Sequential Output Tracing - Direction Sense Test - Logical Sense Test - Logical Venn Diagrams - Alphabet Test	**CO-1** **BTL-2**
MODULE 2 : PRACTICING VERBAL REASONING QUESTIONS	**(3L+P)**
Practice on – Logic - Statement Arguments reasoning-ability - Statement Assumptions - Statement Courses of Action - Statement Conclusions - Deriving Conclusion From Passages - Theme Detection - Cause and Effect Reasoning	**CO-2** **BTL-3**
MODULE 3 : UNDERSTANDING INTERVIEW	**(3L+P)**
What is an Interview? - Types of Interviews - Other assessment methods – Why do interviews take place? What Happens in an interview – What are interviews about? What leads to Success in Interviews ? Providing proof that you are the right candidate – the most common mistakes – De-mystifying the interview – Stressing your contribution	**CO-3** **BTL-3**
MODULE 4: LANGUAGE ACCURACY IN INTERVIEW	**(3L+P)**
Importance of personal Image – creating a positive first impression – appearance – Behaviour – confidence – positive mental attitude – the journey – voice – controlling nerves – Giving a presentation – types of presentation – preparing a presentation – rehearsing your presentation – using visual aids.	**CO-4** **BTL-3**
MODULE 5: PROFESSIONAL PRESENTATION OF THE PERSONAL SKILLS AND KNOWLEDGE	**(3L+P)**

Examples of Interview questions and answers – dealing with tricky situations – internal vacancies – money – Step-by-step checklist – learning from experience – other sources of help.	**CO-5 BTL-4**
TEXT BOOKS	
1	Aggarwal. R.S. (2018). A Modern Approach To Verbal Reasoning. S Chand Publishing; 2nd edition. India
2	Corfield. Rebecca(2019). Successful Interview Skills. Kogan Page Limited. London.
REFERENCE BOOKS	
1.	Examcart Experts. (2021). Examcart Latest Complete VERBAL & LOGICAL REASONING Practice Book For All Type of Government and Entrance Exam (Bank, SSC, Defense, Management (CAT, XAT GMAT), Railway, Police, Civil Services). Agrawal Examcat.India
2.	Lucents (2019), Verbal Reasoning in English for All Competitive Exams, Lucents Publications. India.
3.	Kumar. Krishan(2018). Personal Interview Skills. Friends Publications India. India.
E BOOKS	
1.	https://ccsuniversity.ac.in/bridge-library/magzine/Interview-Skills.pdf
2.	https://cdn.preterhuman.net/texts/employment/Interview%20Skills%20that%20Win%20the%20Job%20Simple%20techniques%20for%20answering%20all%20the%20tough%20questions%20-%20MICHAEL%20SPIROPOULOS.pdf
MOOC	
1.	https://www.coursera.org/specializations/english-interview-resume
2.	https://learning.tcsionhub.in/courses/career-creator/advanced-verbal-ability-online-course/

SEMESTER VI

COURSE TITLE	**ANALYSIS FOR PREDICTIVE MODELS**			**CREDIT**	**4**
COURSE CODE	**BMA01009**	**COURSE CATEGORY**	**CC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	To main objectives of teaching Analysis for Predictive Models are				
Course Objective	1. To introduce students to the fundamentals of Predictive Analytics. 2. To enable students to understand the components of Logistic Regression. 3. To understand and apply basic machine learning models. 4. To equip students with time series forecasting techniques. 5. To learn basic document creation and editing skills.				
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the application of Predictive Analytics in the IT environment. 2. Acquire the meaning and benefits of Predictive analytics 3. Explore key machine learning models for classification and prediction. 4. Apply time series methods and extract relevant features for forecasting. 5. Create and edit structured digital documents effectively.				
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establish random variables.					

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**1**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**1**	**3**	**1**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**1**
CO5	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: MODEL ASSESSMENT AND SELECTION	**(9L+3T=12)**
Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate, Estimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, conditional or expected test error. **Self-Study:** Bayesian approach and BIC, Cross- validation	**CO-1** **BTL-3**
MODULE 2: ADDITIVE MODELS, TREES, AND BOOSTING	**(9L+3T=12)**
Generalized additive models, Regression and classification trees, Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples**.** **Self-Study:** Generalized additive models.	**CO-2** **BTL-3**
MODULE 3: NEURAL NETWORKS, SUPPORT VECTOR MACHINES, K-NEAREST NEIGHBOR	**(9L+3T=12)**
Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest –Neighbour classifiers (Image Scene Classification). **Self-Study:** Reproducing Kernels.	**CO-3** **BTL-3**
MODULE 4: TIME SERIES METHODS IN FORECASTING, FEATURE EXTRACTION	**(9L+3T=12)**
Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height. Average, Energy etc and analyze for prediction.	**CO-4** **BTL-3**

Self-Study: Arima, Measures of Forecast Accuracy.	
MODULE 5: WORKING WITH DOCUMENTS	**(9L+3T=12)**
Standard Operating Procedures for documentation and knowledge sharing, defining purpose and scope documents, understanding structure of documents — case studies, art ides, white papers, technical reports, minutes of meeting etc., Style and format, Intellectual Property and Copyright, Document preparation tools**.** **Self-Study:** Standard Operating Procedures for documentation and knowledge sharing	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Gareth James' Daniela Witten Trevor Hastie Robert Tibshirani (2009), An *Introduction to Statistical Learning with Applications in R,* Pushpa Publishing company, Singapore.
2.	Hastie, Trevor, Robert Tibshirani, and Jerome Friedman (2009), *The Elements of Statistical Learning: Data Mining, Inference, and Prediction,* Second Edition, Springer, Switzerland.
REFERENCE BOOKS	
1.	G. James, D. Witten, T. Hastie, Trispirane (2011), *An introduction to statistical learning with applications* in Springer, Germany.
2.	E. Alpaydin (2010), *Introduction to Machine Learning*, Prentice Hall of India.
E BOOKS	
1.	https://benthambooks.com/book/9789811490491/
2.	https://intranel.com/resources/ebook-predictive-analytics-in-action/

MOOC	
1.	https://www.my-mooc.com/en/mooc/predictive-modeling-in-learning-analytics
2.	https://www.mooc-list.com/tags/predictive-analytics.

COURSE TITLE	BIG DATA ANALYTICS			CREDIT	4
COURSE CODE	BDS01007	COURSE CATEGORY	CC	L-T-P-S	3-1-0-1
Version	0.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course covers the fundamentals of computer systems design, including Boolean logic, digital architecture, assembly language, virtual machines, and compiler construction. Students will gain hands-on experience in designing and programming low-level systems to understand the interaction between hardware and software.				
Course Objective	1. To understand big data. 2. To learn and use NoSQL big data management. 3. To learn map reduce analytics using Hadoop and related tools. 4. To work with map reduce applications 5. To understand the usage of Hadoop related tools for Big Data Analytics				
Course Outcome	Upon completion of this course, the students will be able to 1. Describe big data and use cases from selected business domains. 2. Explain NoSQL big data management. 3. Install, configure, and run Hadoop and HDFS. 4. Perform map-reduce analytics using Hadoop. 5. Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.				
Prerequisites: Knowledge of Boolean Algebra, Basic Programming Language					

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**1**	**1**	**1**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: UNDERSTANDING BIG DATA	**(9L+3T=12)**
Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open 87 source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics. **Self-Study:** Big Data Technologies and Hadoop Ecosystem, Big Data Applications and Industry Use Cases	**CO-1** **BTL-3**
MODULE 2: NOSQL DATA MANAGEMENT	**(9L+3T=12)**
Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients **Self-Study:** NoSQL Databases and Data Models, Cassandra Data Model and Consistency Mechanisms	**CO-2** **BTL-3**
MODULE 3: MAP REDUCE APPLICATIONS	**(9L+3T=12)**
MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats. **Self-Study:** MapReduce Workflows and Job Execution, Testing MapReduce Jobs and Failures in MapReduce and YARN	**CO-3** **BTL-3**

MODULE 4: BASICS OF HADOOP	**(9L+3T=12)**
Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration **Self-Study:** Hadoop Ecosystem: HDFS, Hadoop I/O, and Data Flow, Cassandra Integration with Hadoop and Big Data Processing.	**CO-4** **BTL-3**
MODULE 5: HADOOP RELATED TOOLS	**(9L+3T=12)**
Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries. **Self-Study:** HBase Data Model and Client Operations, Pig Latin Scripting and HiveQL for Data Processing	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Seema Acharya (2015), *Big Data and Analytics*, Wiley, India.
2.	Viktor Mayer-Schonberger *(2013), Big Data: A Revolution That Will Transform How We Live, Work, and Think*, Houghton Mifflin Harcourt, USA.
REFERENCE BOOKS	
1.	Michael Minelli (2013), *Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*, Wily, India.
E BOOKS	
1.	https://craftinginterpreters.com/

MOOC	
1.	Introduction to Logic (Coursera)
2.	https://www.coursera.org/learn/computer-systems
3.	https://www.coursera.org/learn/assembly-language-programming
4.	https://www.coursera.org/learn/compilers

COURSE TITLE	PROJECT			CREDITS	8
COURSE CODE	BMA01801	COURSE CATEGORY	RP	L-T-P-S	0-0-16-0
Version	0.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
CIA	80%		ESE		20%
Course Outcome	Upon completion of the project, the students will be able to 1. Identify real-world data-related challenges and understand their relevance to societal needs. 2. Develop practical, data-driven solutions to address societal problems using mathematical and data science techniques. 3. Apply advanced mathematical models, algorithms, and machine learning methods to solve complex problems. 4. Communicate analytical findings clearly, demonstrating the impact of data science on decision-making in various sectors. 5. Strengthen problem-solving and critical thinking skills, enhancing their ability to innovate and drive positive change using data science.				

CO, PO AND PSO MAPPING										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	1	3	-	-	1	1	2	2
CO2	1	1	1	3	-	-	1	1	2	2
CO3	1	1	1	3	2	-	2	1	2	2
CO4	1	1	1	3	2	2	2	1	2	2
CO5	1	1	1	3	2	2	2	1	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related										

PROJECT
In this project, students will design and develop data-driven solutions to real-world challenges in mathematics and data science. Utilizing relevant software tools and programming languages, they will apply theoretical knowledge from previous semesters to tackle complex problems in data analysis, machine learning, and statistical modeling. The project will culminate in a detailed report outlining the methodologies, solutions, and outcomes of their work.
Assessment is made as follows
Assessment Model: LE

Review / Exam	**Weightage**
First Review	20%
Second Review	20%
Third Review	10%
Project Report & Viva- Voce	50%
TOTAL	**100%**

LIST OF DEPARTMENTAL ELECTIVES – OFFERED BY DEPARTMENT OF MATHEMATICS

COURSE TITLE	ADVANCED CALCULUS			CREDIT		3
COURSE CODE	BMA01500	COURSE CATEGORY	DE	L-T-P-S		2-0-2-1
Version	1.0	Approval Details		LEARNING LEVEL		BTL-3
ASSESSMENT SCHEME						
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to the fundamentals of multivariable calculus, emphasizing key theorems and practical applications through lab-based learning..					
Course Objective	1. To introduce the fundamentals of partial differentiation and its applications in multivariable functions. 2. To equip with skills in vector calculus and integral theorems such as Green's, Gauss's, and Stokes. 3. To enable the application of multivariable calculus concepts in solving real-world and engineering problems. 4. To develop analytical and critical thinking skills through the study of Jacobians, optimization, and transformation techniques.					

Course Outcome	Upon completion of this course, the students will be able to 1. Compute derivatives of multivariable functions. 2. Apply Jacobians for determining functional dependence. 3. Solve optimization problems using Lagrange multipliers. 4. Evaluate surface integrals of scalar and vector fields. 5. Evaluate volume integrals using the Stoke's Theorem.
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establishing random variables.	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**	**1**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**	**1**
CO3	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**1**	**1**
CO4	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**1**	**1**
CO5	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: PARTIAL DIFFERENTIATION	**(6L+6P=9)**
Functions of several variables - Homogeneous functions - Total derivative - Higher order Derivatives, Equality of cross derivatives - Differentials - Directional Derivatives. **Self-Study:** Homogeneous functions. **Lab:** 1. Exploring and Visualizing Homogeneous Functions and Their Degree 2. Numerical and Analytical Calculation of Directional Derivatives and Total Derivative	**CO-1** **BTL-3**
MODULE 2: IMPLICIT FUNCTIONS AND INVERSE FUNCTIONS	**(6L+6P=9)**

Implicit functions - Higher order derivatives - Jacobians - Dependent and independent variables-The inverse of a transformation – Inverse function theorem – Change of variables – Implicit function theorem - Functional dependence – Simultaneous equations. **Self-Study:** Dependent and independent variables. **Lab:** 1. Solving and Visualizing Implicit Functions and Jacobian Matrices 2. Using the Inverse Function Theorem for Change of Variables and Functional Dependence	**CO-2** **BTL-3**
MODULE 3: TAYLOR'S THEOREM AND APPLICATIONS	**((6L+6P=9)**
Taylor's theorem for functions of two variables - Maxima and Minima of functions of two and three variables – Lagrange Multipliers. **Self-Study:** Taylor's theorem for functions of two variables. **Lab:** 1. Taylor's Theorem for Functions of Two Variables 2. Maxima, Minima, and Lagrange Multipliers for Multivariable Functions	**CO-3** **BTL-3**
MODULE 4: LINE AND SURFACE INTEGRALS	**(6L+6P=9)**
Definition of line integrals - Green's theorem - Applications - Surface integrals - Gauss theorem Verification of Green's and Gauss theorems. **Self-Study:** Green's theorem. **Lab:** 1. Computing Line Integrals and Verifying Green's Theorem 2. Surface Integrals and Verifying Gauss's Theorem	**CO-4** **BTL-3**
MODULE 5: TRANSFORMATION AND LINE INTEGRALS IN SPACE	**(6L+6P=9)**
Change of variables in multiple integrals - Definition of line integrals in space - Stoke's theorem - Verification of Stoke's theorem. **Self-Study:** Change of variables in multiple integrals. **Lab:** 1. Change of Variables in Multiple Integrals and Verifying Stokes' Theorem 2. Implementation and Verification of Stokes' Theorem	**CO-5** **BTL-3**
TEXT BOOKS	

1.	Kaplan W (2003), *Advanced Calculus*, Addison Wesley, Fifth Edition, Boston.
2.	Widder D.V (2002), *Advanced Calculus*, Prentice Hall of India, Second Edition, New Delhi, 2002.
REFERENCE BOOKS	
1.	James Stewart, Daniel Clegg and Saleem Watson (2015), *Multivariable Calculus*, 9th Edition, Cengage Learning, Boston.
2.	Carlos Polanzo (2019), *Advanced Calculus*, Bentham Science Publishers Pvt Ltd., Singapore.
E BOOKS	
1.	https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/John-M.-Howie-https://www.researchgate.net/publication/334391360_ADVANCED_CALCULUS_FUNDAMENTALS_OF_MATHEMATICS
2.	https://benthambooks.com/ebook-files/sample-files/9789814998789-sample.pdf

MOOC						
1.	https://www.coursera.org/learn/introduction-to-advanced-calculus					
2.	https://onlinecourses.nptel.ac.in/noc23_ma86/preview					
COURSE TITLE	**COMPLEX ANALYSIS**			**CREDIT**		**3**
COURSE CODE	**BMA01501**	**COURSE CATEGORY**	**DE**	**L-T-P-S**		**2-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**		**BTL-3**
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**

15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to the fundamentals of equations and series, emphasizing theory and applications.					
Course Objective	1. To understand analytic functions and their significance in complex analysis. 2. To apply contour integration techniques to evaluate complex integrals. 3. To analyze convergence of sequences and series, including absolute and uniform types. 4. To expand Taylor series for analytic functions in practical contexts. 5. To explore the properties and relationships of zeros and poles in analytic functions.					
Course Outcome	Upon completion of this course, the students will be able to 1. Apply Cauchy-Riemann equations to test the analyticity. 2. Evaluate the contour integrals. 3. Analyze the convergence of sequence and series. 4. Identify and classify the singularities and compute the residues. 5. Analyze and construct the conformal mapping.					
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establish random variables.						

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO3	**1**	**1**	**3**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO4	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**-**	**-**
CO5	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**-**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: ANALYTIC FUNCTIONS	**(6L+6P=9)**
Functions of a Complex variable - Limits - Theorems on Limits - Limits involving the Point at Infinity – Continuity – Derivatives - Cauchy - Riemann Equations - Sufficient Conditions for Differentiability - Polar Coordinates - Analytic Functions – Examples - Harmonic Functions. **Self-Study:** Functions of a Complex variable – Limits. **Lab:** 1. Visualization and Verification of Analytic Functions Using Cauchy-Riemann Equations 2. Harmonic Functions and Polar Coordinates	**CO-1** **BTL-3**
MODULE 2: COMPLEX INTEGRATION	**(6L+6P=9)**
Contours-Contour Integrals-Some examples-Cauchy - Goursat Theorem-Proof of the Theorem-Simply Connected Domains-Multiply Connected Domains-Cauchy Integral Formula-An Extension of the Cauchy Integral Formula- Liouville‘s Theorem and the Fundamental Theorem of Algebra. **Self-Study:** Multiply Connected Domains-Cauchy Integral Formula-An Extension of the Cauchy Integral Formula. **Lab:** 1. Evaluation of Contour Integrals and Verification of the Cauchy-Goursat Theorem 2. Application of the Cauchy Integral Formula and Liouville's Theorem	**CO-2** **BTL-3**
MODULE 3: SEQUENCE AND SERIES	**(6L+6P=9)**
Convergence of Sequences-Convergence of Series- Taylor Series-Proof of Taylor‘s Theorem-Examples-Laurent Series-Proof of Laurent‘s Theorem- Examples. **Self-Study:** Convergence of Sequences-Convergence of Series- Taylor Series.	**CO-3** **BTL-3**
MODULE 4: RESIDUES AND POLES	**(6L+6P=9)**
Isolated Singular Points- Residues- Cauchy Residue Theorem-Residue at Infinity-The Three Types of Isolated Singular Points- Residues at Poles- Examples-Zeros of Analytic Functions-Zeros and poles. **Self-Study:** Residues at Poles- Examples-Zeros of Analytic Functions-Zeros and poles.	**CO-4** **BTL-3**

Lab: 1. Convergence of Sequences and Series & Taylor Series Expansion 2. Laurent Series and Proof of Laurent's Theorem	
MODULE 5: CONFORMAL MAPPING	**(6L+6P=9)**
Linear Transformations-The Transformation w=1/z - Mappings by 1/z – Linear Fractional Transformations – An Implicit Form. Conformal Mapping: Preservation of Angles- Scale Factors-Local Inverse. **Self-Study:** Linear Transformations-The Transformation w=1/z and Conformal Mapping. **Lab:** 1. Visualization of Linear Transformations and the Transformation w=1/z 2. Linear Fractional Transformations and Conformal Mapping with Applications	**CO-5** **BTL-3**

TEXT BOOKS	
1.	James Ward Brown and Ruel V. Churchill (2004), *Complex Variables and Applications*, McGraw Hill, Inc.
REFERENCE BOOKS	
1	T. K. Manickavachagam Pillai (2009), *Complex Analysis*, S. Viswanathan Publishers Pvt. Ltd, India.
2.	Duraipandian, P. and Laxmi Duraipandian (2001), *Complex Analysis*, Emerald, Publishers, Chennai.
E BOOKS	
1.	https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/John-M.-Howie-Complex-Analysis-Springer-Undergraduate-Mathematics-Series-Springer-2007.pdf
2.	https://homepages.uc.edu/~herronda/complex_analysis/Texts/Intro2ComplexAnalysis.pdf
3.	https://fac.iitg.ac.in/charu/courses/ph503/book.pdf

MOOC	
1.	https://www.coursera.org/learn/complex-analysis
2.	https://onlinecourses.nptel.ac.in/noc20_ma50/preview

COURSE TITLE	COMPUTATIONAL LINEAR ALGEBRA			CREDIT		3
COURSE CODE	BMA01502	COURSE CATEGORY	DE	L-T-P-S		2-0-2-1
Version	0.0	Approval Details		LEARNING LEVEL		BTL-3
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to advanced concepts in linear algebra including vector spaces, linear transformations, canonical forms, and inner product spaces, with real-world applications.					
Course Objective	1. To build a strong foundation in finite-dimensional vector spaces and linear transformations. 2. To analyze linear functionals through characteristic values and annihilating polynomials. 3. To explore invariant subspaces and apply the primary decomposition theorem. 4. To understand Jordan and triangular forms. 5. To introduce inner product spaces and examine their algebraic structures.					
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the knowledge of linear transformations. 2. Apply linear functionals and compute eigenvalues. 3. Understand the concepts of direct sum. 4. Construct the Jordan canonical forms.					

	5. Explore the inner product space.

Prerequisites: Knowledge of collection to editing of primary data, secondary data and establish random variables.

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	-	-	2	-	-
CO2	1	1	3	-	-	-	-	2	-	-
CO3	1	1	3	-	-	-	1	2	-	-
CO4	1	1	3	-	1	-	1	2	-	-
CO5	1	1	3	-	1	-	1	2	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: VECTOR SPACE AND LINEAR TRANSFORMATIONS	**(6L+6P=9)**
Vector Spaces – Subspaces – Bases and Dimension– Computations Concerning Subspaces - Linear transformations – The Algebra of Linear transformations – isomorphism – Representation of transformations by matrices. **Self-Study:** Vector Spaces – Subspaces – Bases and Dimension. **Lab:** 1. Exploration of Vector Spaces, Subspaces, and Linear Transformations 2. Linear Transformations, Isomorphisms, and Matrix Representation in MATLAB	**CO-1** **BTL-3**
MODULE 2: LINEAR FUNCTIONALS AND ANNIHILATING POLYNOMIALS	**6L+6P=9)**
Linear Functionals – The Double Dual – Transpose of Linear Transformation – Characteristic Values - Annihilating Polynomials. **Self-Study:** Linear Functionals **Lab:** 1. Linear Functionals, Double Dual, and the Transpose of Linear Transformations. 2. Characteristic Values and Annihilating Polynomials	**CO-2** **BTL-3**
MODULE 3: DIRECT SUM AND DECOMPOSITION THEOREM	**(6L+6P=9)**

Subspaces – Direct-Sum Decomposition – Invariant Direct Sums -The Decomposition Theorem. **Self-Study:** Subspaces – Direct-Sum Decomposition. **Lab:** 1. Exploring Subspaces, Direct-Sum Decomposition, and Invariant Direct Sums 2. Primary Decomposition Theorem and Subspace Decompositions	**CO-3** **BTL-3**
MODULE 4: CANONICAL FORMS	**(6L+6P=9)**
Triangular Form – Nilpotent Transformations – Jordan form-Triangularization of Complex Matrices-Minimal Polynomial-Applications in Control Theory: Comparison of Diagonalizability and Jordan Form-Powers of Nilpotent Matrices-Primary Decomposition Theorem **Self-Study:** Jordan form. **Lab:** 1. Triangular Form and Jordan Canonical Form Computation 2. Applications in Control Theory and Primary Decomposition Theorem	**CO-4** **BTL-3**
MODULE 5: INNER PRODUCT SPACES	**(6L+6P=9)**
Inner products - Inner product spaces - Linear Functionals and Adjoints, - Unitary Operators - Normal Operators **Self-Study:** Inner products - Inner product spaces. **Lab:** 1. Exploring the Inner Product Spaces. 2. Implementation of Unit and Normal Operators	**CO-5** **BTL-3**

TEXT BOOKS

1.	Kinkaid, D., and Chenny, W. (2013), *Linear Algebra: Theory and Applications, 2nd Edition*, Brooks/Cole: Cengage Learning, USA.
2.	Halmos P.R (2017), *Finite - dimensional Vector spaces*, Courier Dover Publications, New York.
3.	Herstein I.N (2008), *Topics in Algebra*, Wiley Eastern Limited, Second Edition, New York.

REFERENCE BOOKS

1.	Hoffmann K. and Kunze R (2015), *Linear Algebra*, Pearson Education, Second Edition, Noida.

2.	Kumaresan S (2014), *Linear Algebra: A Geometric Approach*, Prentice Hall of India, New Delhi.
3.	Strang G (2017), *Linear Algebra and its applications*, Thomson Brooks, Cengage learning, 4th Edition, New Delhi.
E BOOKS	
1.	https://rksmvv.ac.in/wpcontent/uploads/2021/04/Gilbert_Strang_Linear_Algebra_and_Its_Applicatio_230928_225121.pdf
2.	https://www.mathstat.dal.ca/~selinger/linear-algebra/downloads/LinearAlgebra.pdf

MOOC	
1.	https://www.coursera.org/courses?query=linear%20algebra
2.	https://www.coursera.org/courses?query=linear%20algebra

COURSE TITLE	**NUMBER THEORY AND CRYPTOGRAPHY**			**CREDIT**	**3**	
COURSE CODE	**BMA01503**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-1**	
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examinati**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**

			on Committee "DEC"			
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	To expose students to algebraic structures and number theory, focusing on primes, divisibility, and elliptic curves in modern cryptography.					
Course Objective	1. To apply number theory concepts like primes, divisibility, and congruences in cryptography. 2. To explore modular arithmetic, Fermat's Little Theorem, and the Chinese Remainder Theorem in cryptographic contexts. 3. To apply symmetric ciphers, public-key cryptography, and RSA encryption. 4. To study Diophantine equations, Pell's equation, and elliptic curves in cryptography. 5. To explore elliptic curve cryptography (ECC) and its implications for secure communication.					
Course Outcome	Upon completion of this course, the students will be able to 1. Apply Euclidean algorithm to compute GCD, LCM. 2. Apply Chinese Remainder Theorem in cryptography. 3. Implement symmetric ciphers block ciphers in crypto system. 4. Solve Diophantine equations and apply in cryptography. 5. Explore pairing-based cryptography for secure communication.					
Prerequisites: Knowledge of Algebra, Discrete Mathematics						

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO3	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

CO4	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**2**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: PRIMES AND DIVISIBILITY	**(6L+6P=9)**
Division algorithm — Base — b representations — Number patterns — Prime and composite numbers — GCD — Euclidean algorithm — Fundamental theorem of arithmetic — LCM. **Self-Study:** Modular Arithmetic and its Applications, Prime Factorization and its Role in Cryptography. **Lab:** 1. Division Algorithm and Base-b Representations 2. GCD and LCM Calculation Using the Euclidean Algorithm 3. Prime Factorization and Number Patterns	**CO-1** **BTL-3**
MODULE 2: CONGRUENCES	**(6L+6P=9)**
Modular arithmetic, Consequences of Fermat's theorem, The Chinese Remainder Theorem ,Primality and compositeness testing, Groups, rings, and fields, Primitive roots, Prime power moduli and power residues**.** **Self-Study:** Sub rings, Quadratic Residues and the Law of Quadratic Reciprocity. **Lab:** 1. Modular Arithmetic and Fermat's Little Theorem 2. The Chinese Remainder Theorem and Applications. 3. Primality Testing and Power Residues	**CO-2** **BTL-3**
MODULE 3: INTRODUCTION TO CRYPTOGRAPHY	**(6L+6P=9)**
Symmetric ciphers ,Public key cryptography, Discrete log, RSA Cryptosystem Introduction to PARI, Breaking RSA. **Self-Study:** Timing Attacks and Cryptanalysis of RSA**,** Cryptanalysis of Symmetric Ciphers.	**CO-3** **BTL-3**

Lab: 1. Symmetric Ciphers and Block Cipher Implementation. 2. RSA Cryptosystem - Key Generation, Encryption, and Decryption 3. Breaking RSA - Factorization and the Discrete Log Problem.	
MODULE 4: DIOPHANTINE EQUATIONS	**(6L+6P=9)**
A first view of Diophantine equations, Quadratic Diophantine equations, Units in quadratic number rings, Pell's equation and related problems, Unique factorization in number rings, Elliptic curves, Elliptic curves over F_p. **Self-Study:** Advanced Solutions to Diophantine Equations, Elliptic Curve Cryptography (ECC) and Applications. **Lab:** 1. Solving Quadratic Diophantine Equations. 2. Pell's Equation and its Generalizations. **3.** Elliptic Curves and Cryptographic Applications over Finite Fields.	**CO-4** **BTL-3**
MODULE 5: ELLIPTIC CRYPTOSYSTEMS	**(6L+6P=9)**
Elliptic curve discrete log problem (ECDLP), Elliptic curve cryptography, Lenstra's factorization algorithm, Pairing-based cryptography, Divisors and the Weil pairing **Self-Study:** Post-Quantum Cryptography, Homomorphic Encryption. **Lab:** 1. Elliptic Curve Cryptography and ECDLP 2. Lenstra's Factorization Algorithm 3. Pairing-Based Cryptography and Weil Pairing	**CO-5** **BTL-3**

TEXT BOOKS

1.	Grimaldi, R.P and Ramana, B.V (2007), *Discrete and Combinatorial Mathematics*, Pearson Education, 5th Edition, New Delhi.
2.	Stallings, W. (2017), *Cryptography and Network Security: Principles and Practice*, Pearson, USA.

REFERENCE BOOKS

1.	Lidl, R. and Pitz, G (2006), *Applied Abstract Algebra*, Springer Verlag, New Delhi.
2.	Niven, I., Zuckerman's., and Montgomery, H.L (2004), *An Introduction to Theory of*

	Numbers, John Wiley and Sons, Singapore.
E BOOKS	
1.	https://www.taylorfrancis.com/books/mono/10.1201/9781315282497/cryptography-douglas-robert-stinson-maura-paterson
2.	https://www.ic.unicamp.br/~rdahab/cursos/mo421-mc889/Welcome_files/Stinson-Paterson_CryptographyTheoryAndPractice-CRC%20Press%20%282019%29.pdf
MOOC	
1.	https://www.coursera.org/learn/crypto
2.	https://www.khanacademy.org/computing/computer-science/cryptography
3.	https://www.khanacademy.org/computing/computer-science/cryptography

COURSE TITLE	**BUSINESS ANALYTICS**			**CREDIT**		**3**
COURSE CODE	**BMA01504**	**COURSE CATEGORY**	**DE**	**L-T-P-S**		**2-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**		**BTL-3**
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	To expose students to business analytics, focusing on data-driven solutions for forecasting, intelligence, HR, supply chain, and marketing challenges.
Course Objective	1. To understand the Analytics Life Cycle and its application in business. 2. To acquire and apply business intelligence techniques for informed decision-making. 3. To explore various predictive analytics models for business forecasting. 4. To model and analyze supply chain operations through analytics. 5. To apply analytics in HR, marketing, and sales for business optimization.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply analytics techniques to solve real-world business challenges. 2. Identify business processes for extracting Business Intelligence. 3. Apply predictive analytics for business forecasting. 4. Optimize supply chain and logistics with advanced analytics. 5. Utilize analytics tools to improve marketing strategies and sales.
Prerequisites: Knowledge of Statistics for Business, Data Management and Databases.	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO BUSINESS ANALYTICS	**(6L+6P=9)**
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration **Self-Study:** Understanding the Analytics Life Cycle, Hypothesis Generation	**CO-1** **BTL-3**

LAB: 1. Explore the features of Ms-Excel. 2. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) ii) Perform data import/export operations for different file formats. 3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis	
MODULE 2: BUSINESS INTELLIGENCE	**(6L+6P=9)**
Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence – OLAP – Analytic functions **Self-Study:** Data Warehouse, Data Mart **LAB:** 1. Perform Z-test, T-test & ANOVA 2. Perform data pre-processing operations i) Handling Missing data ii) Normalization 3. Perform dimensionality reduction operation using PCA, KPCA & SVD	**CO-2** **BTL-3**
MODULE 3: BUSINESS FORECASTING	**(6L+6P=9)**
Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics. **Self-Study:** Fundamentals of Business Forecasting, Applications of Predictive Analysis **LAB:** 1.Perform bivariate and multivariate analysis on the dataset. 2.Apply and explore various plotting functions on the data set.	**CO-3** **BTL-3**
MODULE 4: HR & SUPPLY CHAIN ANALYTICS	**(6L+6P=9)**
Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year. **Self-Study:** HR Planning and Recruitment, Recruitment Process	**CO-4** **BTL-3**

LAB: 1. Explore the features of Power BI Desktop 2. Prepare & Load data and develop the data model 3. Perform DAX calculations	
MODULE 5: MARKETING & SALES ANALYTICS	**(6L+6P=9)**
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales. **Self-Study:** Understanding Marketing Strategy, Strategic Planning **LAB:** 1. Design a report 2. Create a dashboard and perform data analysis 3. Presentation of a case study	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Evans, R. James (2017), *Business Analytics, 2nd Edition*, Pearson, USA.
2.	Rao, S.P. (2010), *Human Resource Management, 3rd Edition*, Excel Books, India.
3.	Mahadevan, B. (2018), *Operations Management - Theory and Practice, 3rd Edition*, Pearson Education, India.
REFERENCE BOOKS	
1.	R N Prasad, Seema Acharya (2016), *Fundamentals of Business Analytics*, 2nd Edition, Wiley.
2.	Kotler, Philip, and Kevin Keller (2016), *Marketing Management, 15th Edition*, PHI, India.
E BOOKS	
1.	https://ptgmedia.pearsoncmg.com/images/9780133552188/samplepages/0133552187.pdf
MOOC	
1.	https://www.coursera.org/specializations/business-analytics
2.	https://www.coursera.org/learn/data-driven-decision-making
3.	https://onlinecourses.nptel.ac.in/noc20_mg11/preview
4.	https://onlinecourses.swayam2.ac.in/arp19_ap79/preview
5.	https://onlinecourses.swayam2.ac.in/aic20_sp06/preview

COURSE TITLE	FINANCIAL ANALYTICS			CREDIT		3
COURSE CODE	BMA01505	COURSE CATEGORY	DE	L-T-P-S		2-0-2-1
Version	1.0	Approval Details		LEARNING LEVEL		BTL-3
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to practical financial analytics, covering corporate finance modeling, market analysis, portfolio management, technical forecasting, and credit risk.					
Course Objective	1. To understand the core principles of corporate finance and financial decision-making. 2. To gain a deep knowledge of financial markets, instruments, and institutions. 3. To learn portfolio construction techniques and evaluate the risk-return tradeoff. 4. To apply technical analysis methods for forecasting market trends. 5. To understand credit risk and its implications for financial institutions.					
Course Outcome	Upon completion of this course, the students will be able to 1. Analyze the impact of economic policies and indicators on financial markets. 2. Evaluate the investments with capital budgeting methods. 3. Optimize asset allocation using modern portfolio theory.					

	4. Develop trading strategies using technical analysis techniques. 5. Assess and mitigate credit risk with financial models.
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establishing random variables.	

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	1	1	2	1	1
CO2	1	1	3	1	-	1	1	2	1	1
CO3	1	1	3	2	2	2	1	2	1	1
CO4	1	1	3	2	2	2	1	2	1	1
CO5	1	1	3	2	2	2	1	2	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: CORPORATE FINANCE ANALYSIS	**(6L+6P=9)**
Basic corporate financial predictive modeling- Project analysis- cash flow analysis- cost of capital using sensitivity analysis, Indifference point and Financial Break-even modeling, Capital Budget Model-Payback, NPV, IRR, and MIRR. Bankruptcy Modeling Beaver t test, Ohison logistic regression and Alt man Z score. **Self-Study:** Basic corporate financial predictive modeling. **Lab:** 1. Capital Budgeting and Sensitivity Analysis using NPV, IRR, and Payback Period 2. Bankruptcy Modeling using Beaver T-Test, Ohlson Logistic Regression, and Altman Z-Score	**CO-1** **BTL-3**
MODULE 2: FINANCIAL MARKET ANALYSIS	**(6L+6P=9)**
Estimation and prediction of risk and return (bond investment and stock investment) – adjusting for stock splits, adjusting for mergers, plotting multiple series, data importing from web portal and data cleansing. Time series- examining nature of data, EWMOA, Value at risk, ARMA, ARCH and GARCH.	**CO-2** **BTL-3**

Self-Study: Estimation and prediction of risk and return. **Lab:** 1. Estimating and Predicting Stock Returns and Risk with Adjustments for Stock Splits and Mergers 2. Time Series Analysis Using ARMA, ARCH, and GARCH for Risk Prediction	
MODULE 3: PORTFOLIO ANALYSIS	**(6L+6P=9)**
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Markowitz's mean variance optimization model and cluster analysis for categorisation of portfolio. Option pricing models- binomial model for options, Black Scholes model and Option implied volatility. **Self-Study:** Portfolio Analysis – capital asset pricing model. **Lab:** 1. Portfolio Optimization using Markowitz's Mean-Variance Model and Capital Asset Pricing Model (CAPM) 2. Option Pricing using Binomial Model and Black-Scholes Model with Implied Volatility Calculation	**CO-3** **BTL-3**
MODULE 4: TECHNICAL ANALYSIS	**(6L+6P=9)**
Prediction using chart and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices using machine learning-ANN and SVM. **Self-Study:** Prediction using chart and fundamentals. **Lab:** 1. Technical Analysis for Share Price Prediction Using RSI, MACD, and Moving Averages 2. Predicting Stock Prices Using Machine Learning Algorithms: ANN and SVM.	**CO-4** **BTL-3**
MODULE 5: CREDIT RISK ANALYSIS	**(6L+6P=9)**
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model. **Self-Study:** Feature Engineering and Data Preprocessing for Credit Risk Models, Model Evaluation Metrics for Credit Risk Prediction	**CO-5** **BTL-3**

Lab: 1. Credit Risk Prediction Using Decision Trees 2. Credit Risk Modeling Using Logistic Regression	

TEXT BOOKS	
1.	Pavel Ryzhov (2013), *Haskell Financial Data Modeling and Predictive Analytics*, Lomonosov Moscow State University in Russia.
2.	Edward E Williams, John A Dobelman (2017), *Quantitative Financial Analytics: The Path to Investment Profits*, World Scientific Publishing, Singapore.
REFERENCE BOOKS	
1	Yuxing Yan (2017), *Python for Finance*, McGill University.
2.	James Ma Weiming (2015), *Mastering Python for Finance*, Nanyang Technological University,Singapore.
E BOOKS	
1	https://ebooks.lpude.in/newscheme/commerce/mcom/sem_4/DEFIN526_FINANCIAL_ANALYTICS.pdf
2.	https://www.in.gov/idoi/files/Financial-Analysis-Hanbook-2020.pdf

MOOC	
1.	https://onlinecourses.nptel.ac.in/noc25_mg01/preview
2.	https://onlinecourses.nptel.ac.in/noc25_mg01/preview

COURSE TITLE	**STATISTICAL INFERENCE**			**CREDIT**		**3**
COURSE CODE	**BMA01506**	**COURSE CATEGORY**	**DE**	**L-T-P-S**		**2-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**		**BTL-3**
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**

			the Department Examination Committee "DEC"			
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	To expose students to practical statistics for data-driven problem solving.
Course Objective	1. To apply estimation techniques for parameter inference from real data. 2. To master hypothesis testing for evidence-based decisions. 3. To introduce design of experiments frameworks for study planning. 4. To explore non-parametric tests for distribution-free data analysis. 5. To teach statistical quality control for process monitoring and improvement.
Course Outcome	Upon completion of this course, the students will be able to 1. Evaluate the estimation of parameters using method of moments. 2. Test the hypothesis for small and large samples. 3. Analyze the variances for two way and three-way classifications. 4. Apply non-parametric tests to test for randomness. 5. Compute the tolerant limits using control charts.
Prerequisites: Knowledge of Probability and Statistics, Algebra & Calculus	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**1**	**1**
CO2	**1**	**1**	**3**	**1**	**1**	**-**	**1**	**2**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**	**-**	**1**	**2**	**1**	**1**
CO4	**1**	**1**	**3**	**1**	**1**	**-**	**1**	**2**	**1**	**1**
CO5	**1**	**1**	**3**	**1**	**1**	**-**	**1**	**2**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: ESTIMATION THEORY **(6L+6P=9)**

Statistical Inference- Estimation of Parameters- Point Estimation-Interval Estimation-Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances. **Self-Study:** Exploring the Properties of Estimators, Maximum Likelihood Estimation (MLE) and Method of Moments **Lab:** 1. Estimation of Parameters using Method of Moments and Maximum Likelihood 2. Interval Estimation of Means and Variance Ratios	**CO-1** **BTL-3**
MODULE 2: TESTING OF HYPOTHESIS	**(6L+6P=9)**
Sampling distributions – Testing of Hypothesis –Small samples– t Test, F Test and Chi-square Test – Large samples– Single mean– Difference in means– single proportion and difference in proportions. **Self Study:** Large Sample Hypothesis Testing: Proportions and Means, Exploring t-Tests, F-Tests, and Chi-Square Tests for Small Samples. **Lab:** 1. Hypothesis Testing for Small Samples - t-Test, F-Test, and Chi-Square Test 2. Hypothesis Testing for Large Samples - Proportions and Means.	**CO-2** **BTL-3**
MODULE 3: DESIGN OF EXPERIMENTS	**(6L+6P=9)**
Analysis of variance– One Way Classification–Completely Randomized block design– Two Way Classification – Randomized block design – Latin Square design **Self-Study:** Analysis of variance **Lab:** 1. One-Way ANOVA and Completely Randomized Block Design 2. Two-Way ANOVA and Latin Square Design	**CO-3** **BTL-3**
MODULE 4: NON-PARAMETRIC TESTS	**(6L+6P=9)**
Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests **Self-Study:** Test of Randomness and Kolmogorov-Smirnov Test	**CO-4** **BTL-3**

Lab: 1. Non-Parametric Tests - Sign Test, Signed Rank Test, Rank-Sum Test, U Test, and H Test 2. Test of Randomness and Kolmogorov-Smirnov Test	
MODULE 5: STATISTICAL QUALITY CONTROL	**(6L+6P=9)**
Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling. **Self-Study:** Control Charts for Measurements and Attributes, Tolerance Limits and Acceptance Sampling Methods **Lab:** 1. Control Charts for Measurements ($\bar{X}$ and R charts) 2. Control Charts for Attributes (p, c, and np charts) and Tolerance Limits	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Johnson. R.A., Miller. I.R and Freund. J.E (2016), *Miller and Freund's Probability and Statistics for Engineers*, Pearson Education, Asia..
2.	Milton. J. S. and Arnold. J.C (2007), *Introduction to Probability and Statistics*, Tata Mc Graw Hill.
REFERENCE BOOKS	
1.	John E. Freund (1992), Mathematical Statistics", Prentice Hall, USA.
2.	Gupta. S.C. and Kapoor. V. K (2020), *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
E BOOKS	
1.	https://sde.uoc.ac.in/sites/default/files/sde_videos/STA4C04%20-%20Statistical%20Inference%20and%20Quality%20Control_0.pdf

MOOC	
1.	https://www.coursera.org/learn/statistical-inferences

COURSE TITLE	STOCHASTIC PROCESS			CREDIT		3
COURSE CODE	BMA01507	COURSE CATEGORY	DE	L-T-P-S		2-0-2-1
Version	0.0	Approval Details		LEARNING LEVEL		BTL-3
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to stochastic processes and simulations for modeling random phenomena.					
Course Objective	1. To classify and simulate basic stochastic processes across discrete and continuous spaces. 2. To analyze weakly and strongly stationary processes and implement MA/AR models. 3. To apply discrete-time Markov chain techniques to real-world problems. 4. To solve Kolmogorov-Feller equations and simulate processes in queueing and communication networks. 5. To explore renewal theory and Brownian motion for modeling in finance and regenerative systems.					
Course Outcome	Upon completion of this course, the students will be able to 1. Analyse the Markov chains. 2. Explore Weakly and Strongly Stationary Processes.					

	3. Compute transition probabilities and solve Markov problems. 4. Solve Kolmogorov differential equation. 5. Apply Ito's formula to explore renewal processes.
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establish random variables.	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO3	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**2**	**-**
CO4	**1**	**1**	**3**	**-**	**1**	**-**	**1**	**2**	**2**	**-**
CO5	**1**	**1**	**3**	**-**	**2**	**-**	**1**	**2**	**2**	**-**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO STOCHASTIC PROCESSES	**(6L+6P=9)**
Definition and examples of SPs, classification of random processes according to state space and parameter space, types of SPs, elementary problems. **Self-Study:** Definition and examples of SPs. **Lab:** 1. Simulating and Classifying Random Processes 2. Analyzing Markov Chains and Poisson Processes	**CO-1** **BTL-3**
MODULE 2: STATIONARY PROCESSES	**(6L+6P=9)**
Weakly stationary and strongly stationary processes, moving average and auto regressive processes. **Self-Study:** Weakly stationary and strongly stationary processes. **Lab:** 1. Exploring Weakly and Strongly Stationary Processes. 2. Simulating and Analyzing Moving Average and Autoregressive Processes.	**CO-2** **BTL-3**

MODULE 3: DISCRETE-TIME MARKOV CHAINS	**(6L+6P=9)**
Definition and examples of MCs, transition probability matrix, Chapman-Kolmogorov equations; calculation of n-step transition probabilities, limiting probabilities, classification of states, ergodicity, stationary distribution, transient MC; Random Walk and gambler's ruin problem, applications. **Self-Study:** Chapman-Kolmogorov equations. **Lab:** 1. Simulation of a Markov Chain and Transition Probability Matrix 2. Solving the Gambler's Ruin Problem using Markov Chains	**CO-3** **BTL-3**
MODULE 4: CONTINUOUS-TIME MARKOV CHAINS	**(6L+6P=9)**
Kolmogorov- Feller differential equations, infinitesimal generator, Poisson process, birth-death process, stochastic Petri net, applications to queueing theory and communication networks, Conditional expectations, definition and examples of martingales. **Self-Study:** Kolmogorov- Feller differential equations. **Lab:** 1. Simulation of Poisson Process and Birth-Death Process 2. Stochastic Petri Net for Queueing System and Communication Networks	**CO-4** **BTL-3**
MODULE 5: RENEWAL PROCESSES	**(6L+6P=9)**
Wiener process as a limit of random walk; process derived from Brownian motion, stochastic differential equation, stochastic integral equation, Ito formula, some important SDEs and their solutions, applications to finance, Renewal function and its properties, renewal theorems, cost/rewards associated with renewals, Markov renewal and regenerative processes, non-Markovian queues, applications of Markov regenerative processes. **Self-Study:** Wiener process as a limit of random walk. **Lab:** 1. Simulation of Wiener Process and Brownian Motion 2. Renewal Process and Applications to Queuing Systems	**CO-5** **BTL-3**
TEXT BOOKS	

1.	J. Medhi (2009), *Stochastic Processes*, 3rd Edition, New Age International, United Kingdom.
2.	S.M. Ross (1996), *Stochastic Processes*, 2nd Edition, Wiley.
REFERENCE BOOKS	
1	S Karlin and H M Taylor (1975), *A First Course in Stochastic Processes*, 2nd edition, Academic Press, Colorado State University.
E BOOKS	
1	https://people.math.harvard.edu/~knill/books/KnillProbability.pdf
2.	https://web.ma.utexas.edu/users/gordanz/notes/introduction_to_stochastic_processes.pdf

MOOC	
1.	https://onlinecourses.nptel.ac.in/noc19_ma30/preview
2.	https://onlinecourses.nptel.ac.in/noc20_mg01/preview

LIST OF DEPARTMENTAL ELECTIVES -OFFERED BY DEPARTMENT OF DATA SCIENCE

COURSE TITLE	ADVANCED DATABASE MANAGEMENT SYSTEMS			CREDIT		3
COURSE CODE	BDS01500	COURSE CATEGORY	DE	L-T-P-S		2-0-2-1
Version	0.0	Approval Details		LEARNING LEVEL		BTL-3
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to cutting-edge database paradigms, including relational, object-relational, NoSQL, and big data, for designing and managing next-generation data systems.					
Course Objective	1. To develop expertise in schema design for relational, object-oriented, and NoSQL databases. 2. To optimize disk structures, query processing, and transaction management on distributed platforms. 3. To explore temporal, spatial, multimedia, and deductive databases. 4. To apply modern information retrieval methods for real-time solutions. 5. To master big data and cloud platform integration for database management.					
Course Outcome	Upon completion of this course, the students will be able to 1. Optimise relational and object relational databases. 2. Explore disk management and data access methods. 3. Understand the fundamentals of NoSQL.					

	4. Develop data models for complex and multidimensional data. 5. Design and implement cloud database.
Prerequisites: Knowledge of collection to editing of primary data, secondary data and establishing random variables.	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: RELATIONAL & OBJECT-RELATIONAL DATABASES	**(6L+6P=9)**
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Object and Object-Relational Databases: Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard. **Self-Study:** Database architecture-transaction management. **LAB:** 1. Relational Database Design and Constraint Implementation 2. Object-Relational Database Design and Querying Using OQL.	**CO-1** **BTL-3**
MODULE 2: DISK STORAGE, FILE STRUCTURES, AND DISTRIBUTED DATABASES	**(6L+6P=9)**
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records	**CO-2** **BTL-3**

on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures. Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed. **Self-Study:** The importance of data models, Degrees of data abstraction. **LAB:** 1. File Organization and Hashing Techniques 2. Distributed Database Concepts, Data Fragmentation, and Replication	
MODULE 3: NOSQL DATABASES AND BIG DATA TECHNOLOGIES	**(6L+6P=9)**
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. Big Data Technologies Based on MapReduce and Hadoop: What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion. **Self-Study:** Relational Schemas, Introduction to UML Relational database model. **LAB:** 1. NoSQL Databases - MongoDB Implementation 2. Big Data Technologies - Hadoop and MapReduce	**CO-3** **BTL-3**
MODULE 4: ENHANCED DATA MODELS AND INFORMATION RETRIEVAL	**(6L+6P=9)**
Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases. Introduction to Information Retrieval and Web Search: Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval- AI and Machine Learning in Database Systems- Fault Tolerance and Recovery Mechanisms. **Self-Study:** Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	**CO-4** **BTL-3**

LAB: 1. Working with Temporal and Spatial Databases 2. Information Retrieval and Web Search Using Inverted Indexing	
MODULE 5: ADVANCED DATABASE ARCHITECTURES AND TECHNIQUES (6L+6P=9)	
Distributed Database Systems-Database Clustering and Replication- Data Partitioning and Sharding- Cloud-Based Database Architectures- Database Security and Privacy-Database Optimization and Query Processing-Transaction Management in Distributed Systems- Big Data Architectures: Hadoop & Spark- Graph Databases and Applications- Real-Time Data and Stream Processing- Blockchain in Databases. **Self-Study:** ACID properties, serializability and concurrency control, Lock based concurrency control. **LAB:** 1. Distributed Database Systems and Data Partitioning 2. Big Data Architectures (Hadoop & Spark) and Real-Time Stream Processing	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Elmasri and Navathe (2013), *Fundamentals of Database Systems*, Pearson Education, College of Computing Georgia Institute of Technology.
2.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan (2020), *Database System Concepts*, Seventh Edition, McGraw Hill.
REFERENCE BOOKS	
1	Raghu Ramakrishnan and Johannes Gehrke (2013), *Database Management Systems*, McGraw-Hill, 3rd Edition.
2.	Abraham Silberschatz, Henry F. Korth, S. Sudarshan (2010), Database *System Concepts*, McGraw Hill, 6th Edition.
E BOOKS	
1	https://archive.org/details/ramakrishnan-database-management-systems-3rd-edition
2.	https://books.google.co.in/books/about/Database_Management_Systems.html?id=unaPPwAACAAJ&redir_esc=y
3.	https://highered.mheducation.com/sites/0072465638/index.html

MOOC	
1.	https://link.springer.com/book/10.1007/978-3-7091-2704-9 2. 3. 4. 5.
2.	https://www.youtube.com/watch?v=_qbKMdqQS6E
3.	https://www.researchgate.net/publication/47393965_Data_warehousing_and_data_mining_A_case_study
4.	https://www.youtube.com/watch?v=ywTn9qHyI9I

COURSE TITLE	**DATA WAREHOUSING**			**CREDIT**		**3**
COURSE CODE	**BDS01501**	**COURSE CATEGORY**	**DE**	**L-T-P-S**		**2-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**		**BTL-3**
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	To expose students to data warehousing techniques for building and managing scalable ETL pipelines, OLAP systems, and metadata-driven marts.					
Course Objective	1. To design scalable three-tier, autonomous, and cloud-native data warehouse systems. 2. To develop dynamic ETL/ELT workflows and deploy ROLAP, MOLAP, and HOLAP models. 3. To implement metadata repositories and apply vertical/horizontal partitioning for faster data access. 4. To create and apply star, snowflake, and fact constellation schemas tailored					

	to analytical needs. 5. To ensure seamless data operations, efficient scheduling, and reliable performance.
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the fundamental of Data Warehousing. 2. Explore ETL tools and technologies. 3. Design and implement data marts. 4. Develop dimensional models and schemas. 5. Understand memory management and virtual memory.
Prerequisites: Knowledge of Database Management Systems, SQL and Data Querying Techniques	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**1**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**1**	**2**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**1**	**2**	**1**	**1**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**1**	**2**	**1**	**1**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**1**	**2**	**1**	**1**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: BASIC CONCEPT OF DATA WAREHOUSE	**(6L+6P=9)**
Data warehouse - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse. **Self-Study**: Cloud-Based Data Warehousing Solutions, ETL Processes and Data Integration Techniques	**CO-1** **BTL-3**

Lab: 1. Data exploration and integration with WEKA **2.** Apply Weka tool for data validation	
MODULE 2: ETL AND OLAP TECHNOLOGY	**(6L+6P=9)**
ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP. **Self-Study:** Data Warehouse Design Methodologies (Star Schema, Snowflake Schema), OLAP Cube Design and Optimization Techniques. **Lab:** 1. Plan the architecture for real time application 2. Write the query for schema definition	**CO-2** **BTL-3**
MODULE 3: META DATA MART AND PARTITION STRATEGY	**(6L+6P=9)**
Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition. **Self-Study:** Metadata Management and Best Practices, Data Mart Design and Optimization Techniques **Lab:** 1. Design data ware house for real time applications 2. Analyse the dimensional Modeling	**CO-3** **BTL-3**
MODULE 4: DIMENSIONAL MODELING AND SCHEMA	**(6L+6P=9)**
Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools **Self-Study:** Dimensional Modeling Techniques and Best Practices, Data Warehouse Parallel Processing and Performance Optimization. **Lab:** 1. Case study using OLAP 2. Case study using OTLP	**CO-4** **BTL-3**

MODULE 5: SYSTEM AND PROCESS MANAGERS	**(6L+6P=9)**
Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing. **Self-Study:** Data Warehouse Management and Process Optimization, Backup, Recovery, and System Maintenance in Data Warehousing **Lab:** **1.** Implementation of warehouse testing. **2.** Implementation of Query Optimization and Tuning Techniques in a Data Warehouse.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Alex Berson and Stephen J. Smithm (2008), *Data Warehousing, Data Mining & OLAP,* Tata McGraw – Hill Edition, Thirteenth Reprint.
2.	Ralph Kimball (2013), *The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling,* Wiley & Sons; 3rd edition, Wiley.
REFERENCE BOOKS	
1.	Paul Raj Ponniah (2012*), Data warehousing fundamentals for IT Professionals***,** John Wiley & Sons Inc; 2nd edition.
2.	K.P. Soman, Shyam Diwakar and V. Ajay (2006), *Insight into Data mining Theory and Practice",* Easter Economy Edition, Prentice Hall of India.
E BOOKS	
1	https://books.google.co.in/books/about/The_Data_Warehouse_Toolkit.html?id=4rFXzk8wAB8C&redir_esc=y

MOOC	
1.	https://www.coursera.org/learn/data-warehousing
2.	https://www.edx.org/course/data-warehousing-and-business-intelligence
3.	https://www.udemy.com/course/data-warehousing-concepts-design-and-implementation/

COURSE TITLE	DATA GOVERNANCE AND SECURITY			CREDIT	3	
COURSE CODE	BDS01502	COURSE CATEGORY	DE	L-T-P-S	2-0-2-1	
Version	0.0	Approval Details		LEARNING LEVEL	BTL-3	
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%
Course Description	To expose students to data governance and security practices to meet regulatory, security, and compliance requirements.					
Course Objective	1. To introduce the fundamental concepts and principles of information security. 2. To explore and apply various database security mechanisms. 3. To understand the classification of risk controls and their implementation. 4. To provide strategic insights for planning and enforcing information security policies. 5. To analyze the design and security principles behind smart card technologies.					
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the fundamentals of information security management. 2. Implement access control mechanism. 3. Develop and implement security policies and procedure. 4. Implement the governance frameworks and strategic plans.					

	5. Understand smart card security, OS fundamentals and lifecycle phases.
Prerequisites: Knowledge of Data Management and Databases, Cyber Security	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO THE MANAGEMENT OF INFORMATION SECURITY	**(6L+6P=9)**
Introduction to Security, Key Concepts of Information Security: Threats and Attacks, Management and Leadership, Principles of Information Security Management. **Self-Study:** Types of Security Threats and Attack Vectors in Information Security, Principles of Information Security Management and Leadership **Lab:** 1. Analysis and Mitigation of Common Security Threats and Attacks 2. Information Security Management and Leadership Simulation	**CO-1** **BTL-3**
MODULE 2: DATABASE SECURITY	**(6L+6P=9)**
Recent trends in Database security and access control mechanisms. Role-Based Access Control (RBAC) systems. Recent Trends related to data security management, vulnerabilities in different DBMS. Discretionary Access Control (DAC), Non-Discretionary Access Control, Mandatory Access Control (MAC) **Self-Study:** Blockchain-based data security, Secure Multi-party Computation	**CO-2** **BTL-3**

Lab: 1. Implementation and Comparison of Access Control Mechanisms (RBAC, DAC, MAC). 2. Exploring Data Security Trends and Blockchain-based Data Protection.	
MODULE 3: GOVERNANCE AND STRATEGIC PLANNING FOR SECURITY (6L+6P=9)	
The Role of Planning, Strategic Planning- Information Security Governance, Planning for Information Security Implementation. Risk Management: Introduction to the Management of Risk in Information Security, The Risk Management Process- Risk Treatment, Managing Risk, Alternative Risk Management Methodologies. **Self-Study:** Risk Management Frameworks for Information Security, Aligning Information Security Strategy with Business Objectives. **Lab:** 1. Implementing Risk Management Framework for Information Security. 2. Strategic Planning for Information Security Implementation.	**CO-3** **BTL-3**
MODULE 4: INFORMATION SECURITY POLICY (6L+6P=9)	
Policy, Enterprise Information Security Policy, Issue-Specific Security Policy, System-Specific Security Policy, Guidelines for Effective Policy Development and Implementation. **Self-Study:** Developing and Implementing a Comprehensive Information Security Policy, Best Practices for Policy Development and Security Compliance. **Lab:** 1. Developing and Implementing an Enterprise Information Security Policy. 2. Developing Issue-Specific and System-Specific Security Policies.	**CO-4** **BTL-3**
MODULE 5: SMARTCARD SECURITY (6L+6P=9)	
Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals. **Self-Study:** Smart Card Security Techniques and Authentication Methods, Smart Card Lifecycle and Quality Assurance	**CO-5** **BTL-3**

Lab: 1. Smart Card Data Transmission and Security Techniques. 2. Smart Card Lifecycle Management and File System Implementation.	
TEXT BOOKS	
1.	Robert F Smallwood *(2014), Information Governance for Business Documents and Records,* Wiley company, Wily.
2.	David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli (2003), *Role Based Access Control, Artech House,* Artech House in Norwood, Massachusetts, USA
3.	Krag Brotby (2009), *Information Security Governance: A Practical Development and Implementation Approach,* John Wiley & Sons.
REFERENCE BOOKS	
1.	Brijendra Singh (2009), *Network Security and Management*, Prentice-Hall of India Pvt. Ltd.
2.	Evan Wheeler (2011), *Security Risk Management, Building an Information Security Risk Management Program from the Ground Up,* Syngress publications, Germany.
E BOOKS	
1	https://archive.org/details/informationgover0000smal/page/n5/mode/2up

MOOC	
1.	http://www.smartcard.co.uk/tutorials/sct-itsc.pdf: Smart Card Tutorial.
2.	https://www.coursera.org/learn/data-privacy-security-governance-risk-and-compliance

COURSE TITLE	**DATA WRANGLING TECHNIQUES**			**CREDITS**	**3**
COURSE CODE	**ADS11501**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-1**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%

Course Description	To expose students to data-wrangling techniques for transforming raw data into valuable, usable information for efficient analysis.
Course Objective	1. To Perform data analysis in a literate programming environment 2. To Import and manage structured and unstructured data 3. To Manipulate, transform, and summarize the data 4. To Join disparate data sources and to explore and visualize the data 5. To Develop the functions to the perform basic predictive analytic modeling
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the basics of Data Clean up and work on NoSQL 2. Relate data clean up and test the new dataset 3. Transform and wrangle data 4. Visualize the data using different libraries 5. Scrap data from websites using Beautiful Soap library
Prerequisites: - Basic knowledge of python	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**2**	**-**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO DATA AND DATA CLEAN UP	**(9 Hrs)**
Acquiring and Storing Data: Readability, Cleanliness, and Longevity – NoSQL: Installation and usage-Data Cleanup-Investigation, Matching, and Formatting.	**CO-1** **BTL-2**
MODULE 2: STANDARDIZING AND SCRIPTING	**(9 Hrs)**
Normalizing and Standardizing, Determining What Data Cleanup Is Right for Your Project, Scripting Your Cleanup, Testing with New Data, Data Exploration and Analysis- Importing Data, Joining Numerous Datasets	**CO-2** **BTL-2**
MODULE 3: DATA WRANGLING	**(9 Hrs)**
Handling Missing Data- Data Transformation- String Manipulation, Join, Combine, and Reshape: Hierarchical Indexing Combining and Merging Datasets Reshaping and Pivoting	**CO-3** **BTL-3**
MODULE 4: VISUALIZATION OF DATA	**(9 Hrs)**
Charts, Time-Related Data, Maps, Interactives, Words, matplotlib, Plotting with pandas and seaborn, Other Python Visualization Tools.	**CO4** **BTL-2**
MODULE 5: WEB SCRAPING	**(9 Hrs)**

Acquiring and Storing Data from the Web- Analyzing a Web Page, Reading a Web Page with Beautiful Soup. Screen Scrapers and Spiders- Browser-Based Parsing, Spidering the Web	**CO-5** **BTL-2**
TEXT BOOKS	
1.	Jacqueline Kazil& Katharine Jarmul, "Data Wrangling with Python", O'Reilly Media, Inc,2016.
2.	Wes McKinney, Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, Inc, 2016.
REFERENCE BOOKS	
1.	Jeffrey Heer, Sean Kandel & Connor Carreras, Principles of Data Wrangling: Practical Techniques for Data Preparation, O'Reilly Media, Inc, 2017
2.	AllanVisochek, Practical DataWrangling:ExpertTechniquesforTransformingYourRaw Data into a Valuable Source for Analytics,Packt
E BOOKS	
1.	https://www.fintechfutures.com/files/2017/10/Trifacta_Principles-of-Data-Wrangling.pdf
MOOC	
1.	https://www.coursera.org/learn/data-wrangling-analysis-abtesting
2.	https://www.coursera.org/learn/data-analysis-with-python

COURSE TITLE	INFORMATION RETRIEVAL AND PROCESSING			CREDITS	3
COURSE CODE	ADS11505	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 2
Version	0.0	Approval Details		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)
15%	15%	10%	5%	5%	50%

Course Description	This course gives an insight about processing the languages, tool and techniques behind it.
Course Objective	1. To Work with the basic components of the grammar. 2. To Program the syntax verification process for any grammar. 3. To Resolve programmatically the meaning of the sentence. 4. To Solve issues related to recurrent network for language models. 5. To Design and develop NLP based solutions.
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the basics of Natural language processing. 2. Analyze the text syntactically. 3. Analyze the text content semantically. 4. Implement recurrent network for language models. 5. Implement a sentiment classification and chatbot systems.
Prerequisites: AI, Python Programming	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION	**(6L+6P)**
Introduction to NLP, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit distance, N gram Language Models, Evaluating Language Models **Practical Component:** 1. Convert the text into tokens 2. Find the word frequency 3. Demonstrate a bigram language model 4. Demonstrate a trigram language model 5. Generate regular expression for a given text	**CO-1** **BTL-3**
MODULE 2: SYNTACTIC ANALYSIS	**(6L+6P)**
English Word Classes, The Penn Treebank Part-of-Speech Tagset, Part-of-Speech Tagging, HMM Part of-Speech Tagging, Maximum Entropy Markov Models, Grammar Rules for English, Treebanks, Grammar Equivalence and Normal form, Lexicalized Grammar. **Practical Component:** 1. Perform Lemmatization 2. Perform Stemming 3. Identify parts-of Speech using Penn Treebank tag set. 4. Implement HMM for POS tagging 5. Build a Chunker	**CO-2** **BTL-3**
MODULE 3: SEMANTIC ANALYSIS	**(6L+6P)**
Representation of Sentence Meaning: Computational Desiderata for Representations, Model Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics, Semantic roles, Semantic role labeling.	**CO-3** **BTL-3**

Practical Component: 1. Find the synonym of a word using WordNet 2. Find the antonym of a word 3. Implement semantic role labeling to identify named entities 4. Resolve the ambiguity 5. Translate the text using First-order logic	
MODULE 4: SEQUENCE PARSING WITH RECURRENT NETWORKS	**(6L+6P)**
Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, Words, Characters and Byte-Pairs. **Practical Component:** 1. Implement RNN for sequence labeling 2. Implement POS tagging using LSTM 3. Implement Named Entity Recognizer 4. Word sense disambiguation by LSTM/GRU	**CO-4** **BTL-3**
MODULE 5: CASE STUDY	**(6L+6P)**
Sentiment Classification, Dialog Systems and Chatbots **Practical Component:** 1. Develop a Movie review system 2. Create a chatbot for HITS.	**CO-5** **BTL-3**
TEXT BOOK	
1. Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft), 2019.ISBN 978-81-317-1672-4	
REFERENCE BOOKS	
1. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, First Edition, O'reilly, 2009	
2. Yoav Goldberg, University of Toronto, Neural Network Methods for Natural language Processing, Morgan & Claypool, 2017	
3. Christopher D. Manning, and HinrichSchütze. Foundations of statistical natural language processing. First Edition, MIT press, 1999	
E BOOKS	
1. https://www.nltk.org/book/	

2.	https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_StatisticalNLP.pdf
3.	https://www.nltk.org/genindex.html
MOOC	
1.	https://www.coursera.org/learn/language-processing

COURSE TITLE	**HEALTH CARE ANALYTICS**			**CREDIT**		**3**
COURSE CODE	**BDS01503**	**COURSE CATEGORY**	**DE**	**L-T-P-S**		**2-0-2-1**
Version	**1.0**	**Approval Details**		**LEARNING LEVEL**		**BTL-3**
ASSESSMENT SCHEME						
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	To expose students to advanced analytics and AI techniques for analyzing healthcare data to improve patient care and optimize clinical operations.					
Course Objective	1. To understand healthcare data formats, policies, and interoperability standards. 2. To explore the importance of data analysis and visualization in clinical settings. 3. To acquire knowledge of health data management frameworks and best practices. 4. To apply machine learning and deep learning techniques to healthcare data. 5. To explore healthcare analytics for decision-making in critical care.					

Course Outcome	Upon completion of this course, the students will be able to 1. Understand the basics of healthcare analysis. 2. Apply machine learning for predictive modeling. 3. Understand the basics of Iot and smart sensors in healthcare. 4. Apply convolution neural networks for biomedical image analysis. 5. Implement IoT-based smart ambulance systems in healthcare.
Prerequisites: Knowledge of Boolean Algebra, Basic Programming Language	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**-**	**-**	**2**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: INTRODUCTION TO HEALTHCARE ANALYSIS	**(6L+6P=9)**
Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy -Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning, Probabilistic reasoning and Bayes Theorem, Weighted sum approach. **Self-Study:** Evolution of Healthcare Data Standards, Machine Learning in Healthcare. **Lab:** 1. Implementing Decision Trees for Healthcare Data Classification 2. Implementing Naive Bayes Classifier for Healthcare Data Prediction	**CO-1** **BTL-3**
MODULE 2: ANALYTICS ON MACHINE LEARNING	**(6L+6P=9)**

Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR, Accuracy, ROC, Precision Recall Curves, Valued target variables –Python: Variables and types, Data Structures and containers, Pandas Data Frame: Operations – Scikit –Learn: Pre-processing, Feature Selection. **Self-Study:** Evaluation Metrics in Machine Learning, Data Preprocessing and Feature Selection. **Lab:** 1. Machine Learning Pipeline Implementation for Healthcare Data 2. Model Evaluation and Comparison using Multiple Metrics	**CO-2** **BTL-3**
MODULE 3: HEALTH CARE MANAGEMENT	**(6L+6P=9)**
IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare. **Self-Study:** Migration of Healthcare Data to NoSQL Databases, Clinical Prediction Models and Visual Analytics. **Lab:** 1. Migration of Healthcare Data to NoSQL Cloud Database 2. Implementing Clinical Prediction Models and Visual Analytics for Healthcare	**CO-3** **BTL-3**
MODULE 4: HEALTHCARE AND DEEP LEARNING	**(6L+6P=9)**
Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System. **Self-Study:** Deep Learning in Biomedical Image and Signal Analysis, Natural Language Processing (NLP) in Clinical Data **Lab:** 1. Deep Learning for Biomedical Image Analysis using CNN 2. Natural Language Processing (NLP) for Clinical Data Analysis	**CO-4** **BTL-3**
MODULE 5: CASE STUDIES	**(6L+6P=9)**

Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis. **Self-Study:** Smart Ambulance Systems Using IoT in Healthcare, ECG Data Analysis for Predicting Cardiac Events **Lab:** 1. ECG Data Analysis for Predicting Cardiac Events 2. IoT-Based Smart Ambulance System	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Chandan K. Reddy, Charu C. Aggarwal (2015), *Health Care data Analysis, CRC Press in Boca Raton, Florida, USA.*
2.	Vikas Kumar (2018), *Health Care Analysis Made Simple*, Packt Publishing, Birmingham, UK.
REFERENCE BOOKS	
1.	Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatl (2018), *Health Care Data Analysis and Management*, Cambridge, Massachusetts, USA.
2.	Hui Jang, Eva K.Lee (2016), *HealthCare Analysis : From Data to Knowledge to Healthcare Improvement*, New Jersey, USA.
E BOOKS	
1	https://onlinelibrary.wiley.com/doi/book/10.1002/9781118761946
MOOC	
1.	https://www.coursera.org/learn/healthcare-data-analytics
2.	https://www.edx.org/course/data-science-and-healthcare
3.	https://www.futurelearn.com/courses/health-data-analytics

COURSE TITLE	NATURAL LANGUAGE PROCESSING			CREDITS	3
COURSE CODE	AAD11501	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
VERSION 0.0	APPROVAL DETAILS			LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / Lab records as approved by the Department Examination Committee "DEC"	Attendance	ESE (Theory)	ESE (Practical)
15%	15%	10%	5%	5%	25%	25%

Course Description	This course introduces the theory and methodology of natural language understanding and generation. Topics include stemming, lemmatization, parts of speech tagging, parsing, and machine translation
Course Objective	Develop speech-based applications that use speech analysis (phonetics, speech recognition, and synthesis). Analyze the syntax, semantics, and pragmatics of a statement written in a natural language. Develop a conversational agent that uses natural language understanding and generation.
Course Outcome	Upon completing this course, each student will be able to: 1. Apply the principles and Process of Human Languages such as English and other Indian Languages using computers. 2. Realize semantics and pragmatics of English language for text processing. 3. Create CORPUS linguistics based on digestive approach 4. Check a current method for statistical approaches to machine translation. 5. Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language. 6. Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology. Develop a Statistical Methods for Real

	World Applications and explore deep learning based NLP

Prerequisites: NIL

Pedagogy: Case Studies and Presentations

CO,PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	PSO-3
CO-1	1	1	3	2	2	-	-	1	2	2
CO-2	1	1	3	2	2	-	-	1	2	2
CO-3	1	1	3	2	2	-	-	1	2	2
CO-4	1	1	3	2	2	-	-	1	2	2
CO-5	1	1	3	2	2	2	1	1	2	2

1: Weakly related,2: Moderately related and3: Strongly related

MODULE 1 : IMAGE PROCESSING FOUNDATIONS	**9 Hrs**
Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.	**CO-1** **BTL-3**
MODULE2: TEXT PREPROCESSING AND MORPHOLOGY	**9 Hrs**
Words: Collocations- Frequency-Mean and Variance –Hypothesis testing:The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- N gram model – Statistical Estimators- Combining Estimators Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An information theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus based disambiguation, Disambiguation based on translations in a second-language corpus.	**CO-2** **BTL-3**
MODULE 3: LANGUAGE MODELLING	**9 Hrs**
Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS	**CO-3** **BTL-3**

tagging, Applications of Tagging.	
MODULE4: WORD SENSE DISAMBIGUATION	**9 Hrs**
The Probability of a String, Problems with the Inside-Outside Algorithm, Parsing for disambiguation, Treebanks, Parsing models vs. language models, Phrase structure grammars and dependency, Lexicalized models using derivational histories, Dependency-based models	**CO-4** **BTL-3**
MODULE 5: SYNTAX AND SEMANTICS	**9 Hrs**
Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.	**CO-5** **BTL-3**

TEXT BOOKS	
1	Christopher D. Manning and Hinrich Schutze, " Foundations of Natural Language Processing", 6 th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003
2	Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.
REFERENCE BOOKS	
1	Nitin Indurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
2	James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
3	Chris Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", 2nd edition, MIT Press Cambridge, MA, 2003.
EBOOKS	
1	https://karczmarczuk.users.greyc.fr/TEACH/TAL/Doc/Handbook%20Of%20Natural%20Language%20Processing,%20Second%20Edition%20Chapman%20&%20Hall%20Crc%20Machine%20Learning%20&%20Pattern%20Recognition%202010.pdf
2	https://tjzhifei.github.io/resources/NLTK.pdf
3	https://cseweb.ucsd.edu/~nnakashole/teaching/eisenstein-nov18.pdf
4	http://languagetechnologies.uohyd.ac.in/knm-publications/nlp-book.pdf
MOOCS	
1	https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-natural-

	language-processing
2	https://www.edx.org/learn/natural-language-processing
3	https://www.classcentral.com/subject/nlp

COURSE TITLE	**DIGITAL IMAGE PROCESSING**			**CREDITS**	3
COURSE CODE	**ADS11507**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE (Theory)	ESE (Practical)
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	This course will enable the students to understand and apply social network concepts and methods, to create visualizations of real-world networks and interpret their structural features.
Course Objective	1. To understand the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations. 2.To gain knowledge on the various techniques for intensity transformations functions and spatial filtering for modify or enhancement of an image. 3.To Compute Discrete Fourier Transform and apply Frequency domain filters for image enhancement. 4.To Understand and Apply Color Models in Digital Image Processing. 5.To Illustrate Morphological operation and Apply image segmentation techniques for various applications.
Course Outcome	Upon completion of this course, the students will be able to 1. Infer the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations. 2. Apply the various techniques for intensity transformations functions and spatial filtering for modify or enhancement of an image. Compute Discrete Fourier

	3. Transform and apply Frequency domain filters for image enhancement. 4. Understand and Apply Color Models in Digital Image Processing. 5. Illustrate Morphological operation and Apply image segmentation techniques for various applications.
Prerequisites: Image Visualization	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**-**	**1**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**1**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**1**	**1**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**1**	**1**	**-**	**-**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: DIGITAL IMAGE FUNDAMENTALS	**(6L+3P=9)**
Introduction – Fundamental steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Mathematical Tools Used in Digital Image Processing. **Practical Component**: Find the representation of image, Reading Images, Writing Images, displaying images, handling image types, and handling operators in images using MATLAB	**CO-1** **BTL-2**
MODULE 2: MORPHOLOGICAL IMAGE PROCESSING	**(6L+3P=9)**
Background - Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformations - Histogram Processing. Fundamentals of Spatial Filtering - Smoothing Spatial Filters - Sharpening Spatial Filters. **Practical Component**: Apply Various intensity transformations functions, Computing and plotting image histograms and use standard image processing toolbox Spatial filters in MATLAB	**CO-2** **BTL-2**
MODULE 3: IMAGE SEGMENTATION	**(6L+3P=9)**
Background - Sampling and the Fourier Transform of sampled functions - Discrete Fourier Transform (DFT) - Some Properties of the 2-D Discrete Fourier Transform - The Basics of	**CO-3**

Filtering in the Frequency Domain - Image Smoothing and Sharpening using Frequency Domain Filters - Selective Filtering. **Practical Component**: Compute and visualize the 2-D DFT, implement smoothing and sharpening techniques using lowpass and highpass filters in frequency domain in MATLAB.	**BTL-3**
MODULE 4: FEATURE EXTRACTION	**(6L+3P=9)**
Color Fundamentals - Color Models: RGB, CMY, CMYK, and HSI Color Models - Pseudocolor Image Processing - Color Transformations - Color Image Smoothing and Sharpening. **Practical Component**: Find the representation of color image, Convert to Other Color Spaces, implementcolor transformations, and implement color image Smoothing and Sharpening in MATLAB.	**CO-4** **BTL-3**
MODULE 5: IMAGE PATTERN CLASSIFICATION	**(6L+3P=9)**
Morphological Image Processing: Fundamentals - Erosion and Dilation - Opening and Closing - Some Basic Morphological Algorithms. Image Segmentation: Introduction - Point, Line, and Edge Detection– Segmentation by Region Growing and by Region Splitting and Merging. **Practical Component**: Implement Morphological operations, image segmentation and region-based segmentation in MATLAB.	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, 4th Edition, Pearson, 2018.
REFERENCE BOOKS	
1.	Rafael. C. Gonzalez, RichardE. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc.,2011.
2.	Kenneth R. Castleman, Digital Image Processing Pearson,2006.
3.	AnilK.Jain,“FundamentalsofDigitalImageProcessing”,PersonbEducaiton,2003.
E BOOKS	
1.	https://www.academia.edu/19746149/ Digital_Image_Processing_3rd_Edition_Instructors_Manual_Rafael_C._Gonzalez

2.	https://www.academia.edu/18324189/Digital_image_processing_using_matlab_gonzalez_
3.	https://pdfs.semanticscholar.org/15bd/427a1a5f9bc57a7f67fb1b1fc85c5bb39f46.pdf
MOOC	
1.	https://www.coursera.org/learn/digital
2.	https://www.udemy.com/topic/digital-image-processing/
3.	https://www.edx.org/course/image-processing-and-analysis-for-life-scientists

COURSE TITLE	**COMPUTER VISION TECHNIQUES**			**CREDITS**	3
COURSE CODE	**ADS11506**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**0.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / Lab records as approved by the Department Examination Committee "DEC"**	**Attendance**	**ESE (Theory)**	**ESE (Practical)**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	This course will enable the students to study the basics of image processing and apply the morphological algorithms, image segmentation techniques, feature extraction methods and pattern classification methods for various real-time applications.
Course Objective	1. To understand the fundamentals of computer vision and perform image operations. 2. To summarize various feature extraction techniques. 3. To Demonstrate various segmentation techniques. 4. To Explain Dense Motion Analysis and estimate motion parameters.

	5. To Implement several applications of computer vision using machine and deep learning techniques.
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the fundamentals of computer vision and perform image operations. 2. Explain various feature extraction techniques. 3. Demonstrate various segmentation techniques. 4. Explain Dense Motion Analysis and estimate motion parameters 5. Implement several applications of computer vision using machine and deep learning techniques.
Prerequisites: Basic knowledge in Linear algebra and vector calculus	

CO, PO AND PSO MAPPING										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**2**
CO4	**1**	**1**	**3**	**2**	**2**	**-**	**-**	**1**	**2**	**2**
CO5	**1**	**1**	**3**	**2**	**2**	**2**	**-**	**1**	**2**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related										

MODULE 1: FUNDAMENTALS OF COMPUTER VISION AND IMAGE OPERATIONS	**(6L+3P=9)**
Introduction to computer vision - Geometric primitives: 2D and 3D transformations - 3D to 2D projections - Image formation- Light Models – Camera Geometry – Stereo Vision.Thresholding – Histogram processing – Convolution and Filtering – Image Enhancement – Fourier transform **Practical Component:** UsePython/ MATLAB 1. Apply various intensity transformations functions. 2. Computing and plotting image histograms and use standard image processing toolbox Spatial filters. Implement color image Smoothing and Sharpening.	**CO-1** **BTL-2**
MODULE 2: IMAGE FEATURE EXTRACTION	**(6L+3P=9)**

Edge detection - Canny, LOG, DOG; Line detection; Corner detection; Orientation Histogram, SIFT, SURF, HOG, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. **Practical Component:** Use Python/ MATLAB 1. Implement Morphological operations. 2. Implement Morphological Reconstruction. Implement Grayscale Morphology.	**CO-2** **BTL-2**
MODULE 3: IMAGE SEGMENTATION	**(6L+3P=9)**
Region Growing - Edge Based approaches to segmentation - Graph-Cut - Mean-Shift, MRFs, Texture Segmentation. **Practical Component:** Use Python/ MATLAB 1. Implement Optimum Global Thresholding using Otsu's Method. Implement Image segmentation by Region Growing, Splitting and Merging Implement Image Segmentation by Active Contours using anyone method Snakes and Level Sets.	**CO-3** **BTL-3**
MODULE 4: MOTION ANALYSIS	**(6L+3P=9)**
Background Subtraction and Modeling, Optical Flow - KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. **Practical Component:** Use Python/ MATLAB 1. Implement Boundary Feature Descriptors 2. Implement Topological and Texture Descriptors Implement Scale-Invariant Feature Transform (SIFT)	**CO-4** **BTL-3**
MODULE 5: COMPUTER VISION APPLICATIONS	**(6L+3P=9)**
Image Classification – Image Retrieval- Object Detection -Image Captioning -Generative Models-Video Classification. **Practical Component:** Use Python/ MATLAB 1. Implement Minimum-Distance Classification Algorithm. 2. Implement Optimum (Bayes) Statistical Classification Algorithm. Implement Deep Convolutional Neural Network.	**CO-5** **BTL-3**

TEXT BOOKS

1.	Reinhard Klette, "Concise Computer Vision: An introduction into theory and Algorithms", Springer-Verlag London, 2014.
2.	R. Shanmugamani, "Deep Learning for Computer Vision", Packt Publishing, Jan 2018.

REFERENCE BOOKS

1.	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer International, 2011.
2.	David A forsyth & Jean ponce, "Computer vision – A modern Approach" , Prentice Hall ,2002.
E BOOKS	
1.	http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf
MOOC	
1.	https://in.udacity.com/course/introduction-to-computer-vision--ud810
2.	https://www.edx.org/course/computer-vision-image-analysis-1