Dr. M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
DEEMED TO BE UNIVERSITY
University with Graded Autonomy Status
(An ISO 21001 : 2018 Certified Institution)
Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

FACULTY OF HUMANITIES AND SCIENCE

LEARNING OUTCOME BASED CURRICULUM

CURRICULUM & SYLLABUS

MASTER OF SCIENCE (DATA SCIENCE AND ARTIFICIAL INTELLIGENCE)

REGULATION 2022

(For the Students admitted from 2024 -2025)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DECLARATION

I, **Dr. S. Geetha**, Head of Computer Science and Engineering Department, hereby declare that this copy of the syllabus (Page Numbers from 01 to 88) M.Sc (Data Science and Artificial Intelligence) Full Time / Online 2022 Regulation is the final version which is being taught in the class and uploaded in our University website. I assure that the Syllabus available in our University website is verified and found correct. The Curriculum and Syllabi have been approved by our Academic Council / Vice Chancellor.

Date: **Signature**

Programme : M.Sc (DS & AI)

Vision:

To become a Premier Institution of Excellence in Computer Science and Engineering that would develop self-sustaining and globally competent Computer Science and Information Technology Professionals.

Mission:

M1	Enable students and faculty with the best of Technologies and Knowledge emerging in the domain of Computer Science
M2	Equip the department laboratories with the power of in-demand Technologies and Software for the On-Demand Industry.
M3	Share and Collaborate knowledge across the IT Industries for holistic development of skilled and talented students.
M4	Impart the students with Ethical values, Critical thinking and Broad-based computational skills, to enable students to become Entrepreneurs.
M5	Motivate the students to comprehend problems across Inter Disciplinary Domains and offer innovative solution using ICT.

Program Educational Objectives (PEO)

PEO1: Empower graduates to excel in diverse data science and AI roles, leveraging advanced analytical techniques and machine learning algorithms.
PEO2: Foster a culture of innovation and research, enabling graduates to contribute to cutting-edge advancements in data science and artificial intelligence.
PEO3: Develop leaders who can effectively manage interdisciplinary teams and projects, driving innovation and addressing complex challenges in various industries.
PEO4: Promote ethical practices and responsible use of data and AI technologies, ensuring graduates prioritize privacy, fairness, and transparency in their work.
PEO5: Inspire a commitment to lifelong learning and professional development, equipping graduates to adapt to evolving technologies and industry trends throughout their careers.

Program Outcome:
PO1: Acquire in-depth knowledge related to the discipline.
PO2: Apply the recent advancement in the domain knowledge for solving real-life problems.
PO3: Demonstrate critical thinking skills by analyzing, synthesizing and evaluating various research problems.

PO4: Identify and use qualitative and quantitative methods of research in order to pursue a well-researched written work that makes use of wide range of disciplinary techniques and scientific methods applicable.

PO5: Conceive the ways and means to address various social, economic, environmental, human rights and other ethical issues faced by humanity at the local, national and global levels.
PO6: Demonstrate Professional, leadership and Management skills required for professional development and employability.
PO7: Demonstrate the ability for collaborative work and scientific communication through projects, internship and on-site training.
PO8: Use mathematical, analytical, statistical and information technology tools.
PO9: Ability to update knowledge and skills, participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development.

Program Specific Outcomes (PSO)

PSO1: Graduates proficiently handle and analyze complex datasets using cutting-edge statistical methods and machine learning techniques.
PSO2: Graduates design, implement, and deploy AI models across diverse domains, ensuring ethical considerations and industry standards.
PSO3: Graduates conduct rigorous applied research, contributing to the development of novel data science and AI methodologies and applications for real-world challenges.
PSO4: Graduates effectively communicate technical concepts and collaborate with multidisciplinary teams, translating data insights into actionable strategies and solutions.

PEO with mission statement:

	M1	**M2**	**M3**	**M4**	**M5**
PEO1	3	3	3	2	3
PEO2	1	1	1	1	1
PEO3	3	3	2	1	3
PEO4	2	3	2	2	2
PEO5	3	2	2	2	3

PEO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
PEO1	3	2	2	2	2	2	1	2	1
PEO2	2	3	1	1	2	1	2	_	1
PEO3	2	2	1	2	1	2	1	_	2
PEO4	3	2	3	2	2	2	2	_	3
PEO5	3	3	3	3	1	2	3	3	3

PEO – PSO Mapping

	PSO 1	PSO 2	PSO 3	PSO 4
PEO1	3	2	3	2
PEO2	2	1	2	1
PEO3	3	2	3	2
PEO4	3	3	3	2
PEO5	3	3	3	2

Program Structure: Master of Science (DS&AI)							
I SEMESTR							
S.NO	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T**	**P**	**C**
1.	HMMA22001	Mathematical Foundation For Data Science	Ty	3	1/0	0/0	4
2.	HMCC22001	Research Methodology	Ty	3	0/0	0/0	3
3	HMDS22001	Machine Learning Algorithms	Ty	3	1/0	0/0	4
4.	HMDS22EXX	Elective –I	Ty	3	0/0	0/0	3
5.	HMDS22002	Foundation of Artificial Intelligence	Ty	3	0/0	0/0	3
PRACTICALS*							
1	HMDS22L01	Machine Learning Algorithms Lab	Lb	0	0/0	3/0	2
2	HMDS22L02	Artificial Intelligence and Neural Networks Lab	Lb	0	0/0	3/0	2
3	HMAC22IXX	Audit Course	Ty	2	0/0	0/0	0

Credits Sub Total: 21

II SEMESTER							
S.NO	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T**	**P**	**C**
1.	HMDS22003	Deep Learning Techniques	Ty	3	1/0	0/0	4
2.	HMDS22004	Fuzzy Logic and its Applications	Ty	3	0/0	0/0	3
3.	HMDS22005	Data Analytics Tools	Ty	3	0/0	0/0	3
4.	HMDS22006	Computational Intelligence	Ty	3	0/0	0/0	3
5.	HMDS22EXX	Elective-II	Ty	3	0/0	0/0	3
		PRACTICALS*					
1	HMDS22L03	Data Analytics Tools Lab	Lb	0	0/0	3/0	2
2	HMDS22L04	Deep Learning Techniques Lab	Lb	0	0/0	3/0	2
3	HMDS22I01	Summer Internship	IE	0/0	0/0	4/0	2

Credits Sub Total: 22

III SEMESTER							
S.No.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ETL**	**L**	**T/SLr**	**P/R**	**C**
1	HMDS22007	Digital and Social Media Analytics	Ty	3	1/0	0/0	4
2	HMDS22008	Web Analytics	Ty	3	0/0	0/0	3
3	HMDS22009	Natural Language Processing	Ty	3	0/0	0/0	3
4	HMDS22010	Optimization Technique	Ty	3	0/0	0/0	3
5	HMDS22EXX	Elective-III	Ty	3	0/0	0/0	3
6	HMOL22IE1	Open Elective(Self Study Paper)- Swayam/ NPTEL/ Any Mooc	IE	3	0/0	0/0	3
PRACTICALS*							
1	HMDS22I02	Project Phase –I	IE	0	0/0	4/0	2

Credits Sub Total: 21

	IV SEMESTER						
S.NO	**SUBJECT CODE**	**Title of the Subject**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
1.	HMDS22L05	Project Phase II	Lb	0	0/0	18/0	9
2.	HMDS22I03	Research Publication (Internal Evaluation)	IE	0	0/0	4/0	2
		TOTAL	**Subtotal**				**11**

Credits Sub Total: 11

ELECTIVE-I							
S.No.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
1	HMDS22E01	Principles Of Data Science	Ty	3	0/0	0/0	3
2	HMDS22E02	Knowledge Engineering and Expert Systems	Ty	3	0/0	0/0	3
3	HMDS22E03	Bio Informatics	Ty	3	0/0	0/0	3

ELECTIVE-II							
S.No.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
1	HMDS22E04	Artificial Intelligence Ethics	Ty	3	0/0	0/0	3
2	HMDS22E05	Reinforcement learning	Ty	3	0/0	0/0	3
3	HMDS22E06	Data Visualization Techniques	Ty	3	0/0	0/0	3

ELECTIVE-III							
S.No.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
1	HMDS22E07	Block Chain and Artificial Intelligence	Ty	3	0/0	0/0	3
2	HMDS22E08	Multimedia Analytics	Ty	3	0/0	0/0	3
3	HMDS22E09	Cloud Computing	Ty	3	0/0	0/0	3

C: Credits L:Lecture T:Tutorial P:Practical Ty/Lb: Theory /Lab IE: Internal Evaluation.

LIST OF AUDIT COURSES OFFERED IN H&S

AUDIT COURSE							
Sl. No	**Course Code**	**Course Name**	**Ty/Lb/ETL/IE**	**Teaching Scheme**			
				L	**T/SLr**	**P/R**	**C**
1	HMAC22I01	English for Research paper writing	Ty	2	0/0	0/0	0
2	HMAC22I02	Disaster Management	Ty	2	0/0	0/0	0
3	HMAC22I03	Sanskrit for Technical Knowledge	Ty	2	0/0	0/0	0
4	HMAC22I04	Value Education	Ty	2	0/0	0/0	0
5	HMAC22I05	Constitution of India	Ty	2	0/0	0/0	0
6	HMAC22I06	Pedagogy Studies	Ty	2	0/0	0/0	0
7	HMAC22I07	Stress Management by Yoga	Ty	2	0/0	0/0	0
8	HMAC22I08	Personality Development through Life Enlightenment Skills	Ty	2	0/0	0/0	0
9	HMAC22I09	Life skill	Ty	2	0/0	0/0	0

Credit Summary

Semester 1 : 21
Semester 2 : 22
Semester 3 : 21
Semester 4 : 11

Total Credits:75

TABLE - 1 **Components of Curriculum**

S. No	CATEGORY	Description	No. of Courses	Credits	Total	Credit Weightage In %	Contact hours
1	Core Courses	Core Theory	10	33	41	54.66	495
		Core Lab	04	08			240
2	Elective Courses	Department Electives/Skill enhancement electives	03	09	09	12.00	135
3	Open Electives	Theory	01	03	03	04.00	45
		Lab					
4	Inter Disciplinary / Allied Courses	Theory				00.00	
		Lab					
5	Humanities & Social Sciences, Life Skills & Soft Skills	Language 1 & 2	N/A		04	05.33	
		English 1 & 2	N/A				
		Mathematics	4	04			60
		Soft Skills	N/A				
		Life Skill	01	00			
		Foreign Language	N/A				
		Environmental Studies					
		Management Papers	N/A				
		Entrepreneurship Development					
		Universal Human values					
		Entrepreneurship	N/A				
6	Projects /Internship /Core Skill	Project	02	11	13	17.33	60
		Core Skills	N/A				
		Internship / NSS / NCC	01	02			30
7	Research Component	Research Methodology, Publication, IPR and Patents etc.	02	05	05	6.66	75
8	Any other						
Total			**25**	**75**	**75**	**100**	**1140**

TABLE 2: List of New Courses / value added courses / life skills / Electives / interdisciplinary / courses focusing onemployability / entrepreneurship / skill development

S.No	New Courses (subjects)	Value added Courses	Life Skill (Audit Course)	Electives	Inter Disciplinary	Focus on employability / Entrepreneurship /skill development
Sem. 1			English for Research paper Writing	Knowledge Engineering and Expert system	Research Methodology	
			Disaster Management			
			Sanskrit for Technical Knowledge			
			Value Education			
			Constitution of India			
			Pedagogy Studies			
			Stress Management by Yoga			
			Personality Development through Life Enlightenment Skills			
			Life Skill			
Sem. 2	Deep Learning Techniques, Fuzzy Logic and its Applications, Data Analytics Tools, Computational Intelligence			Reinforcement Learning, Data Visualization Techniques		Summer Internship
Sem. 3	Digital and Social Media Analytics, Web Analytics, Optimization Technique	Open Elective (Self study paper) – Swayam / NPTEL / Any MOOC		Block Chain and Artificial Intelligence, Multimedia Analytics		
Sem.4	Research Publication					Project Work

I SEMESTER

COURSE CODE: HMMA22001	COURSE NAME : MATHEMATICAL FOUNDATION FOR DATA SCIENCE	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: **Nil**	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES :

The students should be made

- To introduce the fundamental concepts of linear algebra.
- To introduce Probability for a program in data science.
- To introduce Statistics required for a program in data science.

COURSE OUTCOMES (COs) : Students will be able to

CO1	Apply the linear algebra in the field of data science.
CO2	Employ the probability techniques and methods related to the area of data science in variety of applications.
CO3	Apply Statistics to understand and solve the problem in context.
CO4	Apply Optimization Techniques in order to solve the problem in Data Science
CO5	Understand the vital concepts in Data Mining

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	2	1	1	1	1	2
CO2	3	3	3	2	1	1	2	1	2
CO3	3	3	2	2	1	1	2	1	1
CO4	3	3	2	2	2	2	1	1	2
CO5	3	3	2	2	2	1	2	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	2	2
CO3	3	3	3	3
CO4	3	3	2	2
CO5	3	3	2	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
			✔						

COURSE CODE:	Course Title	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
HMMA22001	MATHEMATICAL FOUNDATION FOR DATA SCIENCE	Ty	3	1/0	0/0	4

Unit I: **12 Hrs**

Linear Algebra: Eigen Values and Eigen vectors; Matrix factorization; Inner products; Distance measures; Projections; Notion of hyper planes; half – planes.

Unit II: **12 Hrs**

Probability: Probability distributions and density function (univariate distributions), Expectations, Moments, Correlation and Regression Analysis, Sampling distributions, Standard Error.

Unit III: **12 Hrs**

Hypothesis Testing of Means - Proportions, Standard deviation – Confidence Intervals – Students t – test, F – test, Chi – Square test – Analysis of variance (One way, and Two way)

Unit IV: **12 Hrs**

Introduction to Optimization – Classical Optimization Theory – Unconstrained Problems – Necessary and Sufficient Conditions – The Newton-Raphson Method – Constrained Problems Equality Constraints – Inequality Constraints –Deterministic Dynamic Programming – Forward and Backward Recursion.

Unit V: **12 Hrs**

Data Mining: Types of Data and patterns - Database Systems and Information Retrieval - Data Preprocessing - Major Tasks in Data Preprocessing - Data Cleaning - Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification

Total:60 HRS

Reference Books:

1. G. Strang, Introduction to Linear Algebra , Wellesly–Cambridge Press, Sixth edition, USA, 2023
2. Montgomery, D. C and G. C Runger, Applied Statistics and Probability for Engineers, 5th edition John Wiley & Sons, inc., NY, USA, 2011
3. Taha, H.A (2002), Operations Research- An Introduction, Prentice Hall India.
4. Micheline Kamber, Jian Pei, Jiawei Han, Data Mining Concepts and Techniques, Third Edition,Morgan Kaufmann Publishers, 2012.

Subject Code: HMCC22001	**Subject Name: RESEARCH METHODOLOGY**	**Ty/Lb/ETL/EVL**	**L**	**T/SLr**	**P/R**	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L:Lecture T:Tutorial SLr: Supervised Learning P:Project R:Research C:Credits T/L/ETL: Theory/Lab /Embedded Theory and Lab

OBJECTIVES:

- Design and formulation of research problem.
- Analyze research related information and statistical methods in research.
- Carryout research problem individually in a perfect scientific method
- Understand the filing patent applications processes, Patent search, and various tools of IPR, Copyright, and Trademarks

COURSEOUTCOMES(Cos):(3–5) Students completing the course were able to

CO1	Design and Formulation of research problem.
CO2	Analyzeresearchrelatedinformationandstatisticalmethodsinresearch.
CO3	Carry out research problem individually in a perfect scientific method
CO4	Understand Patent Filing application Process.
CO5	Patent Search and various tools used.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	2	2	3	3	3	2	1	3	2
CO2	3	2	1	3	3	1	1	1	1	2	3	2	1
CO3	3	3	2	1	2	2	3	3	3	2	3	2	1
CO4	3	3	2	2	1	2	2	2	2	3	2	1	1
CO5	3	3	3	3	3	2	3	3	3	2	1	1	3

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: HMCC22001	Subject Name: RESEARCH METHODOLOGY	Ty/Lb/ ETL/ EVL	L	T/SLr	P/R	C
	Prerequisite: None	T y	3	0/0	0/0	3
L:LectureT:Tutorial SLr: Supervised Learning P:Project R:Research C:CreditsT/L/ETL:Theory/Lab /Embedded Theory and Lab						

Unit I 9hrs

Introduction to research, Definitions and characteristics of research, Types of Research, Research Process, Problem definition, Objectives of Research, Research Questions, Research design, Quantitative vs. Qualitative Approach, Building and Validating Theoretical Models, Exploratory vs. Confirmatory Research, Experimental vs. Theoretical Research, Importance of reasoning in research.

Unit II 9hrs

Problem Formulation, Understanding Modeling & Simulation, Literature Review, Referencing, Information Sources, Information Retrieval, Indexing and abstracting services, Citation indexes, Development of Hypothesis, Measurement Systems Analysis, Error Propagation, Validity of experiments, Statistical Design of Experiments, Data/Variable Types & Classification, Data collection, Numerical and Graphical Data Analysis: Sampling, Observation, Interpretation of Results.

Unit III 9hrs

Statistics: Probability & Sampling distribution, Estimation, Measures of central Tendency, Arithmetic mean, Median, Mode, Standard deviation, Coefficient of variation (Discrete serious and continuous serious), Hypothesis testing & application, Correlation & regression analysis, Orthogonal array, ANOVA, Standard error, Concept of point and interval estimation, Level of significance, Degree of freedom, Analysis of variance, One way and two-way classified data, 'F' test.

Unit IV 9hrs

Preparation of Dissertation and Research Papers, Tables and illustrations, Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. References, Citation and listing system of documents.

Unit V 9hrs

An intellectual property right (IPR) patents copyrights Trademarks Industrial design geographical indication. Ethics of Research Scientific Misconduct Forms of Scientific Misconduct. Plagiarism, Unscientific practices in thesis work, Ethics in science.

Total Hrs: 45

Text Books:

1. K.S. Bordens, and B.B. Abbott, "Research Design and Methods – A Process Approach", 8th Edition, McGraw Hill, 2011.
2. C.R. Kothari, "Research Methodology – Methods and Techniques", 2nd Edition, New Age International Publishe

COURSE CODE: HMDS22001	COURSE NAME : **MACHINE LEARNING ALGORITHMS**	**Ty/ Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**
	Prerequisite: Fundamental of Mathematics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES :

The student should be made to

- understand the need for machine learning for various problem solving
- Known the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- understand the latest trends in machine learning
- design appropriate machine learning algorithms for problem solving

COURSE OUTCOMES (COs) : Students will be able to

CO1	Understand various machine learning algorithms and terminologies and perform data pre-processing.
CO2	Apply appropriate supervised learning algorithms to design predictive models to solve any given problem.
CO3	Apply appropriate unsupervised learning algorithms and develop applications for performing clustering and dimensionality reduction.
CO4	Evaluate the solutions for complex problems using artificial neural networks and kernel machines.
CO5	Understand and apply probabilistic graphical models for suitable applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	1	3	2	1	1	-
CO2	3	3	3	3	3	1	1	-	-
CO3	3	3	3	3	3	2	1	1	-
CO4	3	3	3	3	3	2	1	-	-
CO5	3	3	3	3	3	1	1	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	3
CO2	3	2	2	2
CO3	3	2	3	3
CO4	3	3	2	3
CO5	3	3	3	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				√					

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
HMDS22001	**MACHINE LEARNING ALGORITHMS**	Ty	3	1/0	0/0	4

UNIT I: FUNDAMENTALS OF MACHINE LEARNING **12 Hrs**

Machine Learning Fundamentals –Types of Machine Learning - Supervised, Unsupervised, Reinforcement- The Machine Learning process. Terminologies in ML- Testing ML algorithms: Overfitting, Training, Testing and Validation Sets-Confusion matrix -Accuracy metrics- ROC Curve- Basic Statistics: Averages, Variance and Covariance, The Gaussian- The Bias-Variance trade off- Applications of Machine Learning.

UNIT II: SUPERVISED LEARNING **12 Hrs**

Regression: Linear Regression – Multivariate Regression- Classification: Linear Discriminant Analysis, Logistic Regression- K-Nearest Neighbor classifier. Decision Tree based methods for classification and Regression- Ensemble methods.

UNIT III: UNSUPERVISED AND REINFORCEMENT LEARNING **12 Hrs**

Clustering- K-Means clustering, Hierarchical clustering - The Curse of Dimensionality –Dimensionality Reduction - Principal Component Analysis - Probabilistic PCA- Independent Components analysis- Reinforcement Learning

UNIT IV: EVALUATION METRICS **12 Hrs**

ROC Curves, Evaluation Metrics, Significance tests – Perceptron- Error correction in Perceptrons - Multilayer perceptron- Back Propagation – Initialization, Training and Validation Support Vector Machines (SVM) as a linear and non-linear classifier.

UNIT V: MACHINE LEARNING IN PRACTICE **12 Hrs**

Data collection – Preprocessing (Missing values, Normalization, Adopting to chosen algorithm etc.,) – Outlier Analysis (Z-Score) - Model selection & evaluation – Optimization of tuning parameters – Setting the environment – Visualization of results.

Total: 60 HRS

TEXT BOOKS

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson Education, 2018.
4. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2011.

REFERENCE BOOKS

1. Andreas C. Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly,2016.
2. Sebastian Raschka, “Python Machine Learning”, Packet Publishing, 2015.

Course Code: **HMDS22002**	Course Name : **FOUNDATION OF ARTIFICIAL INTELLIGENCE**	**Ty/Lb/ETL /IE**	**L**	**T/ S.Lr**	**P/R**	**C**
	Prerequisite: Fundamentals of computer science	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

The students should be made to

- To learn historical perspective of AI and its foundations.
- To become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- The students will be able to solve problems using AI techniques.
- To develop new games using AI techniques.
- To guide the process of deducing information in a computational manner.

COURSE OUTCOMES (COs) : Students will be able to

CO1	Illustrate different types of AI agents and searching strategies.
CO2	Discover to inference the knowledge and plan effectively.
CO3	Discuss the techniques used for game playing using various search algorithms.
CO4	Analyze various types of planning to create effective AI applications.
CO5	Classify various learning techniques.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	3	-	-	1	1
CO2	3	2	3	2	3	1`	1	2	1
CO3	3	2	2	2	3	2	1	3	2
CO4	3	3	3	2	3	3	1	2	1
CO5	3	3	2	2	3	2	1	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	3	3	2
CO3	3	2	2	3
CO4	2	3	3	3
CO5	3	2	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✓					

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
HMDS22002	**FOUNDATION OF ARTIFICIAL INTELLIGENCE**	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION AND AGENTS **9 Hrs**

Introduction– History of AI-Intelligent agent –Structure of Agents– Problem solving agents - Uninformed search strategies.

UNIT II INFORMED SEARCH METHODS AND GAME PLAYING **9 Hrs**

Informed search Strategies – A* Heuristic function – Hill Climbing search – Constraint Satisfaction problem - Optimal decisions in games – Pruning –Alpha-Beta pruning.

UNIT III KNOWLEDGE AND LOGIC **9 Hrs**

Knowledge based agent – The Wumpus world environment –Propositional Logic- First-order logic – Syntax and Semantics of FOL-Knowledge engineering process –Inference in FOL – Forward and backward chaining algorithm.

UNIT IV PLANNING **9 Hrs**

Planning Problem-Language of planning problems-Planning with state space search-Partial order planning- Planning graphs-Planning with propositional logic-Analysis of planning approaches.

UNIT V FORMS OF LEARNING AND ITS APPLICATIONS **9 Hrs**

Inductive learning-Learning Decision trees-Ensemble Learning-Logical formulation of learning-Explanation based learning-Learning using relevance information-Applications-AI powered assistants-Personalized learning-Autonomous vehicles.

Total Hours: 45

TEXT BOOKS

1. Stuart R. Peter N. (2010) Artificial Intelligence A modern Approach, Prentice Hall
2. Elaine R. Kevin K. (2008) Artificial Intelligence Tata McGraw Hill

REFERENCE BOOKS

1. Tim Jones M. (2008) Artificial Intelligence, A System Approach(Computer Science)
2. Ben Coppin (2004) Artificial intelligence illuminated, Jones and Bartlett

COURSE CODE: HMDS22L01	COURSE NAME:	Ty/Lb/ ETL/IE	L	T/S. Lr	P/R	C
	MACHINE LEARNING ALGORITHMS LAB Prerequisite: Python Programming	Lb	0	0/0	3/0	2

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL /IE: Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE :

Students will be able to

1. To learn and understand the different data sets in implementing the machine learning algorithms
2. To familiarize the tools available to implement various machine learning algorithms.

COURSE OUTCOMES (Cos): Students will be able to

CO1	Implement the machine learning algorithms using tools.
CO2	Design Python programs for various machine learning algorithms..
CO3	Apply appropriate datasets to ML algorithms
CO4	Identify ML algorithms to solve real world problems.
CO5	Apply ML algorithms to solve real world problems.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	3	2				1	
CO2	1	1	3	2					
CO3	1	2	2	1	3		2	1	
CO4	1	3	2	2	2	2			
CO5	2	3	3	3	3	2			2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1		1	2	2
CO2		2	2	2
CO3	2	3	3	1
CO4	2	2	3	
CO5	3	3	3	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
									↘

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22L01	**MACHINE LEARNING ALGORITHMS LAB**	**Lb**	**0**	**0/0**	**3/0**	**2**

List of Experiments:

1. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

2. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

3. Write a program to implement the naïve Bayesian classifier for Iris data set. Compute the accuracy of the classifier, considering few test data sets.

4. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Calculate the accuracy, precision, and recall for your data set.

5. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

6. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

7. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

NOTE: It is suggested that these program can be done using MATLAB/ Any other equivalent software.

Total Hours: 45 Hrs

COURSE CODE: HMDS22L02	**COURSE NAME:**	**Ty/Lb/ETL/IE**	**L**	**T/S. Lr**	**P/R**	**C**
	ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS LAB Prerequisite: Python Programming	Lb	0	0/0	3/0	2

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL /IE: Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE :

Students will be able to

1. To enable students to work on custom feed-forward network

2. To understand the layers in neural network

3. To provide skills to set and Training Functions & Parameters

COURSE OUTCOMES (Cos): Students will be able to

CO1	Elicit, analyse and specify software requirements.
CO2	Simulate given problem scenario and analyse its performance..
CO3	Develop programming solutions for given problem scenario
CO4	Create a custom feed-forward network
CO5	Construct Layers in neural network and Set and Training Functions & Parameters

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	2	1	1	1	1	1
CO2	1	1	2	1	2	2		2	
CO3	2	2	2	1	3		2	1	
CO4	1	3	2	2	2	2			3
CO5	2	3	3	3	3	1	1	2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	2
CO2		2	3	2
CO3	3	2	3	
CO4	2	1	2	3
CO5	2	3	3	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
									↘

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22L02	**ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS LAB**	**Lb**	**0**	**0/0**	**3/0**	**2**

List of Experiments:

1. Installation and working on various AI tools viz. Python, R tool, GATE, NLTK, MATLAB, etc.
2. Data pre-processing and annotation and creation of datasets.
Learn existing datasets and Tree banks
3. Implementation of searching techniques in AI.
4. Implementation of Knowledge representation schemes.
5. Natural language processing tool development.
6. Application of Machine learning algorithms.
7. Application of Classification and clustering problem working on parallel algorithms.
8. Scientific distributions used in python for Data Science -Numpy, scify, pandas, scikitlearn, statmodels, nltk.
9. Create a custom feed-forward network consisting of the following Network Layers Constructing Layers Connecting Layers Setting Transfer Functions and Training Functions & Parameters

NOTE: It is suggested that these program can be done using MATLAB/ Any other equivalent software.

Total Hours:45 Hrs

II SEMESTER

COURSE CODE: HMDS22003	COURSE NAME: DEEP LEARNING TECHNIQUES	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Machine Learning	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES :

The students should be made to

- To understand the theoretical foundations, algorithms and methodologies of Neural Networks.
- To design and develop an application using specific deep learning models.
- To provide the practical knowledge in handling and analyzing real world applications.

COURSE OUTCOMES (COs) : Students will be able to

CO1	Recognize the characteristics of deep learning models that are useful to solve real-world problems.
CO2	Understand different methodologies to create application using deepnets.
CO3	Identify and apply appropriate deep learning algorithms for analyzing the data for varietyof problems.
CO4	Implement different deep learning algorithms
CO5	Design the test procedures to assess the efficacy of the developed model.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	2	3	2	2	3
CO3	3	3	3	3	1	3	2	2	3
CO4	3	3	3	3	2	3	2	2	3
CO5	3	3	3	3	2	3	2	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	2	3
CO5	3	2	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE	COURSE NAME	Ty/Lb/ETL/ IE	L	T/ S.Lr	P/R	C
HMDS22003	DEEP LEARNING TECHNIQUES	Ty	3	1/0	0/0	4

UNIT I INTRODUCTION TO DEEP LEARNING and MACHINE LEARNING 12Hrs

Introduction to Deep Learning – Difference between Deep Learning and machine learning - Evolution of AI and ML: Historical Epochs - Learning algorithms - Maximum likelihood estimation - Building machine learning algorithm - Neural Networks Multilayer Perceptron - Back-propagation algorithm and its variants.

UNIT II LEARNING IN DEEP NETWORKS 12Hrs

Back propagation training - Representation Learning - Width and Depth of Neural Networks - Activation Functions: RELU, LRELU, ERELU - Unsupervised Training of Neural Networks - Restricted Boltzmann Machines - Auto Encoders - Batch Learning.

UNIT III CONVOLUTIONAL NEURAL NETWORKS 12Hrs

Architectural Overview - Motivation, Layers, Filters - Parameter sharing – Regularization - Popular CNN Architectures: ResNet, AlexNet – Applications.

UNIT IV RECURRENTNETWORKS 12 Hrs

Recurrent Neural Networks - Bidirectional RNNs - Encoder-decoder sequence to sequence architectures - BPTT for training RNN –Deep Recurrent Networks, Auto Encoders.

UNIT V GENERATIVE DEEP LEARNING 12Hrs

LSTMs to synthesize text - Neural Style transfer and applications - Image synthesis with variational auto encoders - Generative Adversarial Networks: What does a GAN look like? – Generator - Discriminator, Generator vs Discriminator - Training GANs. Deep Learning Applications.

Total: 60 HRS

TEXT BOOKS

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, " Deep Learning", MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.

REFERENCE BOOKS

4. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
5. EthemAlpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
6. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
7. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017.
8. Francois Chollet "Deep Learning with Python", Manning Publications, 2017.

COURSE CODE: HMDS22004	**COURSE NAME: FUZZY LOGIC AND ITS APPLICATIONS**	**Ty/Lb/ ETL/IE**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: **Nil**	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE: Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

The students should be made to

- Develop a strong understanding of fuzzy logic principles.
- Apply fuzzy logic techniques to solve real-world problems.
- Explore various applications of fuzzy logic in different domains.

COURSE OUTCOMES (COs): Students will be able to

CO1	Understand the fundamentals and principles of fuzzy logic. [L2]
CO2	Apply fuzzy logic in solving engineering and decision-making problems. [L3]
CO3	Analyze and design fuzzy inference systems for specific applications. [L4]
CO4	Implement fuzzy logic in control systems and decision support systems. [L4]
CO5	Explore and discuss the ethical considerations in using fuzzy logic in various domains. [L2]

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	2	-	2
CO2	2	3	3	3	2	1	1	-	2
CO3	2	-	3	2	2	3	1	-	1
CO4	3	2	2	3	3	2	2	2	
CO5	-	2	2	3	3	1	2	-	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	2	3	1	2
CO3	2	2	3	1
CO4	1	3	2	2
CO5	3	1	2	2

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE:	Course Title	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
HMDS22004	FUZZY LOGIC AND ITS APPLICATIONS	Ty	3	0/0	0/0	3

Unit I: Introduction to Fuzzy Logic **9Hrs**

Introduction to Fuzzy Logic- Significance of Fuzzy Logic- Classical Logic vs. Fuzzy Logic-Fuzzy Sets-Membership Functions-Operations on Fuzzy Sets-Complement of Fuzzy Sets-Applications of Fuzzy Logic

Unit II: Fuzzy Inference Systems **9Hrs**

Components of Fuzzy Inference Systems (FIS)-Types of Fuzzy Inference Systems-Rule-Based Systems-Rule Evaluation-Aggregation of Rule Outputs-Defuzzification-Rule Base Design-Applications of Fuzzy Inference Systems

Unit III: Applications in Control Systems **9Hrs**

Introduction to Fuzzy Control Systems- Fuzzy Controllers in Industrial Processes-Fuzzy Logic in Temperature Control Systems-Fuzzy Logic in Speed Control-Fuzzy Logic in Automobile Control Systems-Fuzzy Logic in Power Systems-Adaptive Fuzzy Control-Challenges and Future Trends

Unit IV:Fuzzy Logic in Speed Control **9Hrs**

Introduction to Decision Support Systems (DSS)-Fuzzy Decision Making-Fuzzy Logic in Risk Assessment-Fuzzy Logic in Financial Decision Support- Fuzzy Logic in Healthcare Decision Support-Fuzzy Logic in Environmental Decision Support-Explainable Fuzzy Systems (XFS)-Fuzzy Logic in Business Decision Support

Unit V:Ethical Considerations and Emerging Trends **9Hrs**

Ethics in Fuzzy Decision-Making Systems- Transparency in Fuzzy Systems-Privacy and Security Concerns-Impact of Fuzzy Logic on Society-Regulatory Frameworks-Emerging Trends in Fuzzy Logic-Human-AI Collaboration in Decision Support-Responsible AI in Fuzzy Logic

Total Hours: 45

Text Books:

1. George J. Klir and Bo Yuan,"Fuzzy Sets and Fuzzy Logic: Theory and Applications", Latest Edition, Pearson Education India,2022

Reference Books:

1.John Yen and Reza Langari ,"Fuzzy Logic: Intelligence, Control, and Information" Latest Edition,Pearson India, 2022
2.Marc J. de Vries,."Fuzzy Logic: A Practical Approach",Latest Edition,Academic Press; Pap/Dskt edition ,2022

COURSE CODE: HMDS22005	COURSE NAME : DATA ANALYTICS TOOLS	Ty/Lb/ ETL/IE	L	T / S.Lr	P/R	C
	Prerequisite: Data Science	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE :

The students should be made to

- To understand the basics of Knowledge Engineering.
- To discuss methodologies and modeling for Agent Design and Development.
- To design and develop ontologies.
- Learn the Evolution of Knowledge management.
- Be familiar with tools.

COURSE OUTCOMES (COs): Students will be able to

CO1	Explore the fundamental concepts of data analytics
CO2	Understand data analysis techniques for applications handling large data
CO3	Design and develop machine learning algorithms used in data analytics process
CO4	Apply the present the inference using various tools
CO5	Design and develop the ethics surrounding privacy, data sharing and algorithmic decision-making

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	1	1	2	2	-	2
CO2	2	3	2	3	3	1	1	-	2
CO3	3	2	3	3	2	3	1	2	1
CO4	3	2	3	3	3	2	2	1	2
CO5	2	2	2	3	3	1	2	-	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1
CO2	1	1	2	2
CO3	2	1	2	1
CO4	1	2	1	1
CO5	3	2	1	2

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE:	Course Title	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
HMDS22005	DATA ANALYTICS TOOLS	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION **9Hrs**

Data Analytics - Types – Phases - Quality and Quantity of data – Measurement - Exploratory data analysis - Business Intelligence**.**

UNIT II: BIG DATA **9Hrs**

Big Data and Cloud technologies - Introduction to HADOOP: Big Data, Apache Hadoop, MapReduce - Data Serialization - Data Extraction - Stacking Data - Dealing with data.

UNIT III: DATA VISUALIZATION **9Hrs**

Introduction to data visualization – Data visualization options – Filters – Dashboard development tools – Creating an interactive dashboard with dc.js – summary

UNIT IV: ANALYTICS AND MACHINE LEARNING **9Hrs**

Machine learning – Modeling Process – Training model – Validating model – Predicting new observations – Supervised learning algorithms – Unsupervised learning algorithms.

UNIT V: ETHICS AND RECENT TRENDS **9Hrs**

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

Total: 45 Hrs

Text Books:

1. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley,2020.

Reference:

1. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly, 1st edition, 2019.
2. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O' Reilly, 2rd edition, 2019.
3. Eric Siegel, Predictive Analytics The Power to Predict Who Will Click, Buy, Lie, or Die, 2 nd Ed., Wiley

COURSE CODE: HMDS22006	COURSE NAME : COMPUTATIONAL INTELLIGENCE	Ty/Lb/ ETL/IE	L	T / S.Lr	P/R	C
	Prerequisite: Data Structure	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE :

- To provide a strong foundation on fundamental concepts in Computational Intelligence.
- To enable Problem-solving through various searching techniques.
- To apply these techniques in applications which involve perception, reasoning and learning.
- To apply Computational Intelligence techniques for information retrieval

To apply Computational Intelligence techniques primarily for machine learning

COURSE OUTCOMES (COs) : Students will be able to

CO1	Fundamental concepts
CO2	Provide a basic exposition to the goals and methods of Computational Intelligence.
CO3	Study of the design of intelligent Computational Techniques
CO4	Apply the Intelligent techniques for problem solving
CO5	Improve problem solving skills using the acquired knowledge in the areas of, reasoning, natural language understanding, computer vision, automatic programming and machine learning

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	1	-	-	2	--	-
CO2	2	2	2	3	2	-	2	-	2
CO3	3	2	2	1	-	-	2	-	-
CO4	2	2	2	3	2	-	2	-	2
CO5	2	3	3	3	2	-	2	-	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	2	1	3	3
CO3	2	2	2	2
CO4	2	2	3	3
CO5	2	3	3	3

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE:	Course Title	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
HMDS22006	COMPUTATIONAL INTELLIGENCE	Ty	3	0/0	0/0	3

Unit I: Introduction **9Hrs**

Introduction to Artificial Intelligence-Search-Heuristic Search-A* algorithm-Game Playing- Alpha Beta Pruning-Expert systems-Inference-Rules-Forward Chaining and Backward Chaining- Genetic Algorithms.

Unit II: Knowledge Representation and Reasoning **9Hrs**

Proposition Logic - First Order Predicate Logic – Unification – Forward Chaining –Backward Chaining - Resolution – Knowledge Representation - Ontological Engineering - Categories and Objects – Events-Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information - Prolog Programming.

Unit III: Uncertainty **9Hrs**

Non monotonic reasoning-Fuzzy Logic-Fuzzy rules-fuzzy inference-Temporal Logic-Temporal Reasoning-Neural Networks-Neuro-fuzzy Inference.

Unit IV: Learning **9Hrs**

ProbabilitybasicsBayesRuleanditsApplications-BayesianNetworks—ExactandApproximate Inference in Bayesian Networks - Hidden Markov Models - Forms of Learning - Supervised Learning Learning Decision Trees—Regression and Classification with Linear Models - Artificial Neural Networks—NonparametricModels-SupportVectorMachines-StatisticalLearning-Learningwith Complete Data-LearningwithHiddenVariables-TheEMAlgorithm–ReinforcementLearning.

Unit V: Intelligence and Applications **9Hrs**

Natural language processing-Morphological Analysis-Syntax analysis-Semantic Analysis-All applications—Language Models - Information Retrieval—Information Extraction – Machine Translation—Machine Learning-Symbol-Based—Machine Learning: Connectionist—Machine Learning.

Total: 45 HOURS

Text Books:

1.Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Pearson Education / Prentice Hall of India, 2010.
2. Elaine Richand KevinKnight, -Artificial Intelligence‖, Third Edition, TataMcGraw-Hill,2010.

Reference Books:

1. Patrick H.Winston."Artificial Intelligence", Third edition, Pearson Edition, 2006.
2. DanW.Patterson,-IntroductiontoArtificialIntelligenceandExpertSystems, PHI, 2006.
3. NilsJ.Nilsson,-Artificial Intelligence: Anew Synthesis‖, Harcourt Asia Pvt.Ltd. 2000.

COURSE CODE HMDS22L03	COURSE NAME: DATA ANALYTICS TOOLS LAB	Ty/Lb/ ETL/IE	L	T/S. Lr	P/R	C
	Prerequisite: SQL/R/Python Programming	Lb	0	0/0	3/0	2

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES:
The students should be made to
- Implement Big Data Analytics Problems

COURSE OUTCOMES (COs): Students will be able to

CO1	Explore the Big Data Platform Hadoop and its Use cases (L4)
CO2	Implement and demonstrate various algorithms using Hadoop (L5)
CO3	Exposure on Big data Analytics problems. (L3)
CO4	Explore and implement Map Reduce Jobs (L4)
CO5	Exposure to Decision Tree based ID3 problems (L3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	3	3	3	2	1	1
CO2	1	3	1	2	3	2	2	1	1
CO3	3	2	3	3	3	2	1		1
CO4	3	2	3	2	2	2	1		
CO5	2	3	2	2	2	2	1		

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	2	2	2
CO3	3	3	2	1
CO4	2	1	1	2
CO5	3	2	2	1

3/2/1 Indicates Strength of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
									✓

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S. Lr	P/R	C
HMDS22L03	**DATA ANALYTICS TOOLS LAB**	Lb	0	0/0	3/0	2

List of Experiments

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Start-up scripts, Configuration files.

2. Hadoop Implementation of file management tasks, such as Adding files and directories, Retrieving files and Deleting files

3. Implement of Matrix Multiplication with Hadoop Map Reduce

4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

5. Implementation of K-means clustering using Map Reduce

6. Implement and demonstrate the FIND-S Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a CSV file.

7. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

8. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

9. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

10. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

NOTE: It is suggested that these program can be done using MATLAB/ Any other equivalent software.

Total: 45 Hrs

COURSE CODE:	COURSE NAME:	Ty/Lb/ETL/ IE	L	T/S. Lr	P/R	C
HMDS22L04	**DEEP LEARNING TECHNIQUES LAB** Prerequisite: Machine Learning	Lb	0	0/0	3/0	2

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL /IE: Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE :

Students will be able to

7. To understand the historical evolutionary concepts of deep learning
8. To understand the fundamental concepts of Neural Networks
9. To understand the fundamental concepts of Convolution Neural Networks
10. To know about the various models available for sequence analysis
11. To understand the fundamental concepts of Deep
12. Reinforcement Learning.

COURSE OUTCOMES (Cos): Students will be able to

CO1	Make use of deep learning APIs like Keras. (L3)
CO2	Implement multiple conversions for Analysis (L3)
CO3	Apply deep learning techniques for object identification and segmentation (L3)
CO4	Implement RNN and CNN for multiple problems(L3)
CO5	Implement Autoencoders and GAN. (L3)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	2	2	2	2	-	3
CO2	2	-	2	3	2	3	1	2	2
CO3	2	1	1	2	1	-	3	-	3
CO4	1	2	1	3	2	2	2	-	1
CO5	-	2	2	1	2	1	1	1	3

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	3	-	1
CO3	1	2	2	-
CO4	1	-	2	-
CO5	2	2	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
									↘

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22L04	DEEP LEARNING TECHNIQUES LAB	Lb	0	0/0	3/0	2

List of Experiments:

1. To provide hands-on experience in understanding the basics of ANN models, and the pattern recognition tasks they perform

2. Train a recurrent neural network to perform sentiment analysis on movie reviews and classify them as positive or negative.

3. Build a chatbot using NLP techniques and sequence-to-sequence models to understand and generate human-like responses.

4. Create a model combining CNNs and RNNs to generate descriptive captions for images.

5. Develop a simulated environment for training a deep reinforcement learning agent to navigate and make decisions in a virtual autonomous car scenario.

6. Implement an LSTM network to analyze sensor data and predict maintenance needs for industrial machinery.

7. Develop an AI agent capable of playing board games like Tic-Tac-Toe or Connect Four using Monte Carlo Tree Search combined with deep learning techniques.

8. Build a facial recognition system using CNNs to identify individuals from images or video streams.

9. Create a GAN-LSTM hybrid model to generate new music compositions based on a dataset of existing songs.

10. Build a fraud detection system using neural networks and anomaly detection techniques to identify suspicious patterns in financial transactions.

NOTE: It is suggested that these program can be done using MATLAB/ Any other equivalent software.

TOTAL: 45 HOURS

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMCS22I01	**SUMMER INTERNSHIP** Prerequisite: NIL	**IE**	**0/0**	**0/0**	**4/0**	**2**

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

Students are supposed to undergo internship in related Industries for a minimum period of 30 days cumulatively during the semester. They have to prepare a report on the Internship with a certificate in proof from competent authority in the industry. At the end of the semester Viva-Voce examination will be conducted by the Examiners duly appointed by the Head of the department and the students will be evaluated.

SEMESTER III

COURSE CODE: HMDS22007	COURSE NAME: DIGITAL AND SOCIAL MEDIA ANALYTICS	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
	Prerequisite: Data Analytics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL/IE : Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:

Students will be

- Acquire a foundational understanding of Social Analytics, key concepts, methodologies, and their applications.
- Able to measure and analyze diverse user activities on social platforms, utilizing techniques.
- Interpret the types and properties of social networks and applying metrics like degrees and connection counting.
- Gain the ability to apply traditional models, forecasting metrics, and identifying periodicities in user activities.
- Proficient in evaluating the popularity of topics, identifying term occurrences in text, and assessing individual users' interests.

COURSE OUTCOMES (COs) : Students will be able to

CO1	Proficiently apply advanced analytics to derive insights from social data, and User Behavior in Social.
CO2	Excel in network analysis, distinguishing explicit and implicit social networks, and utilizing visualization tools and metrics.
CO3	Demonstrate the ability to analyze temporal patterns and forecast trends in user behavior.
CO4	Showcase expertise in content analysis through NLP, identifying term occurrences, topic modeling, and evaluating individual users' interests' diversity.
CO5	Navigate large dataset processing using MapReduce, addressing challenges related to long-tailed social media data, demonstrating practical skills

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	2	2	2	2			2
CO2	2	3	2	1	3	2	1	2	3
CO3	2	3	2	1	2		2		2
CO4	1	2	2	3	2	1		1	3
CO5	2	2	2	1	3		2		2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3
CO2	2	2	1	2
CO3	1	3	2	1
CO4	3	1	2	2
CO5	2	1	1	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE: HMDS22007	COURSE NAME: DIGITAL AND SOCIAL MEDIA ANALYTICS	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
	Prerequisite: Data Analytics	Ty	3	1/0	0/0	4

Unit 1: Understanding User Behavior in Social Media 12 hrs

Introduction to Social Media Analytics, Measuring User Behavior in Wikipedia, Diversity of User Activities, Power Law and Long Tail in Human Activities, Online Behavior on Twitter: Retrieving Tweets for Users-Logarithmic Binning-User Activities on Twitter.

Unit 2: Exploring Social Networks in Social Media 12 hrs

Types and Properties of Social Networks, Explicit and Implicit Networks, Visualizing Networks, Degrees and Connection Counting, Correlations: Triangles, Clustering, and Assortativity, Social Media Services Online : Search Engines, Content Engagement, Interactions with the Real World, Interactions with People.

Unit 3: Temporal Analysis in Social Media 12 hrs

Traditional Models for Events in Time, Inter-Event Times and Autocorrelations, Periodicities in User Activities, Bursty Activities and Reservoir Sampling, Forecasting Metrics and Time Series Analysis, ARIMA Model. Learn Map: Learning and Mapping, Matrix Factorization, Learning, Training, Regularizing in Matrix Factorization, Non-Negative Matrix Factorization and Sparsity.

Unit 4: Analyzing Content in Social Media 12 hrs

Defining Content and Natural Language Processing, Term Occurrences in Text and Topic Identification, Popularity of Topics, Individual Users' Interests Diversity, Topic Modeling Techniques. Prediction and Recommendation: Evaluation, Overview of Methodologies.

Unit 5: Processing and Learning from Large Datasets 12 hrs

Introduction to MapReduce, Counting Words and Multi-Stage Flows, Joining Data Sources and MapReduce Patterns, Large-Scale MapReduce Models, Challenges with Long-Tailed Social Media Data, Sampling and Approximations Techniques, HyperLogLog, Bloom Filters, Count-Min Sketch, Executing on a Hadoop Cluster

Total : 60 HOURS

TEXT BOOKS:

1. Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulus, John Wiley & Sons, Inc. 2nd edition, 2021.

REFERENCE BOOKS:

1. Seven Layers of Social Media Analytics Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan, 2020.
2. Social Media Analytics :Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, Avinash Kohirkar, IBM Press, 2019.
3. Social Media Analytics Strategy : Using Data to Optimize Business Performance, Alex Gonçalves, APress Business Team, 2020.
4. Charu Aggarwal (ed.) : Social Network Data Analytics, Springer, 2021.

COURSE CODE: HMDS22008	COURSE NAME: WEB ANALYTICS	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: **Machine Learning**	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE: The students should be made to understand

- The importance of qualitative data, get insights and techniques
- About customer-centric approach in dealing with data.
- The principles, tools and methods and web intelligence

COURSE OUTCOMES (COs): Students will be able to

CO1	Understand the techniques of web data analytics
CO2	Apply web data analytics on social, mobile and video data
CO3	Analyze techniques for measuring the success of a website
CO4	Assess the various cases to apply web data analytics
CO5	Propose new metrics-based solutions for user website

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	-	2	--	-
CO2	2	2	3	3	2	-	2	-	2
CO3	3	2	3	3	1	-	2	-	-
CO4	2	3	3	3	2	-	2	-	2
CO5	3	3	3	2	2	-	2	-	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	2	1	3	3
CO3	2	2	2	2
CO4	2	2	3	3
CO5	2	3	3	3

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE:	Course Title	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
HMDS22008	WEB ANALYTICS	Ty	3	0/0	0/0	3

Unit I: Basics of Web **9Hrs**

Foundation of Web Analytics–Techniques and Technologies- Click Stream – Competitive Intelligence - The Tactical Shift – Optimal Strategy for Choosing Web Analytics

Unit II: Click Stream Analysis **9Hrs**

Click Stream Analysis Metrics – Eight Critical Web Metrics-Lick Stream Data- Web Analytics Report Page Tags – First And Third Party Tracking.

Unit III: Strategy for Qualitative Data **9Hrs**

Measuring Success – Key Performance Indicators – Measuring Acquisition – Measuring Conclusion Leveraging Qualitative Data Survey – Web Enabled Emerging User Research Options.

Unit IV: Tools In Testing Segmentation Analysis **9Hrs**

Content Organization Tools – Process Measurement Tools – Victor Segmentation Tools – A/B Testing – Multivariate Testing – Competitive Intelligence Analysis – Audience Identification & Segmentation Analysis.

Unit V: Evolving Analytics **9Hrs**

Social, Mobile, Video: Measuring Social Web – The Data Challenge – Analysing Mobile Customer Experience – Measuring the Success of Blogs – Tracking visitor clicks – Analysing the Performance of Videos.

Total: 45 Hours

Text Books

1. Bernard J, Jansen Understanding User Web Interactions via Web analytics Morgan and Claypool, 2009

Reference Books

1. Avinash Kaushik, Web Analytics2.0, John Wiley and Sons, 2010
2. Brin Clifton, Advanced web metrics with Google Analytics, John Wiley and Sons, 2012
3. Justin Cutroni, Google Analytics, O"Reilly, 2015.

COURSE CODE: HMDS22009	COURSE NAME: NATURAL LANGUAGE PROCESSING	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Artificial Intelligence	TY	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES:

Thestudents should be made to

- To introduce the fundamental concepts and theory of Natural Language Processing
- To learn the challenges of natural language processing
- To understand the use of CFG rules in NLP
- To understand the role of semantics of sentences and pragmatics
- To apply the NLP techniques in practical applications
-

COURSE OUTCOMES (COs) : Students will be able to

CO1	Recognize the concepts and techniques of Natural Language Processing (L2)
CO2	Design and develop NLP Models (L5)
CO3	Implement a rule based system to tackle morphology/syntax of a language (L4)
CO4	Design a tag set to be used for statistical processing for real-time applications (L5)
CO5	Formulate natural language algorithms for processing Linguistic Information. (L3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	1	2	2	1	1		2
CO2	3	3	1	1	3	1	1		2
CO3	2	3	3	2	2	1	1	1	2
CO4	2	3	3	3	3	2	2	2	
CO5	3	2	3	3	2	1	1	1	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2
CO2	3	3	3	1
CO3	2	3	2	2
CO4	3	2	3	2
CO5	3	2	3	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✔					

COURSE CODE	COURSE NAME	Ty/ Lb/ ETL/IE	L	T/ S.Lr	P/R	C
HMDS22009	NATURAL LANGUAGE PROCESSING	Ty	3	0/0	0/0	3

UNIT I- OVERVIEW AND MORPHOLOGY **9 Hrs**

Introduction – Models -and Algorithms - Regular Expressions Basic Regular Expression Patterns – Finite State Automata, Morphology -Inflectional Morphology - Derivational Morphology - Finite-State Morphological Parsing --Porter Stemmer.

UNIT II - WORD LEVEL AND SYNTACTIC ANALYSIS **9 Hrs**

N-grams Models of Syntax - Counting Words - Unsmoothed N- grams- Smoothing- Back off Deleted Interpolation – Entropy - English Word Classes - Tagsets for English - Part of Speech Tagging-Rule Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging.

UNIT III –CONTEXT FREE GRAMMARS **9 Hrs**

Context Free Grammars for English Syntax- Context- Free Rules and Trees - Sentence- Level Constructions– Agreement – Sub Categorization - Parsing – Top-down – Earley Parsing - feature Structures – Probabilistic Context-Free Grammars.

UNIT IV –SEMANTIC ANALYSIS **9 Hrs**

Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus - Representing Linguistically Relevant Concepts -Syntax- Driven Semantic Analysis - Semantic Attachments -Syntax-Driven Analyzer - Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval.

UNIT V –LANGUAGE GENERATION AND DISCOURSE ANALYSIS **9 Hrs**

Discourse -Reference Resolution - Text Coherence - Discourse Structure – Coherence - Dialog and Conversational Agents - Dialog Acts – Interpret ation -Conversational Agents - Language Generation – Architecture - Surface Realizations - Discourse Planning - Machine Translation – Applications of NLP.

Total: 45 Hours

TEXT BOOKS

1. Daniel Jurafsky and James H Martin, ”Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Pearson Publication, 2014.
2. C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA:, 1999

REFERENCE BOOKS

1. Richard M Reese, ―Natural Language Processing with Java‖, O_Reilly Media, 2015.
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

COURSE CODE	COURSE NAME: OPTIMIZATION TECHNIQUE	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
HMDS22010	Prerequisite: Mathematical Foundation	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL/IE : Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:

The students should be made to

- Operation research models using optimization techniques based upon the fundamentals of Engineering mathematics (minimization and Maximization of objective function).
- The problem formulation by using linear, dynamic programming, game theory and queuing models.
- The stochastic models for discrete and continuous variables to control inventory and simulation of manufacturing models for the production decision making.
- Formulation of mathematical models for quantitative analysis of managerial problems in industry

COURSE OUTCOMES (COs): Students will be able to

CO1	Understand Linear algebra and matrices, Elements of probability theory-Elementary multivariable calculus
CO2	Apply the theoretical foundations of various issues related to linear programming modeling to formulate real-world problems as a L P model
CO3	Understand Unconstrained optimization
CO4	Understand constrained optimization
CO5	Analyze Non-linear constrained optimization models

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	3	3	2	2	2
CO2	3	3	3	3	3	3	2	-	2
CO3	3	2	2	2	3	1	-	-	2
CO4	3	3	2	2	3	2	-	2	3
CO5	3	2	3	2	2	2	-	3	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	2	3	2
CO3	3	2	2	3
CO4	3	3	3	2
CO5	3	2	2	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
				✓					

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
HMDS22010	OPTIMIZATION TECHNIQUE	Ty	3	0/0	0/0	3

UNIT- I **9Hrs**

Mathematical preliminaries
Linear algebra and matrices-Vector space, eigen analysis-Elements of probability theory-Elementary multivariable calculus

UNIT-II **9Hrs**

Linear Programming
Introduction to linear programming model - Simplex Method-Duality-Karmarkar's method

UNIT-III **9Hrs**

Unconstrained optimization
One-dimensional search methods - Gradient-based methods -Conjugate direction and quasi-Newton methods

UNIT-IV **9Hrs**

Constrained Optimization
Lagrange theorem-FONC, SONC, and SOSC conditions

UNIT-V **9Hrs**

Non-linear problems
Non-linear constrained optimization models- KKT conditions -Projection methods

Total:45 Hours

Reference Books:
1. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak
2. Nonlinear Programming by Dimitri Bertsekas

Subject Code: **HMOL22IE1**	Subject Name : **OPEN ELECTIVE (SELF STUDY PAPER) – SWAYAM / NPTEL / ANY MOOC**	**Ty/Lb/ ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	IE	3	0/0	0/0	3
L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab						

Open Elective (On Line Course through NPTEL/SWAYAM/Any MOOC)

Students should register for the online course with a minimum course duration of 8 weeks through the online portals such as NPTEL/SWAYAM/Any MOOC in the beginning of the semester. The course can be core/interdisciplinary in such a way that the same course is not repeated during the course of study.

Students are expected to attend the online classes regularly and submit the weekly assignments before the due dates. Students should appear for the online examination and submit the certificate at the end of the semester. Internal examination will be conducted by the examiners duly appointed by the head of the department.

COURSE CODE: **HMDS22I02**	COURSE NAME: **PROJECT PHASE - I**	**Ty/Lb/ ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	IE	0	0/0	4/0	2

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL /IE: Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE:

The students should be made to

- The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : Students will be able to

CO1	Apply the knowledge and skills acquired in the course of study, addressing a specific problem or issue.
CO2	Design the software system effectively
CO3	Encourage students to think critically and creatively about societal issues and develop user friendly solution.
CO4	Support the field experience and get linked with the professional network.
CO5	Equip the students with industry knowledge and understanding of various possible technologies.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	2
CO4	3	2	3	3	3	3	2	3	3
CO5	2	2	2	2	2	2	3	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	2	2	2	2
CO5	3	2	3	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
									✓

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22I02	PROJECT PHASE – I	IE	0	0/0	4/0	2

DESCRIPTION:

Students should select the area of the project work and complete the literature survey. Student should identify the problem of study and start the work. Students are expected to do the project work **individually**. A guide will be allotted to each student based on the area of the Project work. Project reviews will be conducted once in a fortnight to assess the development of the project work.

At the end of the semester students should submit a report of the work completed and should appear for a Project Viva- voce examination conducted by the internal examiner.

Continuous assessment mark (50 marks) will be awarded based on the performance in the reviews.

End semester mark (50 marks) will be awarded for project viva voce examination.

Total Hours: 60

COURSE CODE: HMDS22L05	COURSE NAME : PROJECT PHASE – II	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	**Lb**	**0**	**0/0**	**18/0**	9

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

The students should be made to

- The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs): Students will be able to

CO1	To explain the functionality of the system
CO2	To express proficiency in handling the technologies
CO3	To support the societal problems
CO4	To summarize the innovative ideas with good documentation
CO5	To validate the implementation of the software/Hardware system

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	3	3	1	2
CO2	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	2
CO4	3	2	3	3	3	3	2	3	3
CO5	1	2	2	2	2	2	3	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	2	2	2	2
CO5	3	2	2	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
									✓

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22L05	PROJECT PHASE – II	Lb	0	0/0	18/0	9

DESCRIPTION:

Students are expected to do a Project work either in an Industry or at the University in the area of specialization individually. Each student will be allotted a guide based on the area of Project work

Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.

It is mandatory that the student should have presented his project work as a technical paper in National/international conference /Journals. A copy of the certificate in proof of paper presentation should be enclosed in the project report.

50% weightage (100 marks) will be given for the continuous assessment and 50% weightage (100 marks) for the Project viva a voce examination.

In case of industrial project certificate in proof has to be included in the report along with the bonafide certificate.

Subject Code: **HMDS22I03**	Subject Name : **RESEARCH PUBLICATION**	**Ty/Lb/ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	IE	0	0/0	4/0	2
L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab						

Students are supposed to prepare and publish the article based on either his term paper or area of research in peer reviewed referred journal. Code of research publication ethics should be followed. After publishing the article students should present a seminar in presence of department faculties and PG students. At the end of semester viva examination will be conducted by the examiners appointed by the Head of the department.

ELECTIVE I

COURSE CODE:	COURSE NAME: PRINCIPLES OF DATA SCIENCE	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22E01	Prerequisite: Machine Learning	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL/IE : Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:

The students should be made to

- know the fundamental concepts of data science and analytics
- learn various techniques for mining data streams
- learn Event Modeling for different applications.
- know about Hadoop and Map Reduce procedure

COURSE OUTCOMES (COs): Students will be able to

CO1	Understand the application and process of data science[L2]
CO2	Analyzing the different models with examples[L4]
CO3	Applying various techniques for data mining[L3]
CO4	Write and evaluate efficient algorithms for mining the data from large volumes[L5]
CO5	Understand and apply different Frameworks and Visualization techniques for Real world problems[L3]

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	2	1	1	1	1	2
CO2	3	3	3	2	1	1	2		2
CO3	3	3	2	2	1	1	2	2	1
CO4	3	3	2	2	2	2	1		1
CO5	3	3	2	2	2	1	2	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	2	2
CO3	3	3	3	3
CO4	3	3	2	2
CO5	3	3	2	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✓				

COURSE CODE:	Course Title	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
HMDS22E01	PRINCIPLES OF DATA SCIENCE	Ty	3	0/0	0/0	3

Unit - I Introduction **9Hrs**

Evolution of Data Science, Introduction to Data Science – Types of Data, Data Science Vs Big Data, Concept of Big Data, Concept of Data Warehousing, Introduction to Data Mining, Role of Data Scientist, Data Science Life Cycle, Data Science Roles – Data Science Project Stages – Data Science Applications in Various Fields – Data Security Issues, thinking in a structured way to solve data science problem statements.

Unit– II Pre-processing & collection of data **9Hrs**

Need of Data Pre-processing,Pre-processing of data and data collection, Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization, Data Storage, and management, Data preparation for analytics

Unit– III Exploratory Data Analytics **9Hrs**

Introduction to Data Analytics/Concept of Data Analytics Types of Data Analytics, Descriptive Statistics, Mean, Standard Deviation, Skewness, and Kurtosis, Box Plots, Pivot Table, Heat Map ,Correlation Statistics , ANOVA , Exploratory Data Analytics, Confidence (statistical) intervals; variances and correlations

Unit– IV Regression & Model Development **9Hrs**

Simple and Linear Regression – Visual Model Evaluation – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Insample Evaluation Measures – Prediction and Decision Making

Unit– V Model Evaluation Generalization and Data Visualization **9Hrs**

Metrics for Out-of-Sample Evaluation Error – Cross Validation – Overfitting – Under fitting and Model Selection – Ridge Regression Prediction – Grid Search Testing Multiple Parameters,Data handling /Data wrangling using Python Definition, Types of visualization, data visualization, Data types, Data encoding , mapping variables , Conventional data visualization tools, Techniques for visual data representations, Types of data visualization

Total: 45 Hrs

Text Books

1. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2013.

Reference Books

1. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
2. G. Strang . Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA, 2016.
3. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA, 2010.

COURSE CODE: HMDS22E02	**COURSE NAME : KNOWLEDGE ENGINEERING AND EXPERT SYSTEMS**	**Ty/Lb/ ETL/IE**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Artificial Intelligence	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE :

The students should be made to

- To understand the basics of Knowledge Engineering.
- To discuss methodologies and modeling for Agent Design and Development.
- To design and develop ontologies.
- Learn the Evolution of Knowledge management.
- Be familiar with tools.

COURSE OUTCOMES (COs): Students will be able to

CO1	Explore the fundamental concepts of knowledge engineering
CO2	Understand knowledge representing techniques
CO3	Design and develop knowledge engineering methods
CO4	Describe the concept of agent communication, multi-agent interaction and interaction protocols
CO5	Apply the expert systems using various tools and inference

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	1	1	2	2	1	2
CO2	2		2		3		1		2
CO3		2		3	2	3		2	1
CO4	3	2					2		2
CO5	2	2	2	3	3	1	2		2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1
CO2	1	1	2	2
CO3	2	1	2	1
CO4	1	2	1	1
CO5	3	2	1	2

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✔				

COURSE CODE: HMDS22E02	COURSE NAME : KNOWLEDGE ENGINEERING AND EXPERT SYSTEMS	Ty/Lb/ ETL/ IE	L	T / S.Lr	P/ R	C
	Prerequisite: Artificial Intelligence	Ty	3	0/0	0/0	3

UNIT 1 Knowledge Engineering **9 HRS**

Knowledge Basics- Knowledge Engineering-Knowledge Acquisition- Knowledge Engineer- Difficulties in Knowledge Acquisition- Knowledge Acquisition Techniques- Natural Techniques- Contrived Techniques- Modelling Techniques.

UNIT II Knowledge Representation **9 HRS**

Definitions of Knowledge Representation- Characteristics of Good Knowledge Representation- Basics of Knowledge Representation- Properties of the Symbolic Representation of Knowledge- Properties for the Good Knowledge Representation Systems- Categories of Knowledge Representation Schemes- Types of Knowledge Representational Scheme.

UNIT III Expert Systems **9 HRS**

Definitions of Expert Systems- Features of Good Expert Systems- Architecture and Components of Expert Systems- Roles of the Individuals Who Interact with the System- Advantages of Expert Systems- Disadvantages of Expert Systems.

UNIT IV The Expert System Development Life Cycle **9 HRS**

Stages in the Expert System Development Life Cycle- Problem Selection-Conceptualization-Formalization-Prototype Construction- Implementation –Evaluation- Sources of Error in Expert System Development- Knowledge Errors- Syntax Errors-Semantic Errors.

UNIT V Fuzzy Expert Systems **9HRS**

Need for Fuzzy Expert Systems- Operations on a Fuzzy Expert System-Fuzzification (Fuzzy Input)-Fuzzy Operator-Fuzzy Inferencing (Implication)-Aggregate All Output-Defuzzification.

TOTAL:45 HRS

TEXT BOOKS:

1. Artificial Intelligence and Expert Systems", I. Gupta , G. Nagpal Paperback – Import, 28 April 2020

Reference Books:

1. S. L. Kendal, M. Creen ,"An Introduction to Knowledge Engineering".
2. Mike Greenwell," Knowledge engineering for expert systems"
3. "Expert Systems, Knowledge Engineering For Human Replication", Andrews sofroniou.

Course Code: **HMDS22E03**	Course Name **BIOINFORMATICS**	**Ty/Lb/ETL/ IE**	**L**	**T/ S.Lr**	**P/R**	**C**
	Prerequisite: Statistics	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES

The Students should be made to:

- To study the scope of Bioinformatics
- To understand the types of Databases and their uses
- To analyze the Tools and Algorithms
- To learn the Pair wise Sequence Alignment methods

COURSE OUTCOMES (COs) : Students will be able to

CO1	understand the concepts of Bioinformatics
CO2	recall the basic concepts of database
CO3	Illustrate various tools and techniques used for Bioinfomatics.
CO4	apply the algorithm of bioinformatics
CO5	understand the concepts of Genome analysis and sequence

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	3	1	2	1	
CO2	3	2	3	2	3	2	1	1	2
CO3	3	2	2	2	3	2	1		1
CO4	3	3	3	2	3	2	2		2
CO5	3	3	2	2	3	2	1	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3
CO2	2	3	3	3
CO3	2	3	3	3
CO4	3	3	3	3
CO5	3	3	3	2

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✓				

COURSE CODE	COURSE NAME	Ty/Lb/ETL/IE	L	T/ S.Lr	P/R	C
HMDS22E03	BIOINFORMATICS	Ty	3	0/0	0/0	3

UNIT I- INTRODUCTION **9 HRS**

Introduction-Historical Overview and Definition- Bioinformatics Applications - Major Databases in Bioinformatics- Data Management and Analysis- Molecular Biology and Bioinformatics- Central Dogma of Molecular Biology

UNIT II--DATABASES **9 HRS**

Introduction- Characteristics of Bioinformatics Databases- Categories of Bioinformatics Databases- Navigating databases- Sequence Databases Nucleotide sequence database- secondary Nucleotide sequence database – protein sequence databases- structure databases- Structure file formats- Protein Structure Database Collaboration- PDB- CATH –SCOP- Other databases- Enzyme Databases- MEROPS- Pathway Databases:CAZy

UNIT III – TOOLS **9 HRS**

Introduction- Need for Tools- Knowledge Discovery- Data- Mining Tools- Data Submission tools- Nucleotide Sequence Submission and Protein Submission tools- Data Analysis tools- Prediction Tools- Phylogenetic trees and Phylogenetic Analysis- Modelling Tools

UNIT IV- ALGORITHMS **9 HRS**

Introduction- Classification of Algorithms- Biological Algorithms- Implementing Algorithms- Biological Algorithms- Bioinformatics Tasks and Corresponding Algorithms- Data Analysis Algorithms- Sequence Comparison Algorithms – Substitution Matrices Algorithms –Sequence Alignment Optimal Algorithms- 215 CS-Engg&Tech-SRM-2013 Prediction Algorithms- Phylogenetic prediction Algorithm – Protein Structure Prediction

UNIT V –GENOME ANALYSIS AND SEQUENCE ALIGNMENT **9 HRS**

Introduction- Genome Analysis- Genome mapping- The Sequence Assembly Problem- Genome Sequencing- Biological Motivation of Alignment Problems -Methods of Sequence Alignments- Using Scoring matrices- Measuring Sequence Detection Efficiency- Working with FASTA and BLAST

TOTAL:45 HOURS

TEXT BOOKS

1. Orpita Bosu, Simminder Kaur Thukral , “Bioinformatics: Database, Tools, Algorithms”, Oxford University Press, Chennai, 2007.
2. Rastogi S. C., NamitaMendiratta, Parag Rastogi, “Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery”, Third Edition, PHI Learning Pvt. Ltd., New Delhi, 2011.

REFERENCE BOOKS

1. Bryan Bergeron, “Bioinformatics computing”, PHI Learning Pvt. Ltd, New Delhi, 2010.
2. Rastogi S.C., Namita Mendiratta, Parag Rastogi, “Bioinformatics: Concepts”, Skills & Applications, Second Edition, CBS Publishers & Distributors Pvt. Ltd, 2009
3. Arthur M. Lesk, “Introduction to Bioinformatics”, Third Edition, Oxford University Press, Chennai, 2010
4. Gautham N., “Bioinformatics:Databases and Algorithms”, Alpha Science 2006.

ELECTIVE II

COURSE CODE: HMDS22E04	COURSE NAME: ARTIFICIAL INTELLIGENCE ETHICS	Ty/Lb/E TL/IE	L	T/S. Lr	P/R	C
	Prerequisite: Artificial Intelligence	**Ty**	**3**	**0/0**	**0/0**	**3**

L: LectureT :Tutorial S.Lr: Supervised Learning
P:ProjectR:ResearchC:CreditsTy/Lb/ETL/IE: Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:
The students should be made to
1.Learn about morality and ethics in AI
2.Understand the concepts of Roboethics and Morality with professional responsibilities
3.Acquire the knowledge of real time application ethics, issues and its challenges.

COURSEOUTCOMES (COs):Students will be able to

CO1	Learn about morality and ethics in AI(L1)
CO2	Understand the ethical harms and ethical initiatives in AI (L2)
CO3	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems.(L1)
CO4	Understand the concepts of Robotics and Morality with professional responsibilities.(L2)
CO5	Acquire the knowledge of real time application ethics, issues and its challenges. (L3)

Mapping of Course Outcomes with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	1	2	3	2	3	2
CO2	3	2	2	1	2	3	2	3	2
CO3	3	2	2	1	2	3	2	3	2
CO4	3	2	3	2	3	3	1	3	2
CO5	3	3	3	2	3	3	1	3	3

COs/ PSOs	PSO 1	PSO2	PSO3	PSO4
CO1	3	1	2	2
CO2	3	1	2	2
CO3	3	1	2	3
CO4	3	2	2	3
CO5	3	2	3	3

3/2/1IndicatesStrengthOfCorrelation,3 – High,2-Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical/ Project
					✓				

COURSE CODE:	COURSE NAME: ARTIFICIAL INTELLIGENCE ETHICS	Ty/Lb/ ETL/ IE	L	T/S. Lr	P/R	C
HMDS22E04	Prerequisite: Artificial Intelligence	Ty	3	0/0	0/0	3

UNIT I –INTRODUCTION **9Hrs**

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT II-ETHICAL INITIATIVES IN AI **9Hrs**

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponisation.

UNIT III-AI STANDARDS AND REGULATION **9Hrs**

Model Process for Addressing Ethical Concerns During System Design – Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT IV-ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS 9Hrs

Robot - Roboethics- Ethics and Morality - Moral Theories - Ethics in Science and Technology – Ethical Issues in an ICT Society - Harmonization of Principles - Ethics and Professional Responsibility - Roboethics Taxonomy.

UNIT V- AI AND ETHICS- CHALLENGES AND OPPORTUNITIES **9Hrs**

Challenges – Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI **Total : 45hrs**

TEXTBOOK

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield , ”The ethics of artificial intelligence: Issues and initiatives”, EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2. Patrick Lin, Keith Abney, George A Bekey,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014.

REFERENCE BOOK

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddingt on November 2017

2. Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020

Course Code **HMDS22E05**	**Course Name** **REINFORCEMENT LEARNING**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite : Machine Learning	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P: Project R : Research C : Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES

The Students should be made to:

- To understand the main concepts related to reinforcement learning
- To review real-world applications of reinforcement learning
- To apply reinforcement learning to solve real-life problems

COURSE OUTCOMES (Cos) : Students will be able to

CO1	understand the key features of reinforcement learning (RL) that distinguishes it from AI and non- interactive machine learning
CO2	analysis the application problem should be formulated as a RL problem and state what algorithm is best suited for addressing it
CO3	implement in code common RL algorithms
CO4	apply and perform case study related to reinforcement learning.
CO5	understand about Deep reinforcement learning

Mapping of Course Outcome with Program Outcome (POs)

Cos/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	1	2	2	1	-	2	1
CO2	3	3	3	3	1	1	1	2	2
CO3	3	2	1	3	3	1	1	1	2
CO4	3	3	3	3	1	2	2	1	1
CO5	1	2	2	3	3	2	-	3	1

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1
CO2	2	2	1	2
CO3	2	2	1	2
CO4	2	2	2	2
CO5	3	2	2	1

3/2/1 Indicates Strength of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					√				

Course Code HMDS22E05	Course Name REINFORCEMENT LEARNING	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : Machine Learning	Ty	3	0/0	0/0	3

UNIT:1 INTRODUCTION 9 HRS

Reinforcement learning, Examples, Elements of reinforcement learning, An extended example: Tic-Tac-Toe, Limitations and Scope.

UNIT: 2 TABULAR SOLUTION METHODS 9 HRS

Multi-armed bandits, Gradient Bandit algorithms, Finite Markov Decision Processes, Optimal Policies and Optimal Value Functions, Dynamic Programming and its efficiency, Monte Carlo methods, Monte Carlo Prediction

UNIT: 3 PLANNING AND LEARNING WITH TABULAR METHODS 9 HRS

Models and Planning, Dyna: Integrated Planning, Acting, and Learning, Trajectory Sampling, Real-time Dynamic Programming, Planning at Decision Time, Heuristic Search, Rollout Algorithms, Monte Carlo Tree Search

UNIT: 4 APPLICATIONS AND CASE STUDIES RELATED TO REINFORCEMENT LEARNING 9 HRS

TD-Gammon, Samuel‘s Checkers Player, Watson‘s Daily-Double Wagering, Optimizing Memory Control, Human-level Video Game Play, Mastering the Game of Go, Personalized Web Services, Thermal Soaring, Reinforcement learning in robotics

UNIT: 5 DEEP REINFORCEMENT LEARNING 9 HRS

Introduction to Deep Learning, Deep Q-Learning, Value-based Deep RL: Deep Q-network, Policy-based Deep RL: REINFORCE, Asynchronous Methods for Deep RL: Advantage Actor- Critic (A2C), Model-based Deep RL

TOTAL: 45 Hrs

TEXT BOOKS

1. Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2nd edition, Richard S. Sutton and Andrew G. Barto, A Bradford Book; 2018, ISBN 978-0262039246.

REFERENCE BOOKS

1. Reinforcement Learning Algorithms: Analysis and Applications, Belousov, B., Abdulsamad, H., Klink, P., Parisi, S., Peters, J. (Eds.), Studies in Computational Intelligence Series, Vol. 883, Springer 2021, ISBN 978-3-030-41187-9
2. Reinforcement Learning: Industrial Applications of Intelligent Agents , Phil Winder, O'Reilly.2020, ISBN: 9781098114831
3. Learning to Play: Reinforcement Learning and Games, Aske Plaat, Springer 2020, ISBN 978-3-030-59237
4. Applied Reinforcement Learning with Python WithOpenAI Gym, Tensorflow, and Keras, TawehBeysolow, Apress, 2019, ISBN 978-1-4842-5126

COURSE CODE HMDS22E06	COURSE NAME : DATA VISUALIZATION TECHNIQUES	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Data Analytics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE : The students should be made to

- To outline an overview of exploratory data analysis.
- To perform univariate & bivariate data exploration and analysis
- Supports to summarize use of predictive analytics, data science and data visualization
- Build an effective Data Visualization system

COURSE OUTCOMES (COs) : Students will be able to

CO1	Handle missing data in the real world data sets by choosing appropriate methods.[L2]
CO2	Understand the key techniques and theory behind data visualization [L2]
CO3	Use effectively the various visualization structures (like tables, spatial data, tree and network etc.)[L3]
CO4	Evaluate information visualization systems and other forms of visual presentation for their effectiveness[L5]
CO5	Design and build data visualization systems[L6]

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	1	-	-	2	--	-
CO2	2	2	2	3	2	-	2	-	2
CO3	3	2	2	1	-	-	2	-	-
CO4	2	2	2	3	2	-	2	-	2
CO5	2	3	3	3	2	-	2	-	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	2	1	3	3
CO3	2	2	2	2
CO4	2	2	3	3
CO5	2	3	3	3

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✔				

COURSE CODE HMDS22E06	COURSE NAME : DATA VISUALIZATION TECHNIQUES	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Data Analytics	Ty	3	0/0	0/0	3

Unit I: Introduction to Exploratory Data Analysis 9Hrs

Introduction to Exploratory Data Analysis (EDA) –Steps in EDA, Data Types: Numerical Data – Discrete data, continuous data – Categorical data – Measurement Scales: Nominal, Ordinal, Interval, Ratio – Comparing EDA with classical and Bayesian Analysis – Software tools for EDA

Unit II: Data Transformation Correlation Analysis and Time Series Analysis 9Hrs

Transformation Techniques: Performing data deduplication - replacing values – Discretization and binning. Introduction to Missing data, handling missing data: Traditional methods - Maximum Likelihood Estimation. Types of analysis: Univariate analysis - bivariate analysis - multivariate analysis. Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA – Time based indexing - visualizing time series – grouping time series data - resampling time series data

Unit III: Value of Visualization 9Hrs

What is Visualization and Why do it: External representation – Interactivity – Difficulty in Validation. Data Abstraction: Dataset types – Attribute types – Semantics. Task Abstraction – Analyze, Produce, Search, Query. Four levels of validation – Validation approaches – Validation examples. Marks and Channels

Unit IV: Visualization Analysis and Design: Rules of thumb 9Hrs

Categorical regions – Spatial axis orientation – Spatial layout density. Arrange spatial data: Geometry – Scalar fields – Vector fields – Tensor fields. Arrange networks and trees: Connections, Matrix views – Containment. Map color: Color theory, Color maps and other channels.

Unit V: Manipulate view 9Hrs

Change view over time – Select elements – Changing viewpoint – Reducing attributes. Facet into multiple views: Juxtapose and Coordinate views – Partition into views – Static and Dynamic layers – Reduce items and attributes: Filter – Aggregate. Focus and context: Elide – Superimpose – Distort – Case studies.

Total: 45Hrs

Text Books

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python" 1st Edition, 2020, Packt Publishing.
2. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.

Reference Books

3. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.
4. Scott Murray, Interactive Data Visualization for the Web, O'Reilly, 2013.
5. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012.

ELECTIVE III

COURSE CODE: HMDS22E07	COURSE NAME: BLOCK CHAIN AND ARTIFICIAL INTELLIGENCE	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Cryptography	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL/IE : Theory/Lab/Embedded Theory and Lab Internal Evaluation

OBJECTIVES:

The students should be made to:

- understand the history, types and applications of Blockchain
- acquire knowledge about cryptography and consensus algorithms
- Familiar with future currencies and to create own crypto token

COURSE OUTCOMES (COs) :Students will be able to

CO1	Understand the functional/operational aspects of Block chain[L2]
CO2	Apply the different Consensus Mechanisms[L3]
CO3	Apply the different cryptocurrency for different types of domains[L3]
CO4	Understand emerging abstract models for Block chain Technology[L2]
CO5	Design and analyze the applications based on Block chain Technology[L4]

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	1	1	2	1	1	2
CO2	3	3	2	3	3	1		2	
CO3	3	3	3	3	3	2	2	2	2
CO4	3	3	3	3	3	2		1	
CO5	3	3	3	3	3	1	1	1	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	3
CO2	3	2	2	2
CO3	3	2	3	3
CO4	3	3	2	3
CO5	3	3	3	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✓				

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
HMDS22E07	BLOCK CHAIN AND ARTIFICIAL INTELLIGENCE	Ty	3	0/0	0/0	3

UNIT I Introduction **9Hrs**

Defining Block chain and Distributed Ledger, Blockchain Properties Decentralized, Transparent, Immutable and secure. Block chain Applications. Types of Blockchain: Public, private, and consortium based block chain, When to use, and when not to use Block chain, History of Block chain. Peer to Peer Structure, Network,P2P network for block chain.

UNIT II Block chain Data Characteristics Mechanisms and Consensus **9Hrs**

Cryptographic Hash Functions, Digital Signatures, Public Keys as Identities, Hash Pointers and Hash chain and Merkel tree, Consensus mechanisms--Decentralized Identity management, Transactions, incentivising and mining. Distributed Consensus (PoW),.-Proof of storage, proof of stake**,** proof of deposit, proof of burn, proof of activity. algorithms for adjusting difficulty and retargeting.

UNIT II Bit Coin **9Hrs**

Cryptocurrency as the first blockchain application. Mechanics of Bitcoin, Bitcoin Scripts, Storing and Using Bitcoins, Mining in Bitcoinhardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin Limitations of Bitcoin, alternative cryptocurrencies.

UNIT IV Smart Contracts and Ethereum **9Hrs**

History, Purpose and types of smart contracts, Introduction to Ethereum, bitcoin vs Ethereum stack. P2P network in Ethereum, consensus in Ethereum, scripts in Ethereum, Smart contracts (Ethereum Virtual Machine). Developing and executing smart contracts in Ethereum. State and data structure in Ethereum.

UNIT V Private and Consortium based Block chain: **9Hrs**

Hyperledger-Need for the consortium. Hyperledger stack, Multichain block chain. Innovation in Hyperledger, smart contracts, and distributed applications in hyperledger Case studies/ Enabling Technologies and applications-Application of blockchain in privacy and security, IoT and smart cities, Business and Industry, Data management, e-Governance

Total:45 HOURS

Text Books:

1. Andreas M. Antonopoulos and Dr. Gavin Wood "Mastering Ethereum Building Smart Contracts and DApps " O‟Reilly, Copyright 2019
2. Melanie Swan ,"Blockchain: Blueprint for a New Economy " Copyright 2015 Melanie Swan
3. Imran Bashir," Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks "
4. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing, first edition – 2012

Reference Books:

1. Ritesh Modi, "Solidity Programming Essentials: A Beginner‟s Guide to Build Smart Contracts forEthereum and Block Chain", PacktPublishing.

COURSE CODE: HMDS22E08	COURSE NAME: Multimedia Analytics	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: **Computer Graphics**	Ty	3	0/0	0/0	3

L: Lecture T: Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE: Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

The students should be made to

- Develop a comprehensive understanding of multimedia analytics principles.
- Apply multimedia analytics techniques to analyze various types of media data.
- Explore the applications of multimedia analytics in different domains.

COURSE OUTCOMES (COs): Students will be able to

CO1	Understand the fundamentals and principles of multimedia analytics. [L2]
CO2	Apply multimedia analytics techniques to analyze images, videos, and audio data. [L3]
CO3	Analyze and design multimedia analytics systems for specific applications. [L4]
CO4	Implement multimedia analytics in real-world scenarios, considering ethical considerations. [L4]
CO5	Explore and discuss the emerging trends in multimedia analytics. [L2]

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	2		2
CO2	2	3	3	3	2	1	1		2
CO3	2		3	2	2	3	1		1
CO4	3	2	2	3	3	2	2	2	
CO5		2	2	3	3	1	2		2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	2	3	1	2
CO3	2	2	3	1
CO4	1	3	2	2
CO5	3	1	2	2

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✓				

COURSE CODE:	Course Title	Ty/Lb/ ETL/ IE	L	T / S.Lr	P/ R	C
HMDS22E08	Multimedia Analytics	Ty	3	0/0	0/0	3

Unit I: Multimedia Analytics Fundamentals **9Hrs**

Overview of Multimedia Analytics-Foundations of Image Analysis- Principles of Video Processing-Fundamentals of Audio Processing- Multimodal Data Integration- Applications in Image, Video, and Audio Processing- Privacy and Security Concerns in Analyzing Multimedia Data- Emerging Trends in Multimedia Analytics

Unit II: Image and Video Processing **9Hrs**

Image Processing Techniques-Image Feature Extraction-Image Segmentation Methods-Video Analysis and Tracking-Object Recognition in Videos-Motion Analysis in Videos-Video Compression Algorithms-Multimedia Content Retrieval

Unit III: Audio Processing and Speech Recognition **9Hrs**

Basics of Audio Signal Processing- Feature Extraction in Audio Signals-Music Information Retrieval-Speech Signal Analysis-Speech Recognition Systems-Speaker Identification-Emotion Recognition in Speech-Audio Content Classification

Unit IV:Multimedia Data Mining **9Hrs**

Concepts of Multimedia Data Mining-Mining Patterns in Image Databases-Mining Video Data for Patterns-Mining Audio Data for Trends-Integration of Text and Multimedia Data-Multimedia Data Clustering-Multimedia Data Classification-Multimedia Data Mining Algorithms

Unit V: Emerging Frontiers in Multimedia Analytics **9Hrs**

Next-Generation Approaches in Multimedia Analysis-Innovations in Generative Models-Holistic Multimodal Integration-Interpretable AI in Multimedia Context-Multimedia Insights from Social Platforms-Real-time Multimedia Intelligence-Cross-disciplinary Collaborations in Multimedia Science-Anticipated Paradigm Shifts in Multimedia Analytics

Total : 45 HOURS

Text Books:

1. Sushmita Mitra, Sankar K. Pal, and Pabitra Mitra,"Multimedia Data Mining and Analytics: Disruptive Innovation",Latest Edition,Springer,2022

Reference Books:

1. Zhongfei (Mark) Zhang and Ruofei Zhang,"Multimedia Mining: A Highway to Intelligent Multimedia Documents" ,Latest Edition,Springer US,2022
2.Peter Schauble, Alan Hanjalic, and Arjen P. de Vries,"Multimedia Information Retrieval: Content-Based Information Retrieval from Large Text and Audio Databases",Latest Edition,Springer, 2022.

COURSE CODE	COURSE NAME: CLOUD COMPUTING	Ty/Lb/ ETL/IE	L	T/S. Lr	P/R	C
HMDS22E09	Prerequisite: Data warehouse &data mining	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL/IE : Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:

The students should be made to

- Identify the technical foundations of cloud systems architectures.
- Analyze the problems and solutions to cloud application problems.
- Apply principles of best practice in cloud application design and management.
- Identify and define technical challenges for cloud applications and assess their importance.

COURSE OUTCOMES (COs) :Students will be able to

CO1	Understand the fundamental principles of cloud computing. [L2]
CO2	Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing. [L2]
CO3	Analyze the performance of Cloud Computing. [L4]
CO4	Learn the Concept of Cloud Infrastructure Model. [L1]
CO5	Understand the concept of Cloud Security. [L2]

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	2	1	2		2	3
CO2	2	3	3	2	2	1	2	2	
CO3	3	2		2			2		2
CO4	2	1	2	2		2		2	3
CO5	3	3	2	2	3	2	2	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	2	2	3
CO3	3	3	3	2
CO4	2	1	2	2
CO5	1	2	3	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
					✓				

COURSE CODE	COURSE NAME	Ty/Lb/ ETL/IE	L	T/S.Lr	P/R	C
HMDS22E09	CLOUD COMPUTING	Ty	3	0/0	0/0	3

UNIT I-FOUNDATION **9 Hrs**

Introduction to Cloud Computing, Migrating into a Cloud, Enriching the 'Integration as a Service' Paradigm for the Cloud Era, The Enterprise Cloud Computing Paradigm

UNIT II-INFRASTRUCTURE AS A SERVICE (IAAS) **9 Hrs**

Virtual Machines Provisioning and Migration Services, On the Management of Virtual Machines for Cloud Infrastructures, Enhancing Cloud Computing Environments Using a Cluster as a Service, Secure Distributed Data Storage in Cloud Computing

UNIT III-PLATFORM AND SOFTWARE AS A SERVICE (PAAS/IAAS) **9 Hrs**

Aneka—Integration of Private and Public Clouds, Comet Cloud: An Autonomic Cloud Engine, T-Systems' Cloud-Based Solutions for Business Applications, Workflow Engine for Clouds, Understanding Scientific Applications for Cloud Environments, The Map Reduce Programming Model and Implementations

UNIT IV-MONITORING AND MANAGEMENT **9 Hrs**

An Architecture for Federated Cloud Computing, SLA Management in Cloud Computing: A Service Provider's Perspective, Performance Prediction for HPC on Clouds

UNIT V-APPLICATIONS **9 Hrs**

Best Practices in Architecting Cloud Applications in the AWS Cloud, Massively Multiplayer Online Game Hosting on Cloud Resources, Building Content Delivery Networks Using Clouds, Resource Cloud Mashups

Total: 45 HOURS

TEXT BOOKS:

1.Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, eds. *Cloud computing: Principles and paradigms*. John Wiley & Sons, 2010.

REFERENCE BOOKS:

1.Voorsluys, William, James Broberg, and Rajkumar Buyya. "Introduction to cloud computing." *Cloud computing: Principles and paradigms* (2011): 1-44.
2.Shawish, Ahmed, and Maria Salama. "Cloud computing: paradigms and technologies." *Inter-cooperative collective intelligence: Techniques and applications*. Springer, Berlin, Heidelberg, 2014. 39-67.
3.Birje, Mahantesh N., et al. "Cloud computing review: concepts, technology, challenges and security." *International Journal of Cloud Computing* 6.1 (2017): 32-57

AUDIT COURSE							
Sl. No	**Course Code**	**Course Name**	**Ty/Lb/ETL/ IE**	**Teaching Scheme**			
				L	**T/SLr**	**P/R**	**C**
1	HMAC22I01	English for Research paper writing	Ty	2	0/0	0/0	0
2	HMAC22I02	Disaster Management	Ty	2	0/0	0/0	0
3	HMAC22I03	Sanskrit for Technical Knowledge	Ty	2	0/0	0/0	0
4	HMAC22I04	Value Education	Ty	2	0/0	0/0	0
5	HMAC22I05	Constitution of India	Ty	2	0/0	0/0	0
6	HMAC22I06	Pedagogy Studies	Ty	2	0/0	0/0	0
7	HMAC22I07	Stress Management by Yoga	Ty	2	0/0	0/0	0
8	HMAC22I08	Personality Development through Life Enlightenment Skills	Ty	2	0/0	0/0	0
9	HMAC22I09	Life skill	Ty	2	0/0	0/0	0

Subject Code: HMAC22I01	**Subject Name: ENGLISH FOR RESEARCH PAPER WRITING**	**Ty/Lb/ ETL**	**L**	**T/S. Lr**	**P/R**	**C**
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L:LectureT:Tutorial S.Lr:Supervised Learning P:Project R:Research C:Credits
Ty/Lb/ETL: Theory/Lab/ Embedded Theory and Lab

OBJECTIVES:

This paper deals with:

- To know the art of writing the research paper and thesis.
- To Ensure the good quality of paper at very first-time submission

COURSE OUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title

Mapping of Course Outcomes(COs)with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs)with Program Specific Outcomes(PSOs)

COs/ PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1indicates StrengthofCorrelation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: **HMAC22I01**	**Subject Name**	**Ty/Lb/ETL**	**L**	**T/S. Lr**	**P/ R**	**C**
	ENGLISH FOR RESEARCH PAPER WRITING	Ty	2	0/0	0/0	0

Unit I **5 Hrs**

Planning and Preparation, Word Order, Breaking uplong sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit II **5 Hrs**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit III **5 Hrs**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

Unit IV **5 Hrs**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

Unit V **5 Hrs**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit VI **5 Hrs**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Total Hrs: 30

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R(2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N(1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York D ordrecht Heidelberg London,20

Subject Code: **HMAC22I02**	Subject Name: **DISASTER MANAGEMENT**	**Ty/Lb/ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L:LectureT:Tutorial S.Lr:Supervised Learning P:ProjectR:ResearchC:Credits
Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reductionandhumanitarianresponsepolicyandpracticefrommultipleperspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecifictypesofdisastersandconflictsituations.
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches, planning and programming indifferent countries, particularly their home country or the countries they work in.

COURSEOUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	EvaluatedisasterriskreductionandhumanitarianresponsepolicyandpracticefromMultipleperspectives
CO2	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO3	Understand the strengths and weaknesses of disaster management approaches, planning and programming in Different countries, particularly their home country or the countries they workin.

Mapping of Course Outcomes(COs) with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs) with Program Specific Outcomes(PSOs)

COs/ PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1indicates StrengthofCorrelation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: HMAC22I02	Subject Name	Ty/Lb/ETL	L	T/S.Lr	P/R	C
	DISASTER MANAGEMENT	Ty	2	0/0	0/0	0

Unit I– Introduction **5 Hrs**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude

Unit II –Repercussions Of Disasters And Hazards **5 Hrs**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones,Tsunamis,Floods,DroughtsandFamines,LandslidesandAvalanches, Man-made disaster: Nuclear Reactor Melt down, Industrial Accidents, Oil Slicks and Spills, Outbreak so Disease and Epidemics, War and Conflicts

Unit III –Disaster Prone Areas in India **5 Hrs**

Study of Seismic Zones, Areas Prone To Floods and Droughts ,Landslides and Avalanches, Areas Prone To Cyclonic andCoastalHazardswithSpecialReferencetoTsunami,Post-DisasterDiseasesandEpidemics

Unit IV–Disaster Preparedness and Management **5 Hrs**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard, Evaluation of Risk, Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and community preparedness.

Unit V – Risk Assessment **5 Hrs**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning ,People's Participation in Risk Assessment. Strategies for Survival

Unit VI –Disaster Mitigation **5 Hrs**

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India

Total Hrs: 30

Suggested Readings:

1. R.Nishith, SinghAK, "Disaster Management in India: Perspectives, issues and strategies"' New Royal book Company.
2. Sahni,Pardeep Et.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHallOfIndia,NewDelhi.
3. GoelS.L.,Disaster Administration And Management Text And CaseStudies", Deep& DeepP ublication Pvt.Ltd., NewDelhi.

Subject Code: **HMAC22I03**	Subject Name: **SANSKRIT FOR TECHNICAL KNOWLEDGE**	**Ty/Lb/ ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L:LectureT:TutorialS.Lr:SupervisedLearningP:ProjectR:ResearchC:Credits
Ty/Lb/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- Enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the Huge knowledge from ancient literature

COURSEOUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	Understanding basic Sanskrit language
CO2	Understanding ancient Sanskrit literature about science& technology
CO3	Develop logic in students being a logical language.

Mapping of Course Outcomes(COs)with Program Outcomes(POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs) with Program Specific Outcomes(PSOs)

COs/ PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1indicates StrengthofCorrelation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: **HMAC22I03**	**Subject Name**	**Ty/Lb/ ETL**	**L**	**T/S. Lr**	**P/R**	**C**
	SANSKRIT FOR TECHNICAL KNOWLEDGE	Ty	2	0/0	0/0	0

Unit I **10 Hrs**

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences.

Unit II **10 Hrs**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

Unit III **10 Hrs**

TechnicalconceptsofEngineering-Electrical,Mechanical,Architecture,Mathematics

Total Hrs: 30

Suggested reading

1. "Abhyaspustakam"–Dr.Vishwas,Samskrita-BhartiPublication,NewDelhi
2. "TeachYourselfSanskrit"PrathamaDeeksha-VempatiKutumbshastri,RashtriyaSanskritSansthanam,NewDelhi Publication
3. "India'sGloriousScientificTradition"SureshSoni,Oceanbooks(P)Ltd.,NewDelhi.

Subject Code: **HMAC22I04**	Subject Name: **VALUE EDUCATION**	**Ty/Lb/ ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L:Lecture T:Tutorial S.Lr:Supervised Learning P:Project R:Research
C:Credits Ty/Lb/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the student know about the importance of character

COURSEOUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the over all personality

Mapping of Course Outcomes(COs) with Program Outcomes(POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs) with Program Specific Outcomes(PSOs)

COs/ PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1indicates Strength of Correlation 3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skil l Component	Practical / Project /Internship	Others
			✓						

Subject Code: **HMAC22I04**	**Subject Name**	**Ty/Lb/ETL**	**L**	**T/S. Lr**	**P/R**	**C**
	VALUE EDUCATION	Ty	2	0/0	0/0	0

Unit I **6 Hrs**

- Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non-moral valuation. Standards and principles
- Value judgments

Unit II **8 Hrs**

- Importance of cultivation of values.
- Sense of duty.Devotion,Self-reliance.Confidence,Concentration.Truthfulness,Cleanliness.
- Honesty, Humanity. Power offaith, National Unity.
- Patriotism. Love for nature, Discipline

Unit III **8 Hrs**

- Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation
- Doing best for saving nature

Unit IV **8 Hrs**

- Character and Competence–Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind ,Self-control.
- Honesty, Studying effectively

Total Hrs: 30

Suggested reading

1.Chakroborty,S.K.“Values and Ethics for organizations Theory and practice”,Oxford University Press, New Delhi.

Subject Code:	Subject Name:	Ty/Lb/ETL	L	T/S.Lr	P/R	C
HMAC22I05	**CONSTITUTION OF INDIA**					
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L:LectureT:Tutorial S.Lr:Supervised Learning P:Project R:Research
C:Credits Ty/Lb/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

Students will be able to:

- Understand the premises in for ming the twin the mes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian in tell ectuals' constitutional role and entitle ment to civil and economic rights as well as the emergence of nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik
- Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

COURSEOUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	Understand and explain the significance of Indian Constitution as the fundamental law of the land
CO2	Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building
CO3	Analyze the Indian political system, the powers and functions of the Union, State and Local Governments in detail
CO4	Understand Electoral Process, Emergency provisions and Amendment procedure.

Mapping of Course Outcomes(COs)with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1
CO4	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs)with Program Specific Outcomes(PSOs)

COs/PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1

3/2/1indicates Strength of Correlation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: **HMAC22I05**	**Subject Name**	**Ty/Lb/ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	CONSTITUTION OF INDIA	Ty	2	0/0	0/0	0

Unit I **3 Hrs**

- History of Making of the Indian Constitution:
- History, Drafting Committee,
- Composition& Working.

Unit II **3 Hrs**

- Philosophy of the Indian Constitution:
- Preamble Salient Features

Unit III **6 Hrs**

Contours of Constitutional Rights & Duties:

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit IV **6 Hrs**

Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions

Executive:

- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit V **6 Hrs**

- Local Administration:
- District's Administration head: Role and Importance,
- Municipalities:Introduction,Mayor and role o fElected

Representative CEO of Municipal Corporation.

- Pachayatiraj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit VI **6 Hrs**

- Election Commission:
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the wel fare of SC/ST/OBC and women

Total Hrs: 30

Suggested reading

1. The Constitution of India, 1950 (BareAct), Government Publication.
2. Dr.S.N.Busi, Dr.B.R. Ambedkar framing of Indian Constitution,1st Edition,2015
3. M.P.Jain, Indian Constitution Law,7th Edn., Lexis Nexis,2014.
4. D.D.Basu, Introduction to the Constitution of India, Lexis Nexis,2015

Subject Code: **HMAC22I06**	Subject Name: **PEDAGOGY STUDIES**	**Ty/Lb/ ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L:Lecture T:Tutorial,S.Lr:Supervised Learning P:Project R:Research
C:Credits Ty/Lb/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID ,other agencies and researchers.
- Identify critical evidence gaps to guide the development.

COURSE OUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
CO2	What is the evidence on the effectiveness of the sepedagogical practices, in what conditions, And with what population of learners?
CO3	How can teacher education(curriculum and practicum)and the school curriculum and Guidance materials Best support effective pedagogy?

Mapping of Course Outcomes(COs)with Program Outcomes(POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs)with Program Specific Outcomes(PSOs)

COs/ PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1indicates Strength of Correlation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: HMAC22I06	Subject Name	Ty/Lb/ETL	L	T/S.Lr	P/R	C
	PEDAGOGY STUDIES	Ty	2	0/0	0/0	0

Unit I **6 Hrs**

Introduction and Methodology:

- Aims and rationale, Policy back ground, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education
- Conceptual framework, Research questions
- Overview of methodology and Searching

Unit II **6 Hrs**

- The matic overview: Pedagogical practices are being used by teachers informal andinformal classrooms in developing countries
- Curriculum, Teacher education

Unit III **6 Hrs**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices
- Pedagogictheory and pedagogical approaches
- Teachers' attitudes and beliefs and Pedagogic strategies

Unit IV **6 Hrs**

- Professional development: alignment with classroom practices and follow-up support
- Peer support
- Support from the head teacher and the community
- Curriculum and assessment
- Barrier stole arning: limited resources and large class sizes

Unit V **6 Hrs**

Research gaps and future directions

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Total Hrs: 30

Suggested reading

1. Ackers J ,Hardman F(2001) Classroom interaction in Kenyan primary schools,Compare,31 (2):245-261.
2. Agrawal M(2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies,36(3):361- 379.
3. Akyeampong K(2003) Teacher training in Ghana-doesitcount? Multi-site teacher education research project(MUSTER)country report1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal EducationalDevelopment,33(3):272–282.
5. AlexanderRJ(2001) Culture and pedagogy: International comparisons in primary education. Oxfordand Boston: Blackw ell.
6. ChavanM (2003)Read India: A massscale, rapid, ‘learning toread’ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Subject Code: **HMAC22I07**	Subject Name: **STRESS MANAGEMENT BY YOGA**	**Ty/Lb/ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Pre requisite: NIL	Ty	2	0/0	0/0	0

L:LectureT:Tutorial,S.Lr:Supervised LearningP:ProjectR:Research C:Credits
Ty/Lb/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To introduce health psychology and arrive at the introduction to the philosophy and practice of yoga.

COURSEOUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	Compile the models of health and the psychological component of health
CO2	Classify healthy behavior and health compromising behavior
CO3	Deduce the impact of stress on health and apply effective stress management strategies
CO4	Extrapolate the role of yoga in healthcare

Mapping of Course Outcomes(COs)with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	--	- -	- -	--	- -	3	3
CO2	3	3	2	- -	- -	--	- -	3	3
CO3	3	3	2	- -	- -	--	1	3	3
CO4	3	3	2	- -	- -	--	1	3	3

Mapping of Course Outcomes(COs)with Program Specific Outcomes(PSOs)

COs/PSOs	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	3	3	1
CO3	1	3	2
CO4	1	3	1

3/2/1indicates StrengthofCorrelation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code :HMAC22I07	Subject Name: STRESS MANAGEMENT BY YOGA	Ty/Lb/ETL	L	T/SLr	P/R	C
	Pre requisite :None	Ty	2	0/0	0/0	0

Unit 1 **6 Hrs**

Understanding Stress: Stress and lifestyle disorders: Meaning and definition, development of stress; nature of stressors: Frustration, pressure; Factors predisposing stress: life events and daily hassles; Burnout. Coping with stress: Problem oriented and emotion oriented. Stress management: Meaning and definition; Changing thoughts, behavior and physiological responses.

Unit 2 **10 Hrs**

Yoga Philosophy: Introduction to Yoga and Yogic Practices – Definition, History, Aim and Objectives, Four Paths of Yoga and Principles of Yoga, Hatha Yoga – Distinction between Yoga and Non Yogic Practices, Concept of Yogic diet, Purpose and Utility of Asanas in Hatha Yoga, Introduction to Patanjali,

Unit 3 **14 Hrs**

Yoga in Health Care:

Yoga for specific life style disorders: Asthma, Sleeplessness, Diabetes, Blood pressure and Heart Diseases. Research evidence on the impact of yoga intervention on life style disorders. Halasana and Matsyasana for Thyroid, Dhanurasana and Bhujangasana for Polycystic Ovarian Syndrome Disease,Shishuas anaand AdhoMukhaSvanasanaforArthritis,SuptaMatsyendrasanaandVrikshasana for Lower back pain, Ardha Matsyendrasana and Chakrasana for Diabetes, Apanasana and Paschimottanasana for Indigestion and Stomach Disorder,Padmasana and Sirsasana for Migraine,Baddha Konasana and Sukhasana for Depression, Balasana and Shavasana for Sleeplessness. Evaluation of the applications of psychological knowledge in the area of health and identification of gaps.

Total Hrs: 30

Reference Books

1. Taylor, S.E(2006). Health Psychology. New Delhi: Tata Mc Graw Hill
2. Serafini, E.P&SmithT.W.(2012).Health Psychology: Biopsycho social Interventions. New Delhi: Wiley
3. Hatha Yoga Pradipika by Swami Svatmarama.
4. BKS Iyengar(2013).YOGA-The Pathto Holistic Health

Subject Code: **HMAC22I08**	**Subject Name** **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**Ty/Lb/ ETL**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite: Nil	Ty	2	0/0	0/0	0

L:LectureT:Tutorial S.Lr:Supervised LearningP:ProjectR:ResearchC:CreditsTy/Lb/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To learn to achieve the highest goal happily,
- To become a person with stable mind, pleasing Personality and determination.
- To awaken wisdom in student

COURSEOUTCOMES(COs):(3-5):At the end of this course the students would be able to

CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neetishatakam will help in developing versatile personality of students.

Mapping of Course Outcomes(COs)with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	3	1	1	1

Mapping of Course Outcomes(COs)with Program Specific Outcomes(PSOs)

COs/ PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1indicates Strength ofCorrelation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code: **HMAC22I08**	**Subject Name: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :None	Ty	2	0/0	0/0	0

Unit I **10 Hrs**

Neetishatakam-Holistic development of personality

- Verses-19,20,21,22(wisdom)
- Verses-29,31,32(pride &heroism)
- Verses-26,28,63,65(virtue)
- Verses-52,53,59(dont's)
- Verses-71,73,75,78(do's)

Unit II **10 Hrs**

- Approach today to day work an duties.
- Shrimad Bhagwad Geeta:Chapter2-Verses41,47,48,
- Chapter3-Verses13,21,27,35
- Chapter6-Verses5,13,17,23,35,
- Chapter18-Verses45,46,48

Unit III **10 Hrs**

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta:Chapter2-Verses56,62,68
- Chapter12 -Verses13,14,15,16,17,18
- Personality of Role model. Shrimad Bhagwad Geeta
- Chapter2-Verses17
- Chapter3-Verses36,37,42,
- Chapter4-Verses18,38,39
- Chapter18–Verses37,38,63

Total Hrs:30

Suggested reading

1. Srimad Bhagavad Gita"by Swami Swarupananda Advaita Ashram(Publication
2. Department),Kolkata
3. Bhartrihari's Three Satakam(Niti-sringar-vairagya) by P.Gopinath,
4. Rashtriya Sanskrit Sansthanam,New Delhi.

Subject Code :HMAC22I09	Subject Name: LIFE SKILLS	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite :None	Ty	2	0/0	0/0	0

L:LectureT:TutorialSLr:Supervised Learning P:Project
R:ResearchC:CreditsT/L/ETL:Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- Understand the positive effect of being open to experiences
- Be familiar with impulse control and prosocial behavior
- Describe emotional intelligence, social intelligence, and integrative thinking for effective Leadership
- Describe basic managerial skills. And self-management skills.

COURSEOUTCOMES(Cos):(3 –5)
Students completing the course were able to

CO1	Develop thet end ency to accept self and other sun conditionally
CO2	Regulate their emotional impulsivity and demonstrate prosocial behavior
CO3	Inculcate emotional and social intelligence and integrative thinking for effective Leadership.
CO4	Demonstrate a set of practical skills such a stime management,self-management,handling conflicts, And team leadership.
CO5	Create and maintain an effective and motivated team to work for the society

Mapping of Course Outcomes with Program Outcomes(POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	--	--	1	--	3	2	2	--	--	1	--	3
CO2	--	--	1	--	3	2	1	--	1	1	1	1
CO3	--	2	1	--	3	3	1	--	2	1	2	1
CO4	2	2	1	--	3	3	2	--	3	3	2	1
CO5	1	2	1	--	3	3	2	--	2	1	--	3

3/2/1indicates Strength of Correlation3-High,2-Medium,1-Low

Category	Program Core	Program Elective	Humanities and Social Science	Open Elective	Skill Enhancing Elective	Inter Disciplinary /Allied	Skill Component	Practical / Project /Internship	Others
			✓						

Subject Code :HMAC22I09	Subject Name: LIFE SKILLS	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite :None	Ty	2	0/0	0/0	0

Unit I **6 Hrs**

Openness to experience: developing the tendency to accept and appreciate self and others, the Insights, ideas, values, feelings, and behaviors, cultivate willingness to try new things as well as engage in imaginative and intellectual activities, and creative thinking "thinking outside of the box." Skills.

Unit II **6 Hrs**

Conscientiousness- developing the ability to regulate their impulse control in order to engage in goal-directed behaviors, managing negative emotions such as anger, worry, and sadness and Developing organized and structured approach

Unit III **6 Hrs**

Pro social behavior: developing trust, altruism, kindness, affection, empathetic understanding, Sharing, comforting and cooperating, Assertiveness, emotional expressiveness and social interaction.

Unit IV **6 Hrs**

Innovative leadership Understanding: Concept of emotional and social intelligence, the persona of a leader for deriving holistic inspiration, Drawing insights for leadership, leadership qualities essential to sail through difficult situations, Importance of ethics, Ethical decision-making, Personal and professional moral codes of conduct, Creating a harmonious life.

Unit V **6 Hrs**

Management Skills: Basic Managerial Skills-Planning for Effective Management, Organize Teams ,Delegation of Tasks, Time Management, Conflict and Stress Management, Self-management Skills-Understanding Self-concept, Developing Self-awareness, Self-examination, Self-reflection and introspection, Self-regulation.

Total Hrs:30

References and Suggested Readings

1. A.Pervin& O. P. John (Eds.), Handbook of personality: Theory and research (Vol. 2, pp. 102–138).New York:Guil ford Press.
2. Harry Beilin(1982)The Development of Prosocial Behavior ,Academic Press
3. Ashokan, M.S.2015.Karmayogi: A Biography of E.Sreedharan. London:Penguin.
4. O'Toole,J.2019.The Enlightened Capitalists:Cautionary Tales of Business Pioneers Who Tried to DoWell by Doing Good. New York Harper Collins
5. Brown,T.2012.Change by Design.Harper Business,New,New York
6. LynnA.B.2015.The Emotional Intelligence Activity Book:50 Activities for Promoting EQat Work,Gildan Media Corporation,New York
7. KellyT.,and Kelly D.2014.Creative Confidence:Unleashing the Creative Potential With in Us All.William Collins Harper Collins Publishers India
8. Kurien,V.,and Salve,G.2012.IToo Had a Dream.Roli Books Private Limited New Delhi
9. Carnegie D.2018.Over coming Worry and Stress.New Delhi:Manjul Publishing House.
10. Collins Jim. 2001.Good to Great .New York:Harper Business, 136 Life Skills (Jeevan Kaushal) Facilitators' Manual2022
11. Covey,StephenR.2020.30thed.The 7 Habits of Highly Effective People.New Delhi: Simon & Schuster.
12. Dawkins E.R. 2016. 52 Weeks of Self Reflection—Your Guided Journal of Self Reflection. A B Johns on Publishing,UnitedStates
13. Drucker, Peter F.2006.The Effective Executive.NewYork:Harper Business.
14. GolemanD.1995.Emotional Intelligence.NewDelhi: Blooms bury Publishing India Private Limited.
15. Robbins S.P.,CoulterM.,and FernandezA.2019.Management.14th edition.Noida,India:Pearson Education.