Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE & DATA SCIENCE

Batch: 2021-22

ThirdYear

(VII and VIII SEMESTER)

(Effective from the academic year 2024-2025)

SreeSiddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous institute affiliated to Visvesvaraya Technological University, Belagavi)

(Approved by AICTE, New Delhi, Accredited by NAAC and ISO 9001-2015 certified)

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SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

(Effective from the academic year 2024-2025)

B.E. in Artificial Intelligence & Data Science — Batch:2021-2022

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
VII Semester													
1.	PCC	N7AD01	Deep Learning		3	0	0		3	50	50	100	3
2.	PEC	N7ADPE2x	Professional Elective Course-II		3	0	0		3	50	50	100	3
3.	PEC	N7ADPE3x	Professional Elective Course-III		3	0	0		3	50	50	100	3
4.	OEC	NOE71	Open Elective Course-II		3	0	0		3	50	50	100	3
5.	AEC	RMIP	Research Methodology & Intellectual Property Rights		2	0	0		3	50	50	100	2
6.	Project	ADP	Project Work		Monday to Thursday shall be earmarked for carrying out Project work				3	100	100	200	10
			Total							**350**	**350**	**700**	**24**
		AAP	AICTE Activity Points		40 hours commUNITy service to be documented and produced for the examination								
VIII Semester													
1.	Seminar	ADTS	Technical Seminar		One contact hour /week for interaction between the faculty and students.					100	--	100	1
2.	Internship	INT3	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty and students.					100	100	200	15
3.	NCMC		National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.					50	50	100	0
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
			NCC	NCC									
			Total							**250**	**150**	**400**	**16**
		AAP	AICTE Activity Points							**100**	**---**	**100**	**0**

Professional Elective -II		**Professional Elective - III**	
N7ADPE21	Recommender System	N7CCSPE01	Generative AI & Prompt Engineering
N7ADPE22	Blockchain Traced AI	N7CCSPE02	Real Time Big data Analytics
N7ADPE23	Distributed Data Storage Management	N7ADPE31	Information Retrieval

N7ADPE24	AI Driven Cyber Security	N7ADPE32	High Performance Computing
Note: **PCC**: Professional Core Course, **PEC**: Professional Elective Course, **OEC** –Open Elective Course, **AEC** –Ability Enhancement Course			
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination			

PROJECT WORK (XXP): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instill responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of Project Work Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the project. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of Project Work Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work:

SEE for project work will be conducted by the two examiners appointed by the Chairman-BoE. The SEE marks awarded for the project work, shall be as per the Table mentioned below:

Project Report	25
Presentation & Demonstration	30
Quality of Work	25
Viva-Voce (Q&A Session)	20
Total	**100**

Note: VII and VIII semesters of IV year of the programme

(1) Departments can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

TECHNICAL SEMINAR (XXTS):

The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.

(v) Answer the queries and involve in debate/discussion.
(vi) Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become selfconfident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded by Department Seminar Evaluation Committee DSEC (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course is as shown in Table below:

Relevance of the topic	10 marks
Report	20 marks
Presentation	30 marks
Viva-Voce	20 marks
Guide Assessment	20 marks
Total	**100 marks**

No SEE component for Technical Seminar.

Non-Credit Mandatory Course (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.
(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.
(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.
(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.
(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points:

Apart from technical knowledge and skills, to be successful as professionals, students should have excellent soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. In order to match these multifarious requirements, AICTE has created a unique mechanism of awarding minimum 100 Activity Points for regular students and 75 Activity Points for Lateral Entry students over and above the academic grades.

The activities can be spread over entire duration of the programme and it will be reflected in the Student's VIII Semester Grade Card. It shall not be considered for computation of SGPA/CGPA and for vertical progression. The total duration of the activities for entire programme is 320 hours for regular students and 240 hours for lateral entry students.

Break-up of CIE marks for activity points:

Evaluation by the Proctor	50 marks
Evaluation by DSEC	
(i) Report	20 marks
(ii) Presentation	20 marks
(iii) Outcome	10 marks
Total	**100 marks**

1. No SEE for AICTE Activity Points.
2. Students will be awarded either NP or P grade based on marks obtained..

3. Students will be awarded 'Degree' only on earning P grade in the Activity Points

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE & DATA SCIENCE

Batch: 2021-22

VII SEMESTER

(Effective from the academic year 2024-2025)

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

DEEP LEARNING

Course Code	N7AD01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives: This course will enable students to:

1. Learn deep learning methods for working with sequential data
2. Learn deep recurrent and memory networks
3. Apply deep learning mechanisms to various learning problems.
4. Learn various performance metrics to evaluate deep learning models and apply the same to real world problems..

UNIT-1 **(8 hrs)**

Introduction to AI, Machine Learning, and Deep Learning, Definitions and differences, Real-world applications, The Evolution of Machine Learning, From probabilistic models to neural networks, Key milestones in ML history, Understanding Deep Learning, Key concepts and terminology, Why "deep"? The role of multiple layers, Current Achievements and Future Directions, Notable successes, The hype vs. the reality, Future trends and predictions, Data Representations for Neural Networks, Scalars, vectors, matrices, and tensors, Real-world examples, Tensor Operations, Element-wise operations, Broadcasting, Tensor reshaping, Gradient-Based Optimization, Derivatives and gradients.

UNIT-2 **(8 hrs)**

Overview of TensorFlow and Keras, History and development, Key features and components, Basic TensorFlow Operations, Constant tensors and variables, Basic mathematical operations, Practical Exercise: Linear Classifier in TensorFlow, Building and training a simple linear classifier, Building Blocks of Neural Networks, Layers, models, and the compile step, Choosing Loss Functions and Metrics, Different types of loss functions, Metrics for evaluation, Training and Evaluating Models, The fit() method, Monitoring loss and metrics, Inference and Model Usage, Making predictions.

UNIT-3 **(8 hrs)**

Binary Classification, Regression Analysis, K-fold validation and model evaluation, multiclass classification, and regression, Generalization, Underfitting, and Overfitting, Strategies to avoid overfitting, Model Evaluation Techniques, Training, validation, and test sets, Beating a baseline, Improving Model Fit, Tuning gradient descent parameters, Architectural improvements, Improving Generalization, Data curation and feature engineering, Early stopping and regularization techniques.

UNIT-4 **(8 hrs)**

Basics of Convolutional Neural Networks, Convolution and pooling operations, Training ConvNets from Scratch, Small dataset challenges and solutions, Data Augmentation Techniques, Enhancing training datasets, Image Segmentation, Techniques and applications, Modern ConvNet Architectures, Residual connections, Batch normalization and depthwise separable convolutions, Interpreting ConvNet Outputs, Visualizing intermediate activations and filters, Generating class activation heatmaps

UNIT-5 **(8 hrs)**

Time Series Data and Tasks, Types and challenges, Use cases, Temperature Forecasting Example, Data preparation and model building, Recurrent Neural Networks (RNNs), Basic and advanced RNN techniques, Practical Exercise: Implementing RNNs, Building and training RNNs for time series forecasting, Introduction to Generative Adversarial Networks (GANs), GAN architecture and training.

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe basic concepts of neural network, its applications and various learning models
2. Acquire the knowledge on Recurrent, Recursive Nets
3. Analyze different Network Architectures, learning tasks, Convolutional networks
4. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
5. Analyze performance of deep learning techniques

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Deep Learning with Python	François Chollet	Manning Publications	2nd Edition, Co, ISBN: 9781617296864
2	Deep Learning for Coders with fastai & PyTorch	Jeremy Howard & Sylvain Gugger	O'reilly	ISBN:978-1-492-04552-6
Reference Books				
1	Neural Networks – A Comprehensive Foundation	Simon Haykins	Simon Haykin	2 nd edition, PHI, 2005, ISBN10: 0139083855
2	Deep Learning (Adaptive Computation and Machine Learning Series)	Ian Good Fellow, Yoshua Bengio and Aaron Courville	Ian Good Fellow, Yoshua Bengio and Aaron Courville.	1st edition, MIT Press, 2017, ISBN-13: 978-0262035613
3	Introduction to Artificial Neural Networks	Gunjan Goswami, S.K. Kataria & Sons	Gunjan Goswami, S.K. Kataria & Sons	1 st Edition, 2012, ISBN-13: 978-9350142967.
4	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms	Nikhil Buduma	Nikhil Buduma O'Reilly Publications,	1st Edition, 2016, ISBN-13: 978-1491925614.

Course articulation matrix(CO-PO and CO-PSO mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	1	1	2	2	2	1	3
CO2	3	3	3	2	3	1	1	1	2	2	2	3
CO3	3	3	3	3	3	2	2	2	3	3	3	3
CO4	3	3	3	3	3	1	2	2	2	2	2	3
CO5	3	2	2	3	3	1	1	2	2	2	2	3

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – VIII

RECOMMENDER SYSTEM

Course Code	N7ADPE21	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives: This course will enable students to:

1. To understand basic techniques and problems in the field of recommender systems.
2. Evaluate Types of recommender systems.
3. Apply algorithms and techniques to develop Recommender Systems that are widely used.
4. To develop state-of-the-art recommender systems...

UNIT-1 **(08 hrs)**

Introduction: Introduction to basic concepts, Recent developments, **Collaborative recommendation:** User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, About ratings, Further model-based and preprocessing-based approaches, Recent practical approaches and systems. Attacks on collaborative recommender systems.

(Text Book-1: 1,2.1-2.5,9.1-9.6)

UNIT-2 **(08 hrs)**

Content-based recommendation: Content representation and content similarity, Similarity-based retrieval, Other text classification methods. **Knowledge-based recommendation:** Knowledge representation and reasoning, Interacting with constraint-based recommenders, Interacting with case-based recommenders, Example applications.

(Text Book-1: 3.1-3.3,4.1-4.5)

UNIT-3 **(08 hrs)**

Hybrid recommendation approaches: OpportUNITies for hybridization, Monolithic hybridization design, Parallelized hybridization design, Pipelined hybridization design. **Evaluating recommender systems:** Introduction, General properties of evaluation research, Popular evaluation designs, Evaluation on historical datasets, Alternate evaluation designs.

(Text Book-1: 5.1-5.4,7.1-7.5)

UNIT-4 **(08 hrs)**

Structural Recommendations in Networks: Introduction, **Ranking Algorithms-** PageRank, Personalized PageRank, Applications to Neighborhood-Based Methods, Social Network Recommendations, Personalization in Heterogeneous Social Media, Traditional Collaborative Filtering, SimRank, The Relationship Between Search and Recommendation. **Recommendations by Collective Classification-** Iterative Classification Algorithm, Label Propagation with Random Walks, Applicability to Collaborative Filtering in Social Networks. Recommending Friends: **Link Prediction-** Neighborhood-Based Measures, Katz Measure Random Walk-Based Measures, Link Prediction as a Classification Problem, Matrix Factorization for Link Prediction, Symmetric Matrix Factorization, **Connections Between Link Prediction and Collaborative Filtering-** Using Link Prediction Algorithms for Collaborative Filtering, Using Collaborative Filtering Algorithms for Link Prediction.

(Text Book-1: 10)

UNIT-5 **(7 hrs)**

Advanced Topics in Recommender Systems: Introduction, Learning to rank, Multi armed Bundit Algorithms, Group Recommender Systems, Multi-Criteria Recommender Systems, Active learning in recommender systems, Privacy in recommender systems, Some interesting application domains. **(Text Book-2: 13)**.

Course outcomes:

Upon completion of this course the student will be able to:

1. Describe the concept of collaborative recommendation system.
1. Describe the concept of content-based and knowledge-based recommendation system.
2. Describe the concept of hybrid recommendation and understand the evaluation methods for recommendation systems.
3. Understand the concept of recommendation for networks.
4. Understand some advanced topics of recommender systems like Group Recommender Systems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each UNIT.
- Each full question will have sub- question covering all the topics under a UNIT.
- The students will have to answer five full questions, selecting one full question from each UNIT.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Recommender Systems: An Introduction,	Jannach D., Zanker M. and FelFering A,. Friedrich G.	Cambridge University Press.,	2011
2	Recommender Systems,	Charu C. Aggarwal	Springer International Publishing Switzerland,	2016.
Reference Books				
1	Recommender Systems Handbook	Ricci F., Rokach L., Shapira D., Kantor B.P.	Springer	2011.
2	Recommender Systems For Learning.	Manouselis N., Drachsler H., Verbert K.,	Springer	2013

Course articulation matrix(CO-PO and CO-PSO mapping)

Course Outcome	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		2											2	
CO2	2	2												2	
CO3	2		2											2	
CO4	2	2												2	

Program articulation matrix:

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
N7ADPE21	2	2	2											2	

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

BLOCKCHAIN TRACED AI

Course Code	N7ADPE22	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3	Exam Hours	03

Course objectives:

This course will enable students to:

1. Describe the fundamentals of Blockchain and its organization along with the underlying cryptographic concepts .
2. Analyse the need of blockchain for AI
3. Identify potential blockchain touchpoints for AI
4. Design user interface (UI) for the BTA (Blockchain tethered AI)
5. Build a blockchain traced AI system (BTA).

UNIT-1 **(08 hrs)**

Introduction to Blockchain, Backstory of Blockchain, What is Blockchain?, Centralized vs. Decentralized Systems, Centralized Systems, Decentralized Systems, Layers of Blockchain, Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, Why is Blockchain Important?, Limitations of Centralized Systems, Blockchain Adoption So Far, Blockchain Uses and Use Cases

T1 – Chapter 1

How Blockchain Works: Laying the Blockchain Foundation, Cryptography: Symmetric Key Cryptography, Cryptographic Hash Functions,MAC and HMAC,Asymmetric Key Cryptography, Diffie-Hellman Key Exchange,Symmetric vs. Asymmetric Key Cryptography.

T1 – Chapter 2

UNIT-2 **(08 hrs)**

Why Build a Blockchain Truth Machine for AI: Dissecting AI's Trust Deficit, Machine Learning Concerns, Black Box Algorithms, Genetic Algorithms, Data Quality, Outliers, and Edge Cases, Supervised Versus Unsupervised ML, Reinforcement Learning and Deep Learning, Program Synthesis, Superintelligent Agents, Technological Singularity, Attacks and Failures, Model/Data Drift, Adversarial Data Attacks, Risk and Liability, Blockchain as an AI Tether.

Enterprise Blockchain, Distributed, Linked Blocks, Trust and Transparency, Defining Your Use Case, Audit Trail, Local Memory Bank, Shared Memory Bank, Four Controls, Case Study: Oracle AIoT and Blockchain

T2 – Chapter 1

UNIT-3 **(08 hrs)**

Blockchain Controls for AI: Four Blockchain Controls,
Blockchain Control 1: Pre-establishing Identity and Workflow Criteria for People and Systems
Blockchain Control 2: Distributing Tamper-Evident Verification
Blockchain Control 3: Governing, Instructing, and Inhibiting Intelligent Agents
Blockchain Control 4: Showing Authenticity Through User-Viewable Provenance

T2 – Chapter 2

UNIT-4 **(08 hrs)**

User Interfaces: Design Thinking: Web Interfaces, Blockchain Tethered AI User Interfaces, BTA User Mockups, Functionality, Traceability and Transparency, Smartphone and Tablet Apps, Email and Text Notifications, Spreadsheets.
Third-Party Systems: Working with APIs, Integrated Hardware, Third-Party Services and Tools
System Security: AI Security, Database Security, Blockchain Security, Additional Security.

T2 – Chapter 3

Planning Your BTA: BTA Architecture, Sample Model, AI Factsheet: Traffic Signs Detection Model, How the Model Works, Tethering the Model, Subscribing, Controlling Access: Organization UNITs, Staffings, Users,Analyzing the Use Case: Participants,
Assets, Transactions, Smart Contracts, Audit Trail

T2 – Chapter 4

UNIT-5 (08 hrs)

Preparing for Development: Model , Installation, Bucket, Setting up Blockchain network, Install, Configure, and Launch the Blockchain, BTA- Front end and Backend, Test Your Environment, to begin building the application.

T2 – Chapter 5,6

Course outcomes:

Upon completion of this course the student will be able to:

1. Describe the working of a Blockchain and the underlying concepts of cryptography
2. Analyse the need of blockchain for AI
3. Identify potential blockchain touchpoints for AI
4. Design user interface (UI) for the BTA (Blockchain tethered AI)
5. Build a blockchain traced AI system (BTA).

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	
Textbooks				
1	Beginning Blockchain	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda	Apress Media	2018, ISBN 9781484234433
2	Blockchain Tethered AI: Trackable, Traceable Artificial Intelligence and Machine	Karen Kilroy, Lynn Riley, Deepak Bhatta	Learning, O'Reilly Media (21 March 2023),	First Edition, ISBN - 978-1098130480
Reference Books				
1	Blockchain for Business	Peter Lypovonyav	Packt Publishing Limited ISBN 9781789956023	2019
2	Practical Artificial Intelligence and Blockchain,	Ganesh Prasad Kumble	Packt publishing ,	First Edition, ISBN-978-1838822293, July 2020

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2													2	
CO2		2												2	
CO3	2													2	
CO4			2											2	
CO5			2											2	
Overall CO	2	2	2											2	

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – VII

DISTRIBUTED DATA STORAGE MANAGEMENT

Course Code	N7ADPE23	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3	Exam Hours	03

Course objectives:

This course will enable students to:

1. Understand Distributed Data Storage Management System and various Design Issues.
2. Explore several algorithms for processing queries in distributed environment.
3. Explore to various DDBMS such as parallel, distributed object, P2P, web and data streams..

UNIT-1 **(08 hrs)**

Introduction: Distributed Data Processing, What is a Distributed Database System?, Promises of DDBSs, Design Issues, Distributed DBMS Architecture.
Distributed Database Design: Top-Down Design Process, Fragmentation.
(1.1,1.2,1.4,1.6,1.7,3.1,3.3)

UNIT-2 **(08 hrs)**

Database Integration: Bottom-Up Design Methodology, Schema Matching, Schema Integration, Schema Mapping.
Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, Characterization of Query processors, Layers of Query Processing.
(4.1-4.4,6.1-6.5)

UNIT-3 **(08 hrs)**

Query Decomposition and Data Localization: Query Decomposition, Localization of Distributed Data.
Parallel Database Systems: Parallel Database System Architectures, Parallel Data Placement, Parallel Query Processing, Load Balancing, Database Clusters.
(7.1,7.2,14.1-14.5)

UNIT-4 **(08 hrs)**

Distributed Object Database Management: Fundamental Object concepts and Object models, Object distribution design, Architectural issues, Object management, Distributed object storage, Object query processing.
Peer-to-Peer Data Management: Infrastructure, Schema Mapping in P2P Systems.
(15.1-15.6.16.1,16.2)

UNIT-5 **(08 hrs)**

Web Data Management: Web Graph Management, Web Search, Web Querying.
Data Stream Management.
(17.1-17.3,18.1)

Course outcomes:

Upon completion of this course the student will be able to:

1. Describe the distributed database concepts, issues and architectures.
2. Analyze the working of various distribution database design techniques
3. Analyze the query processing technique for DDBMS.
4. Describe the working of various distributed data management systems such as parallel, distributed object, P2P, web and data streams

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	"Principles of Distributed Database Systems"	M. Tamer Özsu Patrick Valduriez	Prentice Hall.	Third Edition,
Reference Books				
1	Distributed Databases - Principles and Systems	Stefano Ceri Guiseppe Pelagatti	Tata McGraw Hill	1985
2	Fundamental of Database Systems	Elmasri Navathe	Pearson Education; Asia.	
3	Database System Concepts	Korth Sudarshan	TMH	

Course articulation matrix(CO-PO and CO-PSO mapping)

Course Outcome	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	3											2	
CO2		2	2											2	
CO3		2	2											2	
CO4		2	2											2	
CO5		2	2											2	
	2	2	2											1	

Program articulation matrix:

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
	2	2	2											2	

Degree of compliance **1**: Low **2**: Medium **3**: High

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – VII

AI-DRIVEN CYBER SECURITY

Course Code	N7ADPE24	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3	Exam Hours	03

Course objectives:

This course will enable students to:

1. Illustrate the understanding of Cyber Security Fundamentals.
2. Analyses the attacker motivation and the techniques used by them to break the security of the application.
3. Study the vulnerabilities in applications and networks. Analyses the possible attacks that can be built by the hackers.
4. Understand the Artificial Intelligence methods and principles can address cybersecurity challenges
5. Understand and Analyse AI methods and usecases suitable for solving to cybersecurity issues.

UNIT-1 **(08 hrs)**

Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, classification of Cyber Crime, Social Engineering, Categories of Cyber Crime, Property Cyber Crime. Cybercrime-Indian perspective/the Indian ITA 2000, Cyber Offenses: How criminals plan then.

UNIT-2 **(08 hrs)**

Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses, Cybercrime: Mobile and wireless Devices

UNIT-3 **(08 hrs)**

Tools and method used in cybercrime: Proxy servers and Anonymizers, Phishing: methods, techniques, spear phishing, types of phishing scams, toolkits and spy phishing, phishing countermeasures; Identity theft;

Password cracking, keyloggers and spywares, Virus and worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on wireless sensor networks, Cybercrime: Case Studies:

Real-life examples and Online scams.

UNIT-4 **(08 hrs)**

AI for Cybersecurity, The Use Cases Intend to Solve Various Cybersecurity Challenges through A Unified DL Pipeline, AI Conducts Two Reverse Engineering Tasks, Related Work, Model Architecture, Model Training Issues, Model Performance, Deployed Model, Source Code and Dataset, Remaining Issues.

UNIT-5 **(08 hrs)**

AI Detects DNS Cache Poisoning Attack, The Security Problem, Raw Data Generation and Collection, Labeling DNS Sessions, Feature Extraction and Data Sample Representation, Data Set Construction, Model Architecture, Parameter Tuning, Evaluation results, Model Deployment, Remaining Issues, Code and Data Resources.

Course outcomes:
Upon completion of this course the student will be able to:

1. Understand the basic concepts of crime, crime behavior, forensic science and its linkage to crime scenario.
2. Analyze the techniques used by hackers to create frauds
3. Determine and analyse software vulnerabilities and security solutions to reduce the risk of exploitation.
4. Apply the AI principles to solve cybersecurity challenges
5. Interpret and Analyse Deep learning methods for use cases intend to solve various cyber security challenges

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perpectives	Nina Godbole and SUNIT Belapure	Wiley India Pvt Limited"	2011
2	Computer Forensics and Investigations, Cengage Learning	Nelson Phillips and EnfingerSteuart		New Delhi,2009
3	An Incident-Based Approach to Forensic Investigations Malware forensics. In: Practical Cyber Forensics.	Niranjan Reddy	Apress, Berkeley,	CA (2019). https://doi.org/10.100 7/978-1-4842-4460-9
4	AI for Cybersecurity A Handbook of Use Cases, Penn State Cyber Security Lab	Peng Liu, Tao Liu et al.,		
Reference Books				V
1	Incident Response and Computer Forensics,	Kevin Mandia, Chris Prosise, Matt Pepe	Tata McGraw - Hill,	New Delhi, 2006
2	Software Forensics, Tata,	Robert M Slade	McGraw -Hill,.	New Delhi ,2005
3	"Understanding Forensics in IT " ,	Bernadette H Schell, Clemens Martin	Cybercrime, ABC – CLIO Inc, California, 2004.	NIIT Ltd,2005

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2														2
CO2		2													2
CO3		2			2										2
CO4	2														2
CO5		2													2
Overall CO	2	2													2

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VII

GENERATIVE AI AND PROMPT ENGINEERING

Course Code	**N7CCSPE01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03
Lecture Hours	40 Hrs	Practical Hour	-

Course objectives:

This course will enable students to:

- To provide a comprehensive understanding of generative AI models and their applications.
- To explore the key components and workings of LangChain and its comparison with other frameworks.
- To develop skills for building and implementing chatbots using advanced retrieval and vector techniques.
- To introduce the fundamentals and importance of prompt engineering in AI communication.
- To equip students with best practices and strategies for writing effective prompts and addressing common challenges in prompt engineering.

UNIT-1 **7 Hours**

Introducing generative AI: Generative models, Understanding LLMs, What is a GPT?, Other LLMs, Major players, Working of GPT models, Pre-training, Tokenization, Scaling, Conditioning, text-to-image models, LangChain for LLM Apps: Going beyond stochastic parrots, limitations of LLMs, mitigating LLM limitations, LLM app, LangChain.

UNIT-2 **8Hours**

Exploring key components of LangChain, chains, agents, memory, tools, working of LangChain, Comparing LangChain with other frameworks, Summarizing information, Basic prompting Prompt templates, Building a Chatbot like ChatGPT: What is a chatbot?, Understanding retrieval and vectors, Embeddings, Vector storage, Vector indexing, Vector libraries, Vector databases, Loading and retrieving in LangChain, Document loaders, Retrievers in LangChain, kNN retriever, PubMed retriever, Custom retrievers

UNIT-3 **9Hours**

Implementing a chatbot, Document loader, Vector storage, Memory, LLMs for Data Science, The impact of generative models on data science, Automated data science, Data collection, Visualization and EDA, Preprocessing and feature extraction, The Future of Generative Models, The current state of generative AI, Challenges, Trends in model development, Artificial General Intelligence, Economic consequences, Creative industries and advertising, Education, Law, Manufacturing, Medicine, Military, Societal implications.

UNIT-4 **8 Hours**

Introduction to ChatGPT, Overview of Large Language Models, Output Formats Generated By ChatGPT, Use Cases for ChatGPT, Differences Between ChatGPT and Web Search, Introduction to Prompt Engineering: Definition of Prompt Engineering, Importance of Prompt Engineering in AI Communications, Overview of the Different Types of Prompts, Understanding the Foundation of Prompt Engineering, Power Up Your Prompts With Effective Verbs, Elevate Your Prompts with Nuances of Tone, Progressive Experimentation for Refining Prompts, Do You Need Programming Skills to Become a Prompt Engineer?

UNIT-5 **8 Hours**

Writing Effective Prompts, Key Attributes of Good Prompt Writing, Tips for Getting the Most Out of Prompt Responses, Best Practices in Prompt Engineering: Understanding the Nuances of Language & Tone, Testing & Iterating Prompts for Improved Performance, Incorporating Feedback from AI Models to Refine Prompts, Enhancing Reliability of Responses, Give More "Think Time" to the Model, Staying Up to Date with the Latest Advancements, Tips for Getting the Most Out of Prompt Responses, Challenges in Prompt Engineering: Addressing Common Challenges & Pitfalls, Strategies for Improving Prompt Effectiveness, Ethical Considerations in Prompt Engineering.

Course outcomes:
At the end of the course the student will be able to:

CO1: Gain a solid understanding of generative AI models, including large language models and text-to-image models.
CO2: Utilize LangChain for developing advanced LLM applications and understand its components and functionalities.
CO3: Develop practical skills in implementing chatbots, managing vector storage, and employing LLMs for data science.
CO4: Understand the principles of prompt engineering and learn how to design effective prompts for various AI applications.
CO5: Apply best practices in prompt engineering, address challenges, and incorporate ethical considerations in their work.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each UNIT.
- Each full question will have sub- question covering all the topics under a UNIT.
- The students will have to answer five full questions, selecting one full question from each UNIT.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Generative AI with LangChain	Ben Auffarth	Packt Publishing Ltd.	1st Edition, 2023
2	Demystifying Prompt Engineering	Harish Bhat	Harish Bhat	1st Edition, 2023
Reference Books				
1	"Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play.	David Foster	O'Reilly Media	2nd Edition, 2023
2	Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs	James Phoenix, Mike Taylor	O'Reilly Media	1st Edition, 2024

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2													2	
CO2			2											2	
CO3			2											2	
CO4			2		2									2	
CO5	2				2									2	
Overall CO	2		2		2									2	

B.E COMPUTER SCIENCE & ENGINERRING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – VII

REAL TIME BIG DATA ANALYTICS

Course Code	N7CCSPE02	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives: This course will enable students to:

1. Describe the basic paradigms , data model , evolution for Big Data
2. Explain the importance of a serialization framework and limitations of serialization frameworks for Big Data
3. Analyze how the data is stored on the batch layer
4. Design of the batch layer starting from ingesting new data to computing batch views
5. Illustrate how to build the serving layer for Bigdata
6. Describe the real time views of Cassandra's data model for Bigdata
7. Demonstrate how to implement the concepts of queuing and stream processing using real-world tools.

UNIT-1 **(08 hrs)**

A new paradigm for Big Data: Scaling with a traditional database - NoSQL is not a panacea - First principles - Desired properties of a Big Data system - The problems with fully incremental - Lambda Architecture - Recent trends in technology - Example application: SuperWebAnalytics.com.

Data model for Big Data: The properties of data - The fact-based model for representing data - Graph - A complete data model for SuperWebAnalytics.com.

Data model for Big Data - illustration: Why a serialization framework? - Apache Thrift - Limitations of serialization frameworks.

UNIT-2 (08 hrs)

Data storage on the batch layer: Storage requirements for the master dataset - Choosing a storage solution for the batch layer - How distributed file systems work - Storing a master dataset with a distributed file system - Vertical partitioning - Low-level nature of distributed file systems - Storing the SuperWebAnalytics.com master dataset on a distributed file system

Data storage on the batch layer – Illustration: Using the Hadoop Distributed File System - Data storage in the batch layer with Pail - Basic Pail operations - Serializing objects into pails - Batch operations using Pail - Vertical partitioning with Pail - Pail file formats and compression – Summarizing the benefits of Pail - Storing the master dataset for SuperWebAnalytics.com

Batch layer: Computing on the batch layer, Re-computation algorithms vs. incremental algorithms, Scalability in the batch layer, MapReduce: a paradigm for Big Data computing, Low-level nature of MapReduce, Pipe diagrams: a higher-level way of thinking about batch computation

UNIT-3 (08 hrs)

Batch layer: Illustration: An illustrative example - Common pitfalls of data-processing tools - An introduction to JCascalog – Composition

Batch layer - Architecture and algorithms: Design of the SuperWebAnalytics.com batch layer - Workflow overview - Ingesting new data - URL normalization - User-identifier normalization - Deduplicate pageviews - Computing batch views

Batch layer: Implementation: Starting point - Preparing the workflow - Ingesting new data - URL normalization - User-identifier normalization - Deduplicate pageviews - Computing batch views

UNIT-4 (08 hrs)
Serving layer: Performance metrics for the serving layer - The serving layer solution to the normalization/denormalization problem - Requirements for a serving layer database - Designing a serving layer for SuperWebAnalytics.com - Contrasting with a fully incremental solution. Serving layer: Illustration: Basics of ElephantDB - Building the serving layer for SuperWebAnalytics.com. **Realtime views** : Computing realtime views - Storing realtime views - Challenges of incremental computation - Asynchronous versus synchronous updates - Expiring realtime views
UNIT-5 (08 hrs)
Realtime view – Illustration: Cassandra's data model 220 - Using Cassandra. Queuing and stream processing: Queuing, Stream processing, Higher-level, one-at-a-time stream processing, SuperWebAnalytics.com speed layer **Queuing and stream processing:** Illustration: Defining topologies with Apache Storm, Apache Storm clusters and deployment, Guaranteeing message processing

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the basic knowledge related to data models to explain its elements, its analytics, its usage in business context.
2. Illustrate data storage on the batch layer using the Hadoop Distributed File System
3. Design and Develop batch layer to the solution of various real world application problems in the context of real time data
4. Identify the requirement of Computing real time views in Cassandra's data model
5. Implement the concepts of queuing and stream processing using real-world tools.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Big Data - PRINCIPLES AND BEST PRACTICES OF SCALABLE REAL-TIME DATA SYSTEMS	NATHAN MARZ with JAMES WARREN	MANNING Shelter Island	First, 2015
Reference Books				
1	Hadoop: The Definitive Guide	Tom White, Fourth	O'reilly Media	Third Edition,2015
2	Big Data and Analytics	Seema Acharya,Subhashini Chellappan,	Wiley India Publications	4th , May 2015
3	BIG DATA Black Book	D T Editorial Services,	Dreamtech press	2016 Edition

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	3														2
CO2					2										2
CO3			3												3
CO4		2			2										2
CO5					2										2
Overall CO	3	2	3	-	2	-	-	-	-	-	-	-	-	-	3

Program articulation matrix:

Course	PROGRAMME OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
BIG DATA(RCSE32)	3	2	3	-	2	-	-	-	-	-	-	-	-	-	3

Degree of compliance **1**: Low **2**: Medium **3**: High

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VII

INFORMATION RETRIEVAL

Course Code	N7ADPE31	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives: This course will enable students to:

- Examine the Information Retrieval problems and describe the architecture of a search engine
- Analyse Search structures of dictionaries, Wildcard queries and Index construction done information retrieval
- Understand the scoring and ranking in Information retrieval system
- Study the various Information Retrieval Evaluation Techniques and processes involved.
- Understand how web search, web crawling and link analysis is done for information retrieval on the web

UNIT-1 **7 Hours**

Introduction

Search Engines and Information Retrieval : What Is Information Retrieval? , The Big Issues, Search Engines, Search Engineers

Architecture of a Search Engine: What Is an Architecture? ,Basic Building Blocks ,Breaking It Down, Text Acquisition Text Transformation , Index Creation, User Interaction, Ranking ,Evaluation, How Does It Really Work?

Boolean retrieval: An example information retrieval problem , A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval

Vocabulary and postings lists: Document delineation and character sequence decoding: Obtaining the character sequence in a document, Choosing a document UNIT

Determining the vocabulary of terms: Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, Faster postings list intersection via skip pointers

Positional postings and phrase queries: Biword indexes, Positional indexes, Combination schemes

UNIT-2 **7 Hours**

Dictionaries and tolerant retrieval

Search structures for dictionaries, Wildcard queries: General wildcard queries , k-gram indexes for wildcard queries , Spelling correction: Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction.

Index construction :

Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing

Index Compression:

Dictionary Compression, Dictionary as a string, Blocked storage., Postings file compression: Variable byte codes, γ codes

UNIT-3 **7 Hours**

Scoring, term weighting and the vector space model : Parametric and zone indexes : Weighted zone scoring , Learning weights, The optimal weight g, Term frequency and weighting: Inverse document frequency , Tf-idf weighting , The vector space model for scoring: Dot products, Queries as vectors, Computing vector scores, Variant tf-idf functions: Sublinear tf scaling, Maximumtf normalization, Document and query weighting schemes, Pivoted normalized document length

Computing scores in a complete search system

Efficient scoring and ranking: Inexact top K document retrieval, Index elimination, Champion lists, Static quality scores and ordering, Impact ordering, Cluster pruning.

Components of an information retrieval system: Tiered indexes, Query-term proximity, Designing parsing and scoring functions, Putting it all together , Vector space scoring and query operator interaction

UNIT-4 **9 Hours**

Evaluation in information retrieval:

Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance : Critiques and justifications of the concept of relevance , A broader perspective-System quality and user utility: System issues, User utility, Refining a deployed system, Results snippets.

XML retrieval:

Basic XML concepts , Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Language models for information retrieval :

Language models: Finite automata and language models, Types of language models, Multinomial distributions over words , The query likelihood model: Using query likelihood language models in IR, Estimating the query generation probability, Ponte and Croft's Experiments**,** Language modelling versus other approaches in IR, Extended language modelling approaches

UNIT-5 **9 Hours**

Web search basics : Background and history

Web characteristics: The web graph, Spam,Advertising as the economic model, The search user experience: User query needs, Index size and estimation, Near-duplicates and shingling

https://www.youtube.com/watch?v=DkspjZRYD8s

Web crawling and indexes:

Overview: Features a crawler must provide, Features a crawler should provide, Crawling: Crawler architecture: DNS resolution, The URL frontier, Distributing indexes, Connectivity servers

Link analysis:

The Web as a graph: Anchor text and the web graph, PageRank: Markov chain, The PageRank computation, Topic-specific PageRank , Hubs and Authorities: Choosing the subset of the Web.

Course outcomes:

At the end of the course the student will be able to:

CO1: Analyse the Information Retrieval problems and illustrate the architecture of a Search Engine

CO2: Apply Search structures of dictionaries, Wildcard queries and Index construction for information retrieval.

CO3: Apply scoring and ranking mechanisms to design an efficient Search Engine.

CO4: Apply suitable evaluation techniques and language models in the design of Search Engine.

CO5: Analyse web search, web crawling and link analysis mechanisms for information retrieval on the web.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Introduction to Information Retrieval	C. Manning, P. Raghavan, and H. Schutze, 2008.	Cambridge University Press	1st Edition, 2009
2	Search Engines: Information Retrieval in Practice	Bruce Croft, Donald Metzler and Trevor Strohman	Addison Wesley	2nd Edition, 2015
Reference Books				
1	Modern Information Retrieval: The Concepts and Technology behind Search	Ricardo Baeza - Yates and Berthier Ribeiro - Neto	ACM Press	2nd Edition, 2011
2	Information Retrieval Implementing and Evaluating Search Engines	Stefan Buttcher Charles L. A. Clarke Gordon V. Cormack	MIT Press	1st Edition, February 2016

Course Articulation matrix(CO-PO and CO-PSO mapping)

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
CO1		2												2	
CO2	2													2	
CO3			2											2	
CO4			2											2	
CO5		2												2	
Overall CO	2	2	2											2	

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – VII

HIGH PERFORMANCE COMPUTING

Course Code	**N7ADPE32**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3	Exam Hours	3
Lecture Hours	40 hrs	Practical Hour	-

Course objectives: This course will enable students to:

1. To analyse typical parallel algorithm models and its application in scientific computing. (Analysis, Application)
2. To develop programs using message-passing paradigm. (Synthesis)
3. To learn how GPUs works using the CUDA architecture and its applications (Comprehension, Application)
4. To gain practical knowledge by giving hands on experience inGraphics Interoperability, CUDA C on multiple GPUs and CUDA toolkit (Synthesis)
5. To analyze the latest parallel computing techniques and research - prepare a technical document and make a presentation (Analysis, Syntheses and Evaluation)

To develop open ended solution for any of the identified high performance computing problems

UNIT 1 **8 Hours**

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions,Mapping Techniques for Load Balancing ,

Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction , All-to-All Broadcast and Reduction

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs(5.1) , the Effect of Granularity on Performance.

UNIT 2 **7 Hours**

Programming Using the Message-Passing Paradigm:

Principles of Message-Passing Programming , The Building Blocks: Sendand Receive Operations , MPI: the Message Passing Interface

UNIT 3 **8 Hours**

Programming Shared Address Space Platforms:

Thread Basics , Why Threads? , The POSIX Thread API,Thread Creation and Termination, Synchronization Primitives in Pthreads ,Controlling Thread and Synchronization Attributes , Thread Cancellation,Composite Synchronization Constructs, OpenMP: a Standard for Directive Based Parallel Programming

UNIT 4 **8 Hours**

Why CUDA? Why Now?: The Age of Parallel Processing, Central Processing UNITs,The Rise of GPU Computing, A brief history of GPUs, Early GPU computing, CUDA,What is CUDA architecture, using the CUDA architecture, Applications of CUDA,Medical Imaging, Computational Fluid Dynamics, Environmental Science, Introductionto CUDA C: A First Program, Hello world, A kernel call, Passing parameters, Queryingdevices, using device properties, Parallel Programming in CUDA C:CUDA parallel programming, Summing vectors, A fun example.

UNIT 5 **8 Hours**

Graphics Interoperability: Graphics Interoperation, GPU Ripple with Graphics Interoperability - the GPUAnimBitmap structure; GPU Ripple Redux , Heat transfer with Graphics Interop, DirectX Interoperability

CUDA C ON multiple GPUS : Zero-Copy Host Memory -Zero-Copy Dot Product; Zero-Copy Performance, Using Multiple GPUs, Portable Pinned Memory

CUDA Tools: CUDA Toolkit- CUFFT, CUBLAS, NVIDIA GPU Computing SDK, Debugging CUDA C

Topics for Open Ended Activity :

Self Learning component

Parallel Computing models, parallel virtual machines and usage, Data-Parallel Algorithms, Graphics Interoperability, Parallel Computing Strategies, Linear Algebra Image/Video Processing computation, Data Compression, Physically-Based Simulation, Parallel pragma/directive based frameworks, Usage and Performance analysis and comparisons– FPGA, GPUs, GP-GPUS, CPU-GPUs, Analysis of HPC Benchmark Suite/Tools/Solutions/Standard etc, and so on.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply and Analyze various parallel algorithm models

2. Develop programs using message-passing paradigm.

3. Apply and Analyze the Synchronization primitives and parallel pragma directives

4. Analyse the CUDA Architecture and develop parallel programs

5. Design and develop parallel programs using CUDA GPU interoperability and CUDA tools.

6. Do Literature Survey on parallel computing platform -prepare technical report and present before audience convincingly. Also, Create open ended frameworksolution for various high performance computing problems

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to parallel computing (chapters 01,2.1-2.5,3,4.1.1-4.1.3, 5.1, 5.2, 5.3, 6,7)	Ananth Grama,AnshulGupta,Vipinkumar,GeorgeKarypis	Pearson education publishers	second edition, 2015
2	CUDA by example (Chapters 1 ,3, 4, 5, 8, 11, 12)	Jason Sanders Edward Kandrot	NVIDIA Corporation	2015
Reference Books				
1	Parallel Programming for Multicore and cluster systems	Thomas Rauber and GudulaRunger	Springer	International Edition,2009
2	Introduction to Parallel Computing	Niranjan N. Chiplunkar, Raju K	Wiley	2020

Course Outcomes	PROGRAM OUTCOMES												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3		2											2		
CO4			2		2								2		
CO5			2		2								2		
Overall CO	2	2	2		2								2		

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – VII

Research Methodology and IPR

Course Code	**N7CCA01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE Marks	50
Credits	3	Exam Hours	3
Lecture Hours	40 hrs	Practical Hour	-

UNIT 1 **6 Hours**

Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2 **5 Hours**

Research Problem: Effective literature studies approaches, analysis Plagiarism, and Research ethics.

UNIT 3 **5 Hours**

Technical Writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 4 **8 Hours**

Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT..

UNIT 5 **8 Hours**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Course outcomes:

On successful completion of this course, students will be able to:

1. Identify based on the knowledge the basics of research and its types.
2. Apply knowledge to write Literature Review, Technical Reading, Attributions and Citations
3. Practice the knowledge of Ethics in Engineering Research
4. Apply the concepts of Intellectual Property Rights in engineering
5. Apply IPR knowledge for the granting patents and its procedure for new innovative product for grants.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		2								3	3		
CO2	3	3	3		2								3	3		
CO3	3	3	3		2								3	3		
CO4	3	3	3		2								3	3		
CO5	3	3	3		2								3	3		

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Research methodology: an introduction	Wayne Goddard and Stuart Melville	Juta Academic Lt.D.	2nd Edition, 201 ISBN 9780702156601
2	Research methodology: an introduction for science & engineering students,	Stuart Melville and Wayne Goddard	Juta Academic	2nd Edition,
	Research Methodology: A Step by Step Guide for beginners,	Ranjit Kumar	SAGE Publications India Pvt Ltd,	4th Edition, 2023 ISBN: 9789351501336
Reference Books				
1	Intellectual Property Rights Under WTO", , 2008	T. Ramapp	S. Chand	
2	Intellectual Property in New Technological Age",	Robert P. Merges, Peter S. Menell, Mark A.		2016