SHIVAJI UNIVERSITY, KOLHAPUR
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शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SU/BOS/Sci & Tech/ 183 **Date: 10/06/2026**

The Principal / Director,
All Concerned Affiliated Colleges / Institutions,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech.** degree **Programme (Affiliated Colleges)** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of Question paper and equivalence of B. Tech. degree programme under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

Sr. No.	B. Tech Course Syllabus	
1	Civil Engineering	Part-III
2	Mechanical Engineering	Part-III
3	Mechanical and Mechatronic Engineering (Additive Manufacturing)	Part-III
4	Electrical Engineering	Part-III
5	Electrical and Computer Engineering	Part-III
6	Electronics and Telecommunication Engineering	Part-III
7	Electronics & Computer Science Engineering	Part-III
8	Computer Science and Engineering	Part-III
9	Computer Science and Engineering (Artificial Intelligence & Machine Learning) (AIML)	Part-III
10	Computer Science and Engineering (Data Science) (DS)	Part-III
11	Computer Science and Engineering (Artificial Intelligence & Data Science) (AIDS)	Part-III
12	Electronics and communication Engineering (Bio-Medical Engineering)	Part-II

This Syllabus, nature of question and equivalence shall be implemented from the academic year **2026-27** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in>Syllabus>Syllabus as per NEP-2020.**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2026 & March / April 2027. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy. Registrar

Copy to: for Information and necessary action

1	The I/c Dean, Faculty of Science & Technology	7	Appointment A & B Section
2	Director, Board of Examinations & Evaluation	8	Affiliation (T.1) (T.2) Section
3	The Chairperson, Respective Board of Studies	9	P.G.Admission Section,
4	Other Exam 4 Section,	10	P.G Seminar Section
5	Eligibility Section,	11	Computer Centre/ IT Cell
6	Internal Quality Assurance Cell (IQAC)		

NAAC A++ Grade with CGPA 3.52

Shivaji University Kolhapur

Syllabus

Revised Syllabus as per
National Education Policy-2020 (NEP-2.0)

T. Y. B. Tech.
Computer Science & Engineering
(Artificial Intelligence & Data Science)

Under
Faculty of Science and Technology

To be implemented from

Academic Year 2026-27.

SCHEME OF INSTRUCTION & SYLLABI

Programme Artificial Intelligence & Data Science

Scheme of Instructions: Third Year B. Tech. Artificial Intelligence & Data Science

Semester – V

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	AI&DS3101	Artificial Intelligence	3	--	--	3	3	30	10	60	100
2	PCC	AI&DS3102	Machine Learning	3	--	--	3	3	30	10	60	100
3	PCC	AI&DS3103	Java Programming	2	--	--	2	2	30	10	60	100
4	PEC	AI&DS3104	Elective-I	3	--	--	3	3	30	10	60	100
5	MDM	AI&DS3105	Multi-disciplinary Minor – 03	3	--	--	3	3	30	10	60	100
6	OE	AI&DS3106	Open Elective -03	2	--	--	2	2	30	10	60	100
7	PCC	AI&DS3107	Machine Learning Lab	--	1	--	1	1	-	25	-	25
8	PCC	AI&DS3108	Java Programming Lab	--	--	4	4	2	-	25	25	50
9	PEC	AI&DS3109	Elective-I Lab	--	--	2	2	1	-	25	--	25
10	MDM	AI&DS3110	Multi-disciplinary Minor– 03 Lab	--	--	2	2	1	-	50	--	50
11	EL	AI&DS3111	Mini project II	--	--	2	2	1	-	25	25	50
			Total	**16**	**1**	**10**	**27**	**22**	**180**	**210**	**410**	**800**

L- Lecture T-Tutorial P-Practical

MSE- Mid Semester Examination ISE/CA- In Semester Evaluation/Continuous Assessment ESE- End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective other than particular Programme (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular and Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	**16**	**16**	**19**	**-**	**10**	**09**	**14**	**02**	**02**
Semester Credits	**-**	**-**	**11**	**04**	**06**	**-**	**-**	**01**	**-**
Cumulative Sum	**16**	**16**	**30**	**04**	**16**	**09**	**14**	**03**	**02**

PROGRESSIVE TOTAL CREDITS: 88+22=110

SCHEME OF INSTRUCTION & SYLLABI

Programme Artificial Intelligence & Data Science

Scheme of Instructions: Third Year B. Tech. Artificial Intelligence & Data Science

Semester – VI

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	AI&DS3201	Deep Learning	3	--	--	3	3	30	10	60	100
2	PCC	AI&DS3202	Cloud Computing	3	1	--	4	4	30	10	60	100
3	PCC	AI&DS3203	Database Management Systems	3	--	--	3	3	30	10	60	100
4	PEC	AI&DS3204	Elective-II	3	--	--	3	3	30	10	60	100
5	PEC	AI&DS3205	Elective-III	3	--	--	3	3	30	10	60	100
6	MDM	AI&DS3206	Multi-disciplinary Minor – 04	2	--	--	2	2	30	10	60	100
7	PCC	AI&DS3207	Database Management Systems Lab	--	--	4	4	1	-	50	25	75
8	PCC	AI&DS3208	Deep Learning Lab	--	--	2	2	1	-	25	25	50
9	EL	AI&DS3209	Domain Specific Mini Project	--	--	2	2	2	-	50	25	75
			Total	**17**	**1**	**8**	**26**	**22**	**180**	**185**	**435**	**800**

L- Lecture T-Tutorial P-Practical

MSE- Mid Semester Examination ISE/CA- In Semester Evaluation/Continuous Assessment ESE- End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective other than particular Programme (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular and Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	**16**	**16**	**30**	**04**	**16**	**09**	**14**	**03**	**02**
Semester Credits	**-**	**-**	**12**	**06**	**02**	**--**	**-**	**02**	**-**
Cumulative Sum	**16**	**16**	**42**	**10**	**18**	**09**	**14**	**05**	**02**

PROGRESSIVE TOTAL CREDITS: 110+22 =132

Exit option: Award of B. Vocational in Major with 132 credits and an additional 8 credits from following Exit Courses				
Sr. No	**Course Code**	**Course title**	**Mode**	**Credits**
1	AI&DS-EC-05	Web Technology	Online/offline certification Course or project of total 8 credits	8
OR				
2	AI&DS-EC-06	Cyber Security		8

Year and Semester	**ThirdYear B. Tech - Semester V–Artificial Intelligence & Data Science**				
Course Category	**Programme Core Course (PCC)**				
Title of Course	**Artificial Intelligence**			**Course Code**	**AI&DS3101**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	03	**--**	**--**	**03**	**03**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite		
Course Objective	**1**	To introduce students to the fundamental principles of artificial intelligence based on logical reasoning and knowledge representation.
	2	To enable students to understand and apply probabilistic reasoning techniques for decision-making under uncertainty.
	3	To provide foundational knowledge of machine learning and neural network models used in intelligent systems
	4	To develop awareness of ethical, social, and future challenges associated with the deployment of artificial intelligence technologies.
Course Outcomes		
	CO1	Explain the basic concepts of Artificial Intelligence, intelligent agents, and problem-solving techniques.
	CO2	Apply logical reasoning and knowledge representation techniques to design simple intelligent systems.
	CO3	Analyze problems involving uncertainty using probabilistic reasoning methods.
	CO4	Implement basic Machine Learning algorithms and neural network models for simple AI applications.
	CO5	Evaluate the performance of AI models in solving practical problems.
	CO6	Evaluate the ethical, social, and future implications of Artificial Intelligence technologies.

CO PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**3**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Logical Foundations of Artificial Intelligence** Propositional Logic: Syntax and Semantics, Predicate (First Order) Logic, Knowledge Representation using Logic, Logical Inference, Resolution and Unification, Forward and Backward Chaining	6Hrs.
2	**Knowledge Representation** Knowledge-Based Agents**,** Declarative Knowledge**,** Rule-Based Knowledge Representation**,** Semantic Networks**,** Frames**,** Ontologies and Knowledge Graphs	6Hrs.
3	**Reasoning Under Uncertainty** Probability Theory Basics, Probabilistic Reasoning, Bayesian Networks, Conditional Independence, Inference in Bayesian Networks, Decision Making under Uncertainty	6 Hrs
4	**Machine Learning – Basic Concepts** Introduction to Learning Agents, Supervised Learning, Unsupervised Learning, Learning Decision Trees, Regression Models, Model Evaluation and Validation	6Hrs.
5	**Neural Networks** Introduction to Neural Networks, Biological vs Artificial Neurons, Perceptron Model, Multilayer Neural Networks, Backpropagation Algorithm, Deep Learning – Basic Overview	6Hrs.
6	**Ethics and Future Directions of AI** Ethical Issues in AI, Bias and Fairness, Transparency and Explainability, Safety and Security in AI Systems, Social Impact of AI, Future Challenges and Opportunities	6Hrs.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	3rd Edition, Pearson Education.
02	Artificial Intelligence	. Charu C. Aggarwal	

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Artificial Intelligence: A Modern Approach	Peter Norvig	3rd Edition
02	The Sciences of the Artificia	Herbert A. Simon	3rd Edition
03	Artificial Intelligence Application Programming	Tim Jones	Dreamtech Publication

Year and Semester	**ThirdYear B. Tech - Semester V–Artificial Intelligence & Data Science**				
Course Category	**Programme Core Course (PCC)**				
Title of Course	**Machine Learning**			**Course Code**	**AI&DS3102**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	03	**--**	**--**	**03**	**03**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite	**Set Theory, Basic of AI.**	
Course Objective	**1**	To introduce the fundamental concepts, terminology, and mathematical foundations of machine learning.
	2	To develop an understanding of supervised, unsupervised, and reinforcement learning techniques.
	3	To enable learners to design, implement, and evaluate machine learning models using real-world datasets.
	4	To familiarize students with practical challenges in machine learning such as model selection, overfitting, and performance evaluation.
Course Outcomes		
	CO1	Explain the fundamental concepts and algorithms of Machine Learning with appropriate theoretical justification.
	CO2	Describe different types of Machine Learning approaches such as supervised, unsupervised, and reinforcement learning.
	CO3	Apply suitable Machine Learning techniques to solve classification, regression, and clustering problems.
	CO4	Implement Machine Learning models using standard tools and programming frameworks.
	CO5	Evaluate Machine Learning models using appropriate performance metrics and validation methods.
	CO6	Analyze model performance and make informed decisions to improve accuracy and generalization.

CO PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO6	**2**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Machine Learning** Introduction to Probability and Statistics, Machine Learning: Definition, Terminology, Types of learning, Machine Learning Problem categories, Machine learning architecture, process, Lifecycle, Performance measures, tools and framework, data visualization.	**5Hrs.**
2	**Regression** Simple regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression, examples, simple regression in matrix form. Multivariate Linear Regression – Multiple features, hypothesis functions, Gradient Descent for multiple variables, Feature scaling, polynomial regression	**7 Hrs.**
3	**Classification- logistic regression & Naïve Bayes** Logistic Regression – Definition, Hypothesis representation, decision boundary, cost function, Gradient Descent for Logistic Regression. Multiclass Classification, Regularization - Over fitting &Under fitting, cost function, Regularized Linear Regression, Regularized Logistic Regression, Conditional probability and Naïve Bayes Classifier. Instance-based classifier – K- Nearest Neighbor Classifier, Bayesian Network, Hidden Markov Model.	**6 Hrs**
4	**Classification- Decision trees and Support Vector Machine** Decision trees: definition, terminology, the need, advantages, and limitations. Constructing and understanding Decision trees, common problems with Decision trees, Decision tree algorithms, random forest, examples. Support Vector Machine: What is SVM, Kernel Trick, Cost Function, Decision Trees vs. Support Vector Machine.	**6Hrs.**
5	**Unsupervised learning** Clustering, K Means clustering, Hierarchical clustering, Association Rule mining.	**6Hrs.**
6	**Neural Network & Recommendation System** Neural Networks- Neuron representation and model, Hypothesis for neuron, cost function, solution of a problem using single neuron. Gradient descent for a neuron. Neural network,	**6Hrs.**

	Multiclass classification with neural network. Learning in neural network-back propagation algorithm Recommendation System: Popularity based recommender engines, Content based recommendation engines, Classification based recommendation engine, Collaborative filtering	

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Machin Learning with Python.	Abhishek Vijayvargia	New Delhi, India: BPB Publications, n.d.
02	Practical Machine Learning	S. Gollapudi	Birmingham U.K.Packt Publishing Ltd., n.d.
03	Machine Learning	T. M. Mitchell	New York, NY, USA: McGraw-Hill Education, 1997.

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Machine Learning for Dummies	J. P. Müller and S. Guido	Hoboken, NJ, USA: Wiley, 2016.
02	Introduction to Machine Learning	E. Alpaydin	4th ed. Hoboken, NJ, USA: Wiley, 2020

Year and Semester	**Third Year B. Tech - Semester V- Artificial Intelligence and Data Science**				
Course Category	**Programme Core Course (PCC)**				
Title of Course	**Java Programming**			**Course Code**	**AI&DS3103**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	02	**--**	**--**	**02**	**02**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite	**Fundamentals of C ++ Programming**	
Course Objective	**1**	**To introduce the concept of object-oriented programming using java.**
	2	**To learn how to implement reliable and secure application using exception handling and package concept.**
	3	**Have the ability to write program to perform file operations.**
	4	**To understand how to design components with java Swing API and present mechanism of multithreading.**
	5	**To familiarize database connectivity through JDBC and learn the collection framework.**
Course Outcomes		
	CO1	**Students will be able to articulate the principles of object-oriented problem solving and programming.**
	CO2	**Students will be able to illustrate code reusability, security, and abstraction using inheritance, packages, and interfaces.**
	CO3	**Students will be able to develop reliable and user-friendly applications using exception handling and file handling.**
	CO4	**Students will be able to create desktop applications using SWING and event handling, and illustrate multithreading concepts.**
	CO5	**Students will be able to apply multithreading concepts and use the collection framework.**
	CO6	**Students will be able to use JDBC.**

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	–	–	–	–	–	–	–	–
CO2	3	2	2	–	1	–	–	–	–	–	–
CO3	3	2	3	1	2	–	–	–	–	–	–
CO4	3	2	3	1	3	–	–	–	1	1	–
CO5	3	3	3	1	3	–	–	–	1	–	–
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme

- **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %**
- **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).**
- **No compulsory passing for MSE.**
- **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Fundamental Programming in Java:** **The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, Hotspot, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Arrays-Jagged Array.** **Objects and Classes: Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword.**	**5Hrs**

2	**Inheritance, Interface and Packaging** **Inheritance: Definition, Super classes, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods.** **Interfaces: Defining an Interface, Implementing an Interface,** **Using an Interface as a Type, Evolving Interfaces, and Default Methods.** **Packages: Class importing, Creating a Package, Naming a Package, Using Package Members, Managing Source and ClassFiles.**	**5Hrs**
3	**Exception and I/O Streams:** **Exception: Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, , finally clause, Advantages of Exceptions** **I/O Streams: Byte Stream – Input Stream, Output Stream, Data Input Stream, Data Output Stream, File Input Stream, File Output Stream, Character Streams, Buffered Stream, Scanner, Random File Access File.**	**5Hrs**
4	**Graphical User Interfaces using Swing, Event handling** **Introduction to GUI programming in Java, Overview of Java GUI toolkits – AWT and Swing, Features and advantages of Swing, Swing architecture and packages; Creating basic Swing applications; Containers and components; Swing components – JLabel, JButton, JTextField, JTextArea, JCheckBox, JRadioButton, ButtonGroup, JComboBox, JList, JTable, JScrollPane; Menu components – JMenuBar, JMenu, JMenuItem; Layout managers – FlowLayout, BorderLayout, GridLayout, BoxLayout;** **Event-driven programming model: Event handling mechanism; events and listeners; Handling ActionEvent using ActionListener; Mouse events; Keyboard events; Window events; Adapter classes; Handling multiple events; Introduction to MVC pattern in Swing; Development of simple GUI-based applications.**	**5Hrs**
5	**Multithreading, Collections** **Multithreading: Processes and Threads, Runnable Interface and Thread Class , Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Interrupts, Thread States, Thread Properties, Joins, Synchronization** **Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework**	**4Hrs**
6	**Database Programming** **Database Programming : The Design of JDBC, The Structured Query Language, JDBC Installation, Basic JDBC Programming Concepts, Query Execution, Scrollable and Updatable Result Sets, Metadata, Row Sets, Transactions**	**4Hrs**

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Core Java- Volume I Fundamentals**	**Cay Horstmann and Gary Cornell**	**Pearson, Eight edition**
02	**Core Java- Volume II Advanced Features**	**Cay Horstmann and Gary Cornell**	**Pearson, Eight edition**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**JAVA-The Complete Reference**	**Herbert Schildt**	**McGraw Hill, Oracle Press**
02	**Head First Java**	**Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra**	**O'Reilly Publication**
03	**Head First Servlets and JSP**	**Bryan Basham, Kathy Sierra, Bert Bates**	**O'Reilly Publication**

Year and Semester	Third Year B. Tech - Semester V–Artificial Intelligence and Data Science				
Course Category	Programme Elective Course (PEC) - I (AI&DS3104)				
Title of Course	Data Science using R			Course Code	AI&DS3104
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Basics of Python	
Course Objective	1	To get the knowledge about data science using R programming.
	2	To articulate concept of data in data science.
	3	To get introduced basic concepts in R language.
	4	To understand concept of data analysis and preprocessing.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Students will be able to identify the data science concepts.
	CO2	Students will be able to articulate concept data in data science,types of data.
	CO3	Students will be able to interpret basic concepts in R language.
	CO4	Students will be able to illustrate the concept of data analysis and pre-processing concept.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	-	1	-	-	-	1	-	-
CO2	3	2	-	1	2	-	-	-	1	-	-
CO3	3	2	1	2	2	-	-	-	1	-	1
CO4	2	2	-	2	2	-	-	-	1	-	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Data Science and R** Definition and importance of data science, Overview of the data scienceprocess(datacollection,preparation,analysis,modelling,evaluation and deployment)Installation and setup of RStudio,basic operations in R	5 Hrs
2	**Data Types and structures in R** Data Types-Numeric,character,factor and logical datatypes,Type Conversion Data structures-Vectors,matrices,lists,data frames	6 Hrs
3	**R Programming Fundamentals** Conditions and loops,Functions in R,Objects and classes,debugging,string operations in R	6 Hrs
4	**Data import and export in R** Reading CSV and excel files,Reading Data from databases(SQL) Writing Data:Exporting Data to CSV,Excel,and other formats,Saving R objects(RDS files)	6 Hrs
5	**Data manipulation and visualization:**	7 Hrs

	Data manipulation :List management, Data Transformation, merging data frames, outlier detection, Combining multiple vectors **Data visualization**-Creating bar chart and dot plot, ploting with base graphics, plotting and coloring in R	
6	**Linear Models using R:**	**6 Hrs**
	Linear model,simple linear regression and multiple regression, generalized linear models, non linearmodels, Splines- Decision random Forests .	

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	R Programming for Data science:	Roger D. Peng	Leanpub**,2014**
02	Beginning R-The statistical	markgardner	Wiley&Sons,Ic,2012

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Modern Data Science with R	Benjamin S. Baumer, Daniel T. Kaplan & Nicholas J. Horton	
02	R Data Science Quick Reference	Thomas Mailund	

Year and Semester	Third Year B. Tech – Semester V – Artifitial Intelligence & Data Science				
Course Category	Programme Elective Course (PEC)				
Title of Course	IOT Embedded Systems for AI			Course Code	AI&DS3104
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Objective	1	To introduce the fundamentals of embedded systems and Internet of Things (IoT).
	2	To understand IoT architecture, devices, communication models, and protocols.
	3	To explain data handling, cloud platforms, and analytics techniques used in IoT.
	4	To provide knowledge of embedded IoT platforms such as Arduino and Raspberry Pi.
	5	To introduce embedded artificial intelligence concepts and their deployment.
	6	To study real-world IoT applications and system design methodologies.
Course Outcomes	After completition of this course Students will be able to ….	
	CO1	Understand basic concepts of embedded systems and IoT fundamentals
	CO2	Explain IoT architectures, communication models, and protocols.
	CO3	Analyze data collection, preprocessing, and analytics in IoT systems.
	CO4	Use embedded IoT platforms for sensor and actuator interfacing.
	CO5	Apply embedded AI concepts for intelligent IoT applications.
	CO6	Design and evaluate simple IoT-based systems for real-world applications.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1			1						
CO2	3	2		1	2						
CO3	2	3	1	2	2						
CO4	2	2	2	2	3						
CO5	2	3	2	2	3						
CO5	2	2	3	2	3	1	1	1			
CO6	2	2	3	2	3				1	1	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1	**Internet of Things (IoT) Essentials:** Introduction to IoT, Definition and Scope of IoT, Applications of IoT, Reference Architecture for IoT, IoT Devices and Peripherals, Models of Communication in IoT, IoT Communication Protocols, IoT Gateways and Data Acquisition, Challenges in Security with IoT	(4)
2	**Data Handling and Analytics in IoT :** Introduction, Lifecycle of Data in IoT, Data Preprocessing, 2.3 Cloud Platforms for IoT, Edge and Fog Computing, Big Data Analytics in IoT, Machine Learning for IoT, Data Security and Privacy	(5)
3	**Embedded Artificial Intelligence:** Introduction, Definition of Embedded Artificial Intelligence (EAI), Hardware Platforms of EAI, Software Frameworks of EAI, Algorithms of EAI, Deployment of EAI, Applications of EAI, Challenges and Opportunities.	(6)
4	**Embedded System Fundamentals:**Introduction, Introduction to Embedded Systems, Features of an Embedded System, Embedded System Design Process, Microcontroller / Architectures, Memory Organization and Interfacing, Embedded Software Development, Real-Time Operating Systems (RTOS)	(6)
5	**Embedded IoT Platforms:**Introduction, Arduino Platform, Raspberry Pi Platform, Other IoT Platforms, IoT Operating Systems, Middleware and Firmware Development, Cloud Connectivity in IoT, Case Studies	(8)
6	**IoT Applications and System Design:** Introduction, Smart Homes and Buildings, Smart Cities, Healthcare IoT, Industrial IoT (IIoT), Agricultural IoT, Transportation and Logistics, IoT System Design and Development, Future Trends in IoT.	(7)

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Embedded Artificial Intelligence: A Comprehensive Literature Review	Xiaoyuan Huang, Hongcheng Wang, Shiyin Qin, and Su-Kit Tang.	
02	Xiaoyuan Huang, Hongcheng Wang, Shiyin Qin, and Su-Kit Tang.	Aadhitya, S. V.	
03	Embedded Systems: Architecture, Programming and Design	Raj Kamal.	

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Internet of Things: Principles and Paradigms,	RajkumarBuyya and Amir VahidDastjerdi.	
02	Embedded Systems Design: An Introduction to Processes, Tools, and Techniques	Arnold S. Berger.	
03	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases,	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry.	
04	Data Analytics for Internet of Things,	Hongning Wang, Shoujin Wang, and Qing He.	

Year and Semester	Third Year B. Tech - Semester V–Artifitial Intelligence & Data Science				
Course Category	Programme Elective Course (PEC)				
Title of Course	Software Engineering and Testing			Course Code	AI&DS3104
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Objective	1	To expose the students to basic concepts & principles of software engineering.
	2	To make the student aware of the importance of SDLC in their project development work.
	3	To expose the students to software testing techniques and software quality management
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Students will be able to identify relevant software process model for software development.
	CO2	Students will be able to use appropriate principles of software modeling to create data design and prepare SRS document for aproject.
	CO3	Students will be able toplan and manage software projects using scheduling, staffing, risk management, and quality standards.
	CO4	Students will be able to design software systems using function-oriented and object-oriented design principles with appropriate metrics.
	CO5	Students will be able to apply different software testing types to ensure the quality of software product.
	CO6	Students will be able toidentify defect to improve the overall quality of the software using automated testing tools.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1						2	2
CO2	3	3	2	2	1						1
CO3	2	2	2	1	1				2	3	3
CO4	3	2	3	2	2					1	1
CO5	3	3	2	3	2				1		1
CO6	2	2	2	1	2	1		1		2	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units)**

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1	**The software Problem** Cost, Schedule & Quality, Scale and Change, **Software Processes:** Process & Project, Component Software Processes, SoftwareDevelopment process Models, Project Management Process.	(5)
2	**Software Requirements Analysis & specification** Value of Good SRS,Requirement Process, Requirements Specification, Other Approaches for Analysis, Validation	(4)
3	**Software Planning & Scheduling** Responsibilities of Software Project Manager,Project Planning, Project Scheduling, Project Staffing, People CMM, Risk Management	(5)
4	**Design** Design Concepts, Function Oriented Design, Object Oriented Design, Detail Design, Verification, Metrics	(6)
5	**Basics of Software Testing** Software testing, objective of testing, software testing life cycle (STLC), Failure, fault, error, defect, bug terminology, Test case, when to start and stop testing,Static and dynamic testing **Quality assurance, quality control andverification** - validation, Quality evaluation standards: Six sigma, CMMI levels **The box approaches:** Compare white boxtesting, black box testing	(8)

	Levels of testing: Unit testing, integrationtesting, system testing, acceptance testing	
6	**Test and Defect Management** **Test planning**: Preparing a test plan, **Test management:** Test infrastructure management, **Test reporting:** Executing test cases, preparingtest summary report **Defect Management:** Definition and types of defect, defect life cycle,defect template**,** Comparison of manual testing and automationtesting, **Metrics and measurement:** Types of metrics -product metrics and process metrics	(8)

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Software Engineering: A precise Approach**	**Pankaj Jalote**	**Wiley India**
02	**Software Engineering Principles & Practices**	**Rohit Khurana**	**Vikas Publishing House Pvt. Ltd.**
03	**Software Testing: Principles and Practices**	**Srinivasan Desikan, Gopalaswamy Ramesh**	**PEARSON Publisher: Pearson India 2007**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Software Engineering – Concepts & Practices**	**Ugrasen Suman**	**Cenage Learning**
02	**Software Engineering Fundamentals**	**Behforooz& Hudson**	**Oxford: Indian Edition1st**
03	**Software Testing**	**Ron Patton**	**Sams Publishing, 2nd edition**
04	**Software Testing: Principles, Techniques and Tools**	**M. G. Limaye**	**Tata McGraw Hill Education, New Delhi.,2009.**

Year and Semester	ThirdYear B. Tech - Semester V–Artificial Intelligence & Data Science				
Course Category	Programme Elective Course (PEC)				
Title of Course	Computer Vision			Course Code	AI&DS3104
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Basic knowledge of linear algebra, probability and statistics, Python programming, image processing fundamentals, and machine learning concepts.	
Course Objective	1	Introduce the fundamentals and applications of computer vision in real-world systems.
	2	Understand image formation, representation, and basic image processing techniques.
	3	Study feature extraction, image segmentation, and object detection methods.
	4	Analyse traditional computer vision algorithms and modern deep learning–based approaches.
	5	Develop the ability to design and implement computer vision solutions for practical problems.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Understand fundamental concepts and techniques in computer vision.
	CO2	Implement image processing algorithms for various applications.
	CO3	Apply feature extraction methods for object detection and recognition.
	CO4	Apply image segmentation and object detection techniques to identify and analyse objects in digital images.
	CO5	Analyse the performance of computer vision system
	CO6	Design deep learning models for image classification and object detection tasks.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1								
CO2	3	3	2	2	2						
CO3	3	3	2	2	2						
CO4	3	3	3	2	2						
CO5	2	3	2	3	2						
CO6	2	3	3	2	3						
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Computer Vision** **Human vision vs. computer vision, Applications of computer vision, Image formation and camera models, Image acquisition and representation, Basics of digital image processing**	**5Hrs.**
2	**Image Processing Fundamentals** **Image enhancement techniques, Spatial and frequency domain filtering, Edge detection (Sobel, Canny), Image smoothing and sharpening, Morphological operations**	**7 Hrs.**
3	**Feature Detection and Description** **Corner detection (Harris, FAST), Feature descriptors (SIFT, SURF, ORB), Feature matching techniques, Image registration and alignment**	**6 Hrs**
4	**Image Segmentation and Object Detection** **Thresholding techniques, Region-based segmentation, Contour detection, Traditional object detection methods, Introduction to CNN-based detectors.**	**6Hrs.**
5	**Motion Analysis and Tracking** **Optical flow, Background subtraction, Object tracking methods, Kalman and Particle filters, Video analytics applications**	**6Hrs.**
6	**Deep Learning for Computer Vision** **Convolutional Neural Networks (CNNs), Transfer learning, Object detection models (YOLO, SSD), Face recognition systems, Ethical issues in vision-based AI**	**6Hrs.**

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Digital Image Processing**	**Gonzalez R. C., Woods R. E**	**PHI, Second Edition**
02	**Digital Image Processing**	**Sonka Milan, Vaclav Hlavac,**	**Cengage Learning**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Computer Vision: Algorithms and Applications**	**Richard Szeliski**	**Springer, 2nd Edition**
02	**Computer Vision: A Modern Approach**	***David A. Forsyth, Jean Ponce***	**Pearson Education**
03	**Deep Learning for Computer Vision**	**Adrian Rosebrock**	**PyImage Search**

Year and Semester	**Third Year B. Tech - Semester V–Artificial Intelligence & Data Science**				
Course Category	**Multi-disciplinary Minor – 03**				
Title of Course	**Machine Learning**			**Course Code**	**AI&DS3105**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	03	**--**	**--**	**03**	**03**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite		
Course Objective	**1**	To introduce the fundamental concepts, terminology, and mathematical foundations of machine learning
	2	To develop an understanding of supervised, unsupervised, and reinforcement learning techniques
	3	To enable learners to design, implement, and evaluate machine learning models using real-world datasets
	4	To familiarize students with practical challenges in machine learning such as model selection, overfitting, and performance evaluation
Course Outcomes		
	CO1	Explain core machine learning concepts and algorithms with appropriate theoretical justification.
	CO2	Describe different types of machine learning techniques including supervised, unsupervised, and reinforcement learning.
	CO3	Apply suitable machine learning algorithms to solve classification and regression problems.
	CO4	Implement machine learning models using standard tools and programming frameworks.
	CO5	Evaluate machine learning models using appropriate performance metrics and validation techniques.
	CO6	Analyze model performance and make informed decisions to improve accuracy and generalization.

CO PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO6	**2**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Machine Learning** Introduction to Probability and Statistics, Machine Learning: Definition, Terminology, Types of learning, Machine Learning Problem categories, Machine learning architecture, process, Lifecycle, Performance measures, tools and framework, data visualization	6 Hrs.
2	**Regression** Simple regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression, examples, simple regression in matrix form.	6 Hrs.
3	**Classification- logistic regression & Naïve Bayes** Logistic Regression – Definition, Hypothesis representation, decision boundary, cost function, Conditional probability and Naïve Bayes Classifier. Instance-based classifier – K-Nearest Neighbor Classifier	7 Hrs
4	**Classification- Decision trees and Support Vector Machine: Decision trees** Definition, terminology, the need, advantages, and limitations. Constructing and understanding Decision trees, common problems with Decision trees, Decision tree algorithms, random forest, examples. Support Vector Machine: What is SVM, Kernel Trick	6 Hrs.
5	**Unsupervised learning** Clustering, K Means clustering, Hierarchical clustering, Association Rule mining	4 Hrs.
6	**Neural Network** Neural Networks- Neuron representation and model, Hypothesis for neuron, cost function, solution of a problem using single neuron. Gradient descent for a neuron. Neural network, Multiclass classification with neural network. Learning in neural network-back propagation algorithm	7 Hrs.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Machine Learning with Python	Abhishek Vijayvargia	New Delhi, India: BPB Publications
02	Practical Machine Learning	S. Gollapudi	U.K.: Packt Publishing Ltd
03	Machine Learning	T. M. Mitchell	McGraw-Hill Education

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Machine Learning for Dummies	J. P. Müller and S. Guido	Hoboken, NJ, USA: Wiley, 2016.
02	Introduction to Machine Learning	E. Alpaydin	E. Alpaydin

Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Programme Core Course (PCC)				
Title of Course	Machine Learning Lab			Course Code	AI&DS3107
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	1	--	01	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Pre-Requisite	Set Theory, Basic of AI.	
Course Objective	1	To familiarize students with Machine Learning tools, libraries, and development environments such as Anaconda, TensorFlow, and Keras.
	2	To enable students to implement and analyze supervised learning algorithms for regression and classification problems.
	3	To develop practical skills in applying instance-based, probabilistic, and tree-based learning techniques on real datasets.
	4	To provide hands-on experience in designing and training neural network models for classification tasks.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Set up a Machine Learning programming environment and use Python libraries for data preprocessing and visualization.
	CO2	Explain the working principles of Machine Learning algorithms used for regression and classification tasks.
	CO3	Implement regression and classification models such as Linear Regression, Logistic Regression, Naïve Bayes, KNN, Decision Trees, and SVM.
	CO4	Evaluate Machine Learning models using appropriate performance metrics and validation techniques.
	CO5	Analyze model performance and select suitable algorithms for given Machine Learning problems.
	CO6	Design, train, and test neural network models using Keras for real-world applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	3	-	-	-	-	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-
CO3	2	2	3	2	3	-	-	-	-	-	-
CO4	2	3	2	3	2	-	-	-	-	-	-
CO5	2	3	2	2	1	-	-	-	-	-	-
CO6	2	2	3	3	3	-	-	-	-	-	-

Marking Scheme
<u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u> **Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.**

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics.	
Exp. No.	**Title of Experiment/ Problem Statement**
1	Installation and configuration of Anaconda, TensorFlow, NumPy and Keras.
2	Use of Python basics for Machine Learning applications.
3	Implementation of Simple Linear Regression.
4	Implementation of Multiple Linear Regression.
5	Implementation of Binary classification using Logistic Regression.
6	Implementation of the Naïve Bayes Classifier.
7	Implementation of the K-Nearest Neighbor (KNN) Classifier.
8	Construction of Decision Tree and Random Forest models.
9	Implementation of Support Vector Machine (SVM) for classification.
10	Design and training of a Neural Network using Keras.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Deep Learning with Python**	**Vijayvargia**	**BPB Publicationsn. d. New Delhi, India**
02	**Practical Machine Learning**	**S. Gollapudi**	**U.K.:Packt Publishing Ltd., n.d.**
03	**Machine Learning,**	**T. M. Mitchell**	**1st ed. New York, NY, USA: McGraw-Hill Education, 1997.**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Machine Learning for Dummies**	**J. P. Müller and S. Guido**	**Hoboken, NJ, USA: Wiley, 2016.**
02	**Introduction to Machine Learning**	**E. Alpaydin**	**4th ed. Hoboken, NJ, USA: Wiley, 2020**

Year and Semester	Third Year B. Tech - Semester V - Artificial Intelligence and Data Science				
Course Category	Programme Core Course				
Title of Course	Java Programming Lab			Course Code	AI&DS3108
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	04	04	02
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	25	50	

Course Pre-Requisite	Fundamentals of C ++ Programming	
Course Objective	1	To introduce the concept of object-oriented programming using java.
	2	To learn how to implement reliable and secure application using exception handling and package concept.
	3	Have the ability to write program to perform file operations.
	4	To understand how to design components with java Swing API and present mechanism of multithreading.
	5	To familiarize database connectivity through JDBC and learn the collection framework.
Course Outcomes		
	CO1	Develop programs using Java fundamentals, classes, objects, methods, and arrays.
	CO2	Implement inheritance, interfaces, and polymorphism in Java applications.
	CO3	Apply exception handling and perform file input/output operations.
	CO4	Create GUI applications using Swing and implement multithreading.
	CO5	Utilize collections, packages, and JDBC for advanced Java programming.

CO PO Mapping

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

Level of Mapping as: Low 1, Moderate 2, High 3

Marking Scheme
<u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u> **Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.** **<u>End Semester Evaluation has 25 Marks</u>** **External Practical Examination with Performance and Oral Examination**

Guidelines for LabPerformance	
Faculty can create Experiment list based on following listed topics. **Minimum 15 Experiments should get performed.**	
Exp. No.	**Title of Experiment/ Problem Statement**
1.	Create a class called Employee that includes three pieces of information as instance variables- first name, a last name and a monthly salary. Your class should have a constructor that initializes the three instance variables. Provide a set and a get method for each instance variable. If the monthly salary is not positive, set it to 0.0. Write a test application named EmployeeTest that demonstrates class Employee's capabilities. Create two Employee objects and display each object's yearly salary. Then give each Employee a 10% raise and display each Employee's yearly salary again.
2.	Create class SavingsAccount. Use a static variable annualInterestRate to store the annual interest rate for all account holders. Each object of the class contains a private instance variable savingsBalance indicating the amount the saver currently has on deposit. Provide method calculateMonthlyInterest to calculate the monthly interest by multiplying the savingsBalance by annualInterestRate divided by 12 this interest should be added to savingsBalance. Provide a static method modifyInterestRate that sets the annualInterestRate to a new value. Write a program to test class SavingsAccount. Instantiate two savingsAccount objects, saver1 and saver2, with balances of Rs 2000.00 and Rs 3000.00, respectively. Set annualInterestRate to 4%, then calculate the monthly interest and print the new balances for both savers. Then set the annualInterestRate to 5%, calculate the next month's interest and print the new balances for both savers.
3.	Create Vehicle Interface with name, maxPassanger, and maxSpeed variables. Create LandVehicle and SeaVehicleInteface from Vehicle interface. LandVehicle has numWheels variable and drive method. SeaVehicle has displacement variable and launch method. Create Car class from LandVehicle, HoverCraft from LandVehicle and SeaVehicle interface. Also create Ship from SeaVehicle. Provide additional methods in HoverCraft as enterLand and enterSea. Similarly provide other methods for class Car and Ship. Demonstrate all classes in a

	application.
4.	Create abstract class Shape which has instance variables side, area and perimeter and methods calculateArea(), calculatePerimeter() as abstract methods and display() as concrete method. Write subclasses which extend Shape class like Triangle, Rectangle, Circle, Cube and Squere and override abstract methods and display methods in subclass take instance variable if needed as per the formula. And use parameterized constructor to initialize instance variables using "this" reference variable. Write Test class and Create a reference variable of Shape which will hold the objects of all the sub classes and calculate respective area, perimeter and display the results.
5.	Create the interface stack which has variable size, abstract methods push (), pop (), display (), overflow () and underflow (). We need to implement 3 subclasses IntegerStack, StringStack and Double Stack respectively by implementing interface. All the methods in interface are declared for string. And in subclass for integerStack convert string to integer. Same thing to all other. Create one test class and check for the working of all the classes.
6.	Develop a mathematical package for Statistical operations like Mean, Median, Average, Standard deviation. Create a sub package in the math package -convert. In "convert" package provide classes to convert decimal to octal, binary, hex and vice-versa. Develop application program to use this package, and build executable jar file of it.
7.	Develop application which can handle any 5 combination of predefined compile time and runtime exceptions using multiple catch blocks. Use throws and finally keywords as well.
8.	Create Employee and Manager classes. Demonstrate inheritance, method overriding, and use of super keyword.
9.	Develop a BankAccount class which should contain all methods of Bank i.e. balanceEnquery(), withdraw(), transfer() and deposit(). You should create at least two objects of BankAccount using array and do all operations mentioned above. Also generate user defined exception LowBalanceException, NegetiveNumberException and PasswordMismatchException whenever required. To transfer amount from one account to another use two BankAccount objects.
10.	Write a program to read a text file and copy its content to another file using byte and character streams.
11.	Take file name as input to your program through command line, if file exists then open and display contents of the file. After displaying contents of file ask user – 1. do you want to add the data at the end of file or 2. replace specified text in file by other text. Based on user's response, then accept data from user and append it to file. If file is not existing then create a fresh new file and store user data into it. User should type exit on new line to stop the program. Do this program using Character stream classes.
12.	Take Student information such as name, age, weight, height, city, phone from user and store it in the file using DataOutputStream and FileOutputStream and Retrieve data using DataInputStream and FileInputStream and display the result. Use Serialization concept and

	Bytestream classes.
13.	Develop a Swing GUI based standard calculator program. Use event handling, Layout of swing package.
14.	Create Stop Watch with Swing GUI and Multithreading. Provide Facility for Lap Counting.
15.	Create two threads: one prints numbers from 1 to 50, another prints even numbers. Demonstrate sleep(), join(), and synchronization.
16.	Write a program to read a text file one line at a time. Read each line as a String and place that String object into a LinkedList. Print all of the lines in the LinkedList in reverse order.
17.	Fill a HashMap with key-value pairs. Print the results to show ordering by hash code. Extract the pairs, sort by key, and place the result into a LinkedHashMap. Show that the insertion order is maintained.
18.	Write a GUI based program to create a student registration and Login. Store Registration data in Database and take Login information from Database.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Core Java- Volume I Fundamentals**	**Cay Horstmann and Gary Cornell**	**Pearson, Eight edition**
02	**Core Java- Volume II Advanced Features**	**Cay Horstmann and Gary Cornell**	**Pearson, Eight edition**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**JAVA-The Complete Reference**	**Herbert Schildt**	**McGraw Hill, Oracle Press**
02	**Head First Java**	**Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra**	**O'Reilly Publication**
03	**Head First Servlets and JSP**	**Bryan Basham, Kathy Sierra, Bert Bates**	**O'Reilly Publication**

Year and Semester	Third Year B. Tech - Semester V–Artifitial Intelligence & Data Science				
Course Category	Programme Elective Course (PEC)				
Title of Course	Data Science using R Lab			Course Code	AI&DS3109
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Objective	1	Introduce students to the R programming environment and fundamental syntax for data analysis.
	2	Enable students to perform data acquisition, cleaning, and preprocessing tasks on real-world datasets.
	3	Develop skills in exploratory data analysis and statistical interpretation.
Course Outcomes	**After competition of this course Students will be able to ….**	
	CO1	Use R and RStudio to execute basic programming and data handling operations.
	CO2	Import, clean, transform, and manage datasets for analysis.
	CO3	Perform exploratory data analysis using statistical measures and correlations.
	CO4	Create meaningful visualizations using appropriate R packages such as ggplot2.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3		2	2						
CO2	3		3	2	3					2	
CO3	2	3		3	2						
CO4	2			3	2						
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
<u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u> **Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.**

Guidelines for LabPerformance	
Faculty can create Experiment list based on following listed topics. **Minimum 10 to 12 Experiments should get performed.**	
Exp. No.	**Title of Experiment/ Problem Statement**
1	Installing R and R studio
2	Learn all basics of R programming(data types,variables,operators)
3	Implement R loops with different examples.
4	Learn the basic of functions in R and implement it with examples.
5	Write R program to convert given matrix into 1 D array,create a 3 D array of 24 elememts with dim() function.
6	To perform data cleaning and preprocessing by handling missing values, duplicates, and data transformation.
7	To visualize data using histograms, bar charts, boxplots, scatter plots, and ggplot2
8	To perform data manipulation using dplyr functions such as filter, select, arrange, group_by, and summarize.
9	To implement simple and multiple linear regression models and interpret the results.
10	To apply classification techniques such as logistic regression, k-NN, and decision trees.
11	To perform clustering using k-means and hierarchical clustering methods and analyze the clusters formed.
12	To perform time series analysis and forecasting OR develop a mini data science project using R.

Year and Semester	Third Year B. Tech - Semester V - Artificial Intelligence and Data Science				
Course Category	Programme Elective Course I (PEC)				
Title of Course	IOT Embedded Systems for AI			Course Code	AI&DS3109
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Pre-Requisite		
Course Objective	1	To understand the architecture and functional features of 8051 microcontroller and Arduino/ESP32 boards.
	2	To develop programs for basic input–output interfacing using microcontrollers.
	3	To interface sensors and output devices with Arduino and ESP32.
	4	To implement serial communication between microcontroller and computer.
	5	To design simple embedded applications using sensors and actuators.
	6	To implement IoT-based monitoring and remote control using Blynk platform.
Course Outcomes		
	CO1	Explain architecture, memory organization, and development tools of 8051, Arduino, and ESP32.
	CO2	Develop and execute programs for digital input–output interfacing.
	CO3	Interface analog sensors and analyze acquired data using ADC.
	CO4	Implement serial communication between microcontroller and computer system.
	CO5	Design and test simple embedded systems using sensors and actuators.
	CO6	Develop IoT-based applications for remote monitoring and control using ESP32 and Blynk.

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			1						
CO2	3	2	2		2						
CO3	2	3	2	1	2						
CO4	2	2	2	1	3						
CO5	2	2	3	2	3				1		
CO6	2	2	3	2	3	1			2	1	

Level of Mapping as: Low 1, Moderate 2, High 3

Marking Scheme
<u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u> **Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.**

Guidelines for LabPerformance	
Faculty can create Experiment list based on following listed topics.	
Exp. No.	**Title of Experiment/ Problem Statement**
1	Study of 8051 Microcontroller • Identify pins and functional blocks of the 8051 microcontroller. • Study internal architecture and memory organization. • Understand register set and special function registers. • Observe development tools used for 8051 programming.
2	Interfacing LED and Switch with 8051 • Connect LED and switch to appropriate I/O pins. •Write assembly/C program for input–output operation. •Compile and load the program into 8051. •Verify LED control using switch input.
3	Study of Arduino Board and IDE •Identify Arduino board components and pin configuration. •Install and configure Arduino IDE. •Write and upload a basic Arduino program. •Verify program execution using onboard LED.
4	Interfacing LED, Button, and Buzzer • Connect LED, button, and buzzer to Arduino pins. •Write program to read button input. •Control LED and buzzer based on input. •Observe output response on hardware.
5	Interfacing Analog Sensor with Arduino • Connect temperature/LDR sensor to analog input.

	•Read sensor values using ADC. •Display sensor data on serial monitor. •Analyze variation in readings.
6	Interfacing Output Devices with Arduino • Connect relay or DC motor using driver circuit. •Write program to control output device. •Upload program and test switching operation. •Observe safe operation of output device.
7	Serial Communication Using Arduino • Configure serial communication parameters. •Transmit data from Arduino to computer. •Receive data using serial monitor. •Verify proper data transmission.
8	Simple Embedded Application Using Arduino • Select sensor and actuator for application. •Interface hardware components. •Develop program logic for application. •Test and verify system operation.
9	Sensor Interfacing with ESP32 • Identify ESP32 GPIO and ADC pins. •Connect sensor to ESP32 board. •Write program to read sensor data. •Display readings on serial monitor.
10	Output Device Control Using ESP32 • Connect LED or relay to ESP32 GPIO. •Write control program for output device. •Upload code and test operation. •Verify correct response of output device.
11	Sending Sensor Data to Blynk • Create project and dashboard in Blynk app. • Configure ESP32 with Wi-Fi and Blynk credentials. • Send sensor data to Blynk cloud. • Visualize data on mobile dashboard.
12	Remote Device Control Using Blynk • Add control widgets in Blynk application.

	•Configure virtual pins for control. •Write ESP32 program for remote control. •Verify device operation through mobile app.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	The 8051 Microcontroller and Embedded Systems	Muhammad Ali Mazidi (Author), Janice G. Mazidi (Author), Rolin D. McKinlay (Author)	--
02	Arduino Cookbook, 3rd Edition	Michael Margolis, Brian Jepson, Nicholas Robert Weldin	--

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Programming Arduino Getting Started with Sketches. Second Edition	Simon Monk	--
02	Hands-on ESP32 with Arduino IDE: Unleash the power of IoT with ESP32 and build exciting projects with this practical guide	Asim Zulfiqar	--
03	Mastering ESP32 Practical Projects With IDE Programming	Furuta Kimiko	--

Year and Semester	Third Year B. Tech - Semester V–Artifitial Intelligence & Data Science				
Course Category	Programme Elective Course I (PEC)				
Title of Course	Software Engineering and Testing Lab			Course Code	AI&DS3109
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Objective	1	To expose the students to basic concepts & principles of software engineering.
	2	To make the student aware of the importance of SDLC in their project development work.
	3	To expose the students to software testing techniques and software quality management
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Students will be able to identify relevant software process model for software development.
	CO2	Students will be able to use appropriate principles of software modeling to create data design and prepare SRS document for aproject.
	CO3	Students will be able toplan and manage software projects using scheduling, staffing, risk management, and quality standards.
	CO4	Students will be able to design software systems using function-oriented and object-oriented design principles with appropriate metrics.
	CO5	Students will be able to apply different software testing types to ensure the quality of software product.
	CO6	Students will be able toidentify defect to improve the overall quality of the software using automated testing tools.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1						2	2
CO2	3	3	2	2	1						1
CO3	2	2	2	1	1				2	3	3
CO4	3	2	3	2	2					1	1
CO5	3	3	2	3	2				1		1
CO6	2	2	2	1	2	1		1		2	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
<u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u> **Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.**

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. **Minimum 10 to 12 Experiments should get performed.**	
Exp. No.	**Title of Experiment/ Problem Statement**
1	To study software problems related to cost, schedule, quality, scale, and change and understand their impact on software development.
2	To study software processes, process vs project, component-based software process, and software development process models such as Waterfall, Spiral, V-Model, and Agile.
3	To study project management processes, roles and responsibilities of the Software Project Manager, and project control activities.
4	To perform software requirements analysis and identify functional and non-functional requirements for a given system.
5	To prepare an SRS document, understand the value of good SRS, requirement process, validation, and specification standards.
6	To perform project planning, effort estimation, scheduling using Gantt/PERT charts, and project staffing strategies.
7	To identify project risks, perform risk analysis and mitigation, and study People Capability Maturity Model (People CMM).
8	To design a software system using Design Concepts, Function-Oriented Design, Object-Oriented Design, and detailed design techniques.
9	To study software testing fundamentals, objectives of testing, STLC, testing terminology (error, fault, defect, bug, failure), and test case design.
10	To perform and compare white box testing and black box testing approaches using a given software module.
11	To perform unit testing, integration testing, system testing, and acceptance testing on a sample application.
12	To prepare a test plan, execute test cases, generate test summary report, manage defects (defect life cycle & template), compare manual vs automation testing, and analyzeproduct and process metrics.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Software Engineering: A precise Approach**	**Pankaj Jalote**	**Wiley India**
02	**Software Engineering Principles & Practices**	**Rohit Khurana**	**Vikas Publishing House Pvt. Ltd.**
03	**Software Testing: Principles and Practices**	**Srinivasan Desikan, Gopalaswamy Ramesh**	**PEARSON Publisher: Pearson India 2007**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Software Engineering – Concepts & Practices**	**Ugrasen Suman**	**CenageLearning**
02	**Software Engineering Fundamentals**	**Behforooz & Hudson**	**Oxford: Indian Edition1st**
03	**Software Testing**	**Ron Patton**	**Sams Publishing, 2nd edition**
04	**Software Testing: Principles, Techniques and Tools**	**M. G. Limaye**	**Tata McGraw Hill Education, New Delhi.,2009.**

Year and Semester	Third Year B.Tech- Semester V- Artificial Intelligence & Data Science				
CourseCategory	Programme Elective Course I (PEC)				
Titleof Course	Computer Vision Lab			CourseCode	AI&DS3109
TeachingScheme	L	T	P	Contact Hrs./Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Pre-Requisite	Basic knowledge of linear algebra, probability and statistics, Python programming, image Processing fundamentals, and machine learning concepts.	
Course Objective	1	Introducethefundamentalsandapplicationsofcomputervisioninreal-world systems.
	2	Understandimageformation,representation,andbasicimageprocessing techniques.
	3	Study feature extraction, image segmentation, and object detection methods.
	4	Analysetraditionalcomputervisionalgorithmsandmoderndeeplearning–based approaches.
	5	Developtheabilitytodesignandimplementcomputervisionsolutionsfor Practical problems.
Course Outcomes	AftercompetitionofthiscourseStudentswillbeableto….	
	CO1	Implement image acquisition and basic image processing operations using OpenCV for computer vision applications.
	CO2	Apply image enhancement, filtering, edge detection, and corner detection Techniques to extract meaningful visual information.
	CO3	Perform feature extraction, feature matching, and image segmentation to Support object recognition tasks.
	CO4	Implement object detection and motion tracking systems using traditional Methods and pre-trained CNN models.
	CO5	Design and demonstrate a mini project that solves a real-world computer vision Problem using appropriate tools and techniques.

COPOMapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1		2						
CO2	3	3	2	2	2						
CO3	3	3	2	2	2						
CO4	3	3									
CO5	2	3	3	3	3				2	2	2
LevelofMappingas:Low1,Moderate2,High3											

MarkingScheme
In Semester Evaluation/Continuous Assessment has 25 Marks **Parameters for In Semester Evaluation could be: Attendance, Assignments, Experiments, oral, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.**

GuidelinesforLabPerformance	
Faculty can create Experiment list based on following listed topics. Minimum 10 to 12 Experiments should get performed.	
Exp.No.	**TitleofExperiment/ProblemStatement**
1	**Image acquisition and basic operations using OpenCV.**
2	**Image enhancement and filtering techniques.**
3	**Edge and corner detection implementation.**
4	**Feature extraction and matching.**
5	**Image segmentation techniques.**
6	**Object detection using pre-trained CNN models.**
7	**Motion detection and tracking.**
8	**Mini project on real-world vision application.**

Textbooks			
Sr.no.	**Title**	**Author**	**Edition/Publication**
01	**DigitalImageProcessing**	**GonzalezR. C., Woods R.E**	**PHI,SecondEdition**
02	**DigitalImageProcessing**	**Sonka Milan, Vaclav Hlavac,**	**CengageLearning**

ReferenceBooks			
Sr.no.	**Title**	**Author**	**Edition/Publication**
01	**ComputerVision:Algorithmsand Applications**	**Richard Szeliski**	**Springer, 2ndEdition**
02	**ComputerVision:AModernApproach**	**DavidA.Forsyth,Jean Ponce**	**PearsonEducation**
03	**DeepLearningforComputerVision**	**Adrian Rosebrock**	**Py Image Search**

Year and Semester	Third Year B. Tech - Semester V–Artificial Intelligence And Data Science				
Course Category	Multi-Disciplinary Minor-03 Lab				
Title of Course	Machine Learning Lab			Course Code	AI&DS3110
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	50	--	50	

Course Objective	1	To familiarize students with Machine Learning tools, libraries, and development environments such as Anaconda, TensorFlow, and Keras.
	2	To enable students to implement and analyze supervised learning algorithms for regression and classification problems.
	3	To develop practical skills in applying instance-based, probabilistic, and tree-based learning techniques on real datasets.
	4	To provide hands-on experience in designing and training neural network models for classification tasks
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Set up a Machine Learning programming environment and use Python libraries for data preprocessing and visualization.
	CO2	Implement and evaluate regression and classification models such as Linear Regression, Logistic Regression, Naïve Bayes, KNN, Decision Trees, and SVM.
	CO3	Analyze model performance and select appropriate algorithms for given Machine Learning problems.
	CO4	Design, train, and test neural network models using Keras for real-world applications.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1		3				1	1	
CO2	3	3	3	2	3				2	1	
CO3	2	3	2	3	2						
CO4	3	3	3	2	3	1		1	2	2	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. **Minimum 10 to 12 Experiments should get performed.**	
Exp. No.	**Title of Experiment/ Problem Statement**
1	Installation and configuration of Anaconda, TensorFlow, NumPy and Keras
2	Use of Python basics for Machine Learning applications
3	Implementation of Simple Linear Regression
4	Implementation of Multiple Linear Regression
5	Implementation of Binary classification using Logistic Regression
6	Implementation of the Naïve Bayes Classifier
7	Implementation of the K-Nearest Neighbor (KNN) Classifier
8	Construction of Decision Tree and Random Forest models
9	Implementation of Support Vector Machine (SVM) for classification
10	Design and training of a Neural Network using Keras

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Machine Learning with Python**	**Abhishek Vijayvargia**	**New Delhi, India: BPB Publications, n.d.**
02	**Practical Machine Learning.**	**S. Gollapudi**	**Birmingham, U.K.: Packt Publishing Ltd., n.d.**
03	**Machine learning**	**Mitchell, T. M. (1997)**	**McGraw-Hill.**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Machine Learning for Dummies**	**J. P. Müller and S. Guido**	**Hoboken, NJ, USA: Wiley, 2016.**
02	**Introduction to Machine Learning**	**E. Alpaydin**	**4th ed. Hoboken, NJ, USA: Wiley, 2020**

Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Experiential Learning (EL)				
Title of Course	Mini Project II			Course Code	AI&DS3111
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	25	50	

Course Pre-Requisite	Fundamentals of OOP, Python, Java.	
Course Objective	1	To identify the problem statement and objectives of the project by applying the knowledge of science and engineering and also by analysing existing systems.
	2	To build a design by using engineering principles and evaluating alternative solutions.
	3	To apply common, special and interdisciplinary knowledge and modern tools and techniques for system development keeping social, ethical and environmental aspects in view.
	4	To demonstrate inter-personal communication skills, team-work, leadership and project management qualities in carrying out the project work.
	5	To demonstrate the ability to communicate effectively through written and oral presentation with the help of appropriate tools and visual aids.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Understand, plan, and execute the project with team.
	CO2	To practice acquired knowledge within the chosen area of technology for project development.
	CO3	Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
	CO4	Communicate and report effectively project related activities and findings.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		3						3		
CO2					3						2
CO3		3				3					
CO4										3	
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations** • **ISE/CA will be evaluated based on different review presentations.**

	Details
	• **Platform: C++, Python, Java.** **Course Guidelines:** • Students can choose project based on industry defined problem or user defined problem which must emulate the real-life problems. • It is desirable that students should work on the project in group of 3 or 4 but not more than four. • After making the group, students must decide the title of the project and they will present to the department. Also, students will prepare the synopsis report of 4-5 pages and submit at the time of presentation. • At the end, students must submit the final report of the project and the format for the same will be given by the department. • The students will report to the respective guide/supervisor at every fortnight to discuss their progress. • The final evaluation of the project will be done based on the demonstration and presentation.

Project Assessment Rubrics:

CO	Rubric 1	Rubric 2	Rubric 3
CO1	Creativity and Originality in problem statement	Domain knowledge of the problem statement	Use of Resources
CO2	Study and analysis of methodology / approaches to solve the problem in hand	Developing effective design to solve the problem	Identification of alternative solutions to the problem
CO3	Problem solving ability by applying common, special and interdisciplinary engineering knowledge social, ethical and environmental aspects in view	Understanding and proper code development of project using modern tools and techniques	Testing of project modules
CO4	To demonstrate interpersonal communication skills, teamwork and leadership qualities for project management	Understanding and contribution in coding, Technical Contents in the report	Successfully completion of the changes suggested in code development, Preparation of genuine reports using modern tools

Year and Semester	**Third Year B. Tech - Semester VI–Artificial Intelligence & Data Science**				
Course Category	**Programme Core Course (PCC)**				
Title of Course	**Deep Learning**			**Course Code**	**AI&DS3201**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	03	**--**	**--**	**03**	**03**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite		
Course Objective	**1**	To provide foundational knowledge of Machine Learning and Deep Learning concepts, algorithms, and mathematical principles.
	2	To enable students to design and implement regression, classification, and neural network models using Python-based frameworks
	3	To develop the ability to analyze datasets, select appropriate learning techniques, and evaluate model performance
	4	To familiarize students with modern Machine Learning tools and libraries for real-world problem solving
Course Outcomes		
	CO1	Explain the fundamental concepts of Machine Learning and Deep Learning including supervised and unsupervised learning techniques.
	CO2	Describe neural network–based learning and its role in solving complex computational problems.
	CO3	Implement Machine Learning models such as regression and classification using Python.
	CO4	Develop and evaluate deep neural network models for data analysis and prediction tasks.
	CO5	Apply suitable Machine Learning algorithms and optimization techniques to solve real-world problems.
	CO6	Analyze results, interpret model performance, and communicate findings effectively in practical applications.

CO PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	-	-	1	-	-	-	-	-	-
CO2	2	2	1	-	1	-	-	-	-	-	-
CO3	2	2	3	2	3	-	-	-	-	-	-
CO4	2	2	3	3	2	-	-	-	-	-	-
CO5	2	3	3	2	2	-	-	-	-	-	-
CO6	-	1	-	2	-	-	-	-	-	-	-
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Neural Network and Deep Learning** Neural Network and Deep Learning Introduction to AI, ML and Deep Learning, A brief history, Need of Deep Learning, Basics of neural network, Data representation for neural network, Gradient based optimization, anatomy of neural network	6 Hrs.
2	**Introduction to Tensorflow , Keras and hyperparameters Tensorflow:** Introduction, Downloading and installation of Tensorflow, The computation graph, Modelling cyclic dependencies, Building and running visualization, Computing graph and distribution, Simple math operation and distribution, Tensors, Rank of tensors, Tensor math, Numpy and tensors, Tensorflow example, Keras: Introduction, Models, Layers, Prerocessing, Deep Learning case studies, Hyperparameters: Learning rate, No of iterations, hidden layers, hidden units, choice of activation function, momentum, mini batch size, Overfitting and underfitting, regularization	6 Hrs.
3	**Convolutional Neural Networks** The convolutional operation, The max pooling operation, Training a convnet from scratch on a small dataset, Using pre-trained convnet, Visualizing what convnet learn	7 Hrs
4	**Sequence Models** One hot encoding, Using word embeddings, A recurrent layer in Keras, Understanding the LSTM and GRU layers, Example of LSTM in Keras, Advanced use of Recurrent Neural Network	6 Hrs.
5	**Advanced Deep Learning Best Practices** Going beyond the sequential model: The Keras functional API, Inspecting and monitoring deeplearning models using Kerascallbacks and Tensor Board, Getting the most out of your models	4 Hrs.
6	**Generative Deep Learning** Text generation with LSTM, Deep Dream, Neural Style Transfer, Generating images with variational auto encoders, Introduction to generative adversarial network.	7 Hrs.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Deep learning with Python	Chollet, F. (2018).	Manning Publications
02	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Géron, A. (2019).	O'Reilly Media.
03	Machine learning	Mitchell, T. M. (1997)	McGraw-Hill.

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Deep learning	Goodfellow, I., Bengio, Y., &Courville, A. (2016)	MIT Press
02	Pattern recognition and machine learning	Bishop, C. M. (2006).	Springer
03	Machine learning: A probabilistic perspective	Murphy, K. P. (2012).	MIT Press.

Year and Semester	Third Year B. Tech - Semester VI – Artificial Intelligence & Data Science				
Course Category	Programme Core Course (PCC)				
Title of Course	Cloud Computing			Course Code	PCC- AI&DS3202
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	01	--	04	04
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Objective	1	To study fundamental concepts of cloud computing.
	2	To understand cloud computing architecture, reference models, characteristics, and migration approaches.
	3	To understand virtualization concepts, techniques, and their role in cloud computing.
	4	To learn various data storage methods on cloud.
	5	To understand industry cloud platforms and their applications across different domains.
	6	To study risk management in cloud computing.
Course Outcomes	After completion of this course Students will be able to ….	
	CO1	Define cloud computing and list its roots and basic terminology.
	CO2	Explain cloud architecture and apply basic cloud migration steps.
	CO3	Explain virtualization techniques and identify suitable virtualization platforms.
	CO4	Use appropriate data storage technique on Cloud, based on Cloud application
	CO5	Explain major cloud platforms and apply them to basic real-world applications.
	CO6	Explain cloud security risks and apply basic security principles in cloud environments.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	3	2	2		2						
CO3	3	2	2		3						
CO4	3	3	2	2	3						
CO5	3	3	3	2	3	1					
CO6	3	3	2	2	2	2	1	2			
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme

- **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %**
- **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).**
- **No compulsory passing for MSE.**
- **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1	**Introduction to Cloud Computing:** Introduction, Roots of Cloud Computing, Cloud Service Models, Cloud Deployment Models, Desired Features of a Cloud, Overview of computing paradigm: Recent trends in Computing -Grid Computing, Cluster Computing, Distributed Computing, Utility Computing.	(4)
2	**Cloud Computing Architecture:** Introduction, The cloud reference model - Architecture. **Move To Cloud Computing:** Pros and Cons of Cloud Computing, Nature of the Cloud, Technologies in Cloud Computing, Migrating into the Cloud, Nature of the Cloud, Technologies in Cloud Computing, Migrating into the Cloud, Seven-step Model.	(5)
3	**Virtualization:** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization. Technology Examples (Overview)- XEN, VMware and Microsoft Hyper-V.	(6)
4	**Data Storage:** Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage. Applications Utilizing Cloud Storage.	(6)
5	**Cloud Platforms in Industry: Amazon Web Services (AWS)**: Compute services, Storage services, Communication services, Additional services. **Microsoft Cloud Services:** Azure core concepts, SQL Azure, Windows Azure Platform Appliance. **Google App Engine**: Architecture and core concepts, Application life cycle, Cost model. **Cloud Computing Applications:** Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking,	(8)
6	**Security in Cloud Computing:** Risks in Cloud Computing: Introduction, Cloud impact, Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Current State, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.	(7)

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Mastering Cloud Computing**	**Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi**	**McGraw Hill Education**
02	**Cloud Computing: A Practical Approach for Learning and Implementation**	**A. Srinivasan, J. Suresh**	**Pearson**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Cloud Computing: Principles and Paradigms**	**Rajkumar Buyya, JamesBroberg, Andrzej Goscinski,**	**Wiley India**
02	**Cloud Computing Bible**	**Barrie Sosinsky**	**Wiley India**
03	**Cloud Security**	**Ronald Krutz,Russell Dean Vines**	**Wiley-India**

Year and Semester	Third Year B. Tech - Semester VI - Computer Science and Engineering				
Course Category	Programme Core Course (PCC)				
Title of Course	Database Management System			Course Code	AI&DS3203
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Set Theory, Operating System, Data Structures	
Course Objective	1	To understand fundamental concepts and algorithms of Database Systems.
	2	To gain familiarity with SQL and DBMS
	3	To learn database design techniques.
	4	To understand transactions, concurrency control, failures in database and appropriate recovery techniques.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Explain the fundamentals and components of DBMS.
	CO2	Design databases using Entity–Relationship modelling.
	CO3	Apply normalization techniques to improve database design.
	CO4	Write SQL queries to manage and retrieve data effectively.
	CO5	Apply transaction management and concurrency control techniques.
	CO6	Implement database recovery mechanisms for failure handling.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2									
CO2	2	3	2	1							
CO3	2	3	3	1	2						
CO4	2	2	3	2							
CO5	2	2	2	2							
CO6	2	2	2	2							
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**INTRODUCTION TO DATABASES** **Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users & Administrators, Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations.**	**6Hrs**
2	**E-R MODEL AND DATABASE DESIGN** **[E-R Model: Text Book 1] [Normalization: Text Book 2]** **E-R Model: The Entity-Relationship Model, Mapping Constraints, Keys, Entity-Relationship Diagrams, Reduction to Relational Schemas, Extended ER features-Specialization,Generalization, Aggregation.** **Normalization: Data Redundancies & Update Anomalies, Functional Dependencies. Canonical Cover, The Process of Normalization, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form**	**7Hrs**
3	**STRUCTURED QUERY LANGUAGE (SQL)** **Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Aggregate Functions, Nested sub Queries, Modification of Databases, Join expression, Views.**	**5Hrs**
4	**DATA STORAGE & INDEXING** **File Organization, Organization of records in File, Basic Concepts indexing & hashing, Ordered Indices, B+ Tree Index files, Multiple-Key Access, Static Hashing, Dynamic Hashing.**	**6Hrs**
5	**TRANSACTION MANAGEMENT** **Transaction Concept, A Simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols.**	**7 Hrs**

6	**RECOVERY SYSTEM**	**5 Hrs**
	Failure Classification, Storage, Recovery and Atomicity, **Recovery Algorithm, Failure with Loss of Nonvolatile Storage, Remote Backup Systems.**	

Textbooks

Sr. no.	Title	Author	Edition/Publication
01	Database System Concepts	A. Silberschatz, H.F. Korth, S. Sudarshan	McGraw Hill Education
02	Database Systems -A practical approach to Design, Implementation and Management	Thomos Connolly, Carolyn Begg	3rd Edition, Pearson Education

Reference Books

Sr. no.	Title	Author	Edition/Publication
01	Database Systems – Design, Implementation and Management	Rob & Coronel	5th Edition Thomson Course Technology
02	Fundamentals of Database Systems	RamezElmasri, Shamkant B. Navathe	4th Edition, Pearson Education

Year and Semester	**T. Y. B. Tech (Artificial Intelligence and Data Science) Sem –VI**				
Course Category	**Programme Elective Course II (PEC)**				
Title of Course	**AI in Robotics**			**Course Code**	**AI&DS3204**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	03	**--**	**--**	**03**	**03**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite	Basic understanding of any one programming language (C / C++ / Python), Engineering Mathematics (Basics), Data Structures (Introductory Level), Fundamentals of Artificial Intelligence	
Course Objective	**1**	Introduce basic concepts of robotics and artificial intelligence
	2	Understand robot motion, sensing, and perception
	3	Learn fundamental AI techniques used in robotics
	4	Familiarize students with applications of intelligent robotic systems
Course Outcomes	**After competition of this course Students will be able to ….**	
	CO1	Describe basic concepts of robotics and artificial intelligence
	CO2	Explain robot motion, kinematics, and sensors
	CO3	Apply basic AI techniques for simple robotic problems
	CO4	Identify applications and societal impact of AI-based robots
	CO5	Analyze intelligent control and learning methods in robotic systems.
	CO6	Identify applications, ethical, and societal aspects of AI in robotics.

CO PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**	**2**	**1**	**1**	**1**						**1**
CO2	**2**	**3**	**2**	**2**	**1**						**1**
CO3	**2**	**3**	**2**	**2**	**1**						**1**
CO4	**2**	**2**	**3**	**2**	**2**						**1**
CO5	**1**	**2**	**2**	**2**	**2**						**1**
CO6	1	1	1	2	1	2	2	2	1	1	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Robotics and Artificial Intelligence:** Introduction to robotics and its evolution, Types of robots and their applications, Basic components of a robot, Introduction to Artificial Intelligence, Intelligent agents, Role of AI in robotics	**4 Hrs**
2	**Robot Kinematics and Motion:** Coordinate systems in robotics Degrees of freedom, Forward and inverse kinematics (basic concepts), Types of robot motion, Introduction to trajectory planning	**5 Hrs**
3	**Sensors and Perception:** Introduction to sensors in robotics, Types of sensors: proximity, range, vision, force, Sensor data acquisition, Basic concept of robot perception, Introduction to vision-based sensing	**6 Hrs**
4	**Artificial Intelligence Techniques for Robotics:** Problem solving and search techniques, State space representation, Introduction to path planning, Basics of machine learning, Rule-based decision making	**8 Hrs**
5	**Intelligent Control and Learning:** Introduction to intelligent control, Basics of neural networks, Introduction to fuzzy logic, Basics of reinforcement learning, Learning behavior in robots	**6Hrs**
6	**Applications of AI in Robotics:** Industrial robots, Mobile and service robots, Healthcare and assistive robots, Drones and autonomous systems, Ethical and safety issues in robotics	**7Hrs**

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig :	4th Edition, Pearson / Prentice Hall
02	Introduction to Robotics: Mechanics and Control	John J. Craig	3rd Edition, Pearson / Prentice Hall

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Introduction to Robotics	Saeed B. Niku	3rd Edition**,** John Wiley & Sons
02	Probabilistic Robotics	SebastianThrun, Wolfram Burgard & Dieter Fox	First Edition, The MIT Press
03	Reinforcement Learning: An Introduction	Richard Sutton & Andrew Barto	The MIT Press

Year and Semester	**Third Year B. Tech - Semester VI–Artificial Intelligence and Data Science**				
Course Category	**Programme Elective Course II (PEC)**				
Title of Course	**Cryptography & Network Security**			**Course Code**	**AI&DS3204**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	03	**--**	**--**	**03**	**03**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite		
Course Objective	**1**	**To introduce the principles of Crypto-Systems**
	2	**To expose students to various security services and mechanisms used.**
	3	**To make the students aware of the security features of PGP, S/MIME, Digital Signatures, IPSec& SSL.**
	4	**To make the students understand the system level security issues concerning threats, intruders and use of firewalls and trusted systems.**
	5	**To make students to explore non-cryptographic and software vulnerabilities**
Course Outcomes	**After competition of this course Students will be able to ….**	
	CO1	**Understand principles of Crypto-systems.**
	CO2	**Compare and analyze various security services and mechanisms**
	CO3	**Apply and use the features of PGP, S/MIME, DSA, IPSec, SSL in their profession**
	CO4	**Take precautions of their personal computing system from possible threats and attacks.**
	CO5	**Explore newer vulnerabilities and provide the solutions to them.**

CO PO Mapping												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	–	–	–	2	–	–	–	2
CO2	3	3	2	2	2	–	–	2	–	–	–	2
CO3	3	3	3	2	2	–	–	2	1	–	–	2
CO4	3	2	3	2	3	1	–	2	1	1	–	2
CO5	3	3	2	2	2	2	1	3	1	1	–	3
Level of Mapping as: Low 1, Moderate 2, High 3												

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1	**Security Concepts:** Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security **Cryptography Concepts and Techniques**: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.	(7)
2	**Symmetric Ciphers key:** Block Cipher principles, DES, AES, Block cipher operation, Stream ciphers, **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Knapsack Algorithm.	(7)
3	**Message Authentication and Hash Functions** **Cryptographic Hash Functions**: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure	(7)
4	**Electronic mail and IP Security** Email, IP and Web Security PGP, S/MIME, IPSec Architecture, Authentication Header, ESP, Combining Security Association, Key Management, Web Security Consideration, SSL and TLS, Secure Electronic Transaction (SET).	(6)
5	**Web and System Security** System Security Intruders , Intrusion Detection, Virus and Worms, Virus Counter-Measures, DDOS attack, DOS and DDOS attack, Firewall Design Principles, Trusted Systems).	(5)
6	**Non-Cryptographic Protocol Vulnerabilities** Session Hijacking and Spoofing, Pharming attacks. Software Vulnerabilities - Phishing, Buffer Overflow, Format String attacks, SQL Injection.	(4)

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Cryptography and Network Security – Principles and Practice	William Stallings	Pearson Education 6th Edition
02	Cryptography and Network Security	Atul Kahate	McGraw Hill
Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Cryptography and Network Security	C. K. Shyamala, N. Harini, Dr. T. R. Padmanabhan	Wiley India
02	Cryptography and Network Security	Behrouz A. Forouzan, Debdeep Mukhopadhyay	McGraw Hill
03	Information Security: Principles and Practice	Mark Stamp	Wiley India
04	Principles of Computer Security	Wm. Arthur Conklin, Greg White	TMH (Tata McGraw-Hill)
05	Introduction to Network Security	Neal Krawetz	Cengage Learning
06	Network Security and Cryptography	Bernard Menezes	Cengage Learning

Year and Semester	ThirdYear B. Tech - Semester VI–Artificial Intelligence & Data Science				
Course Category	Programme Elective Course II (PEC)				
Title of Course	Business Intelligence System			Course Code	AI&DS3204
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Databases, SQL, data structures, and statistics, with fundamentals ofprogramming and data analysis.	
Course Objective	1	Understand the fundamentals of Business Intelligence, BI lifecycle, and data quality issues in organizational contexts.
	2	Apply BI architectures, KPIs, and analytics techniques to support effective business decision-making.
	3	Analyze organizational performance using dashboards, scorecards, and advanced BI tools.
	4	Design and implement data warehouse architectures and ETL processes for large-scale data integration.
	5	Model multidimensional data and perform OLAP operations to extract meaningful business insights.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Explain basic concepts of Business Intelligence, BI life cycle, and data quality issues.
	CO2	Apply BI implementation strategies, KPIs, and business analytics techniques for decision-making.
	CO3	Analyse business performance using dashboards, scorecards, and advanced BI tools.
	CO4	Design data warehouse architecture and implement ETL processes.
	CO5	Model multidimensional data and perform OLAP analysis.
	CO6	Apply business analytics and data mining techniques to generate business insights.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	2	3	2		2						
CO3	2	3	2	2	2						
CO4	2	3	3	2	3						
CO5	2	3	3	2	3						
CO6	2	3	3	3	3						
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme

- **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %**
- **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).**
- **No compulsory passing for MSE.**
- **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	Introduction to Business Intelligence Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics, BI Life Cycle. Data for BI – Data Issues and Data Quality for BI.	5Hrs.
2	BI Implementation Key Drivers, Key Performance Indicators and operational metrics, BI Architecture/Framework, Best Practices, Business Decision Making. Business Analytics: Objective Curve, Web Analytics and Web Intelligence, Customer Relationship Management.	7 Hrs.
3	Business/Corporate Performance Management Dash Boards and Scorecards, Business Activity Monitoring, Six Sigma. Advanced BI: Big Data and BI, Social Networks, Mobile BI, emerging trends. Working with BI Tools: Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse design, implementation, and utilization.	6 Hrs
4	Data Warehousing	6Hrs.

	Data Warehousing (DW): Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery. ETL: Data Extraction, Data Transformation – Conditioning, Scrubbing, Merging, etc., Data Loading, Data Staging, Data Quality.	
5	Dimensional modeling& OLAP Dimensional Modeling: Facts, dimensions, measures, examples; Schema Design – Star and Snowflake, Fact constellation, slow changing Dimensions. OLAP: OLAP Vs OLTP, Multi-Dimensional Databases (MDD); OLAP – ROLAP, MOLAP, HOLAP	6Hrs.
6	Business Analytics and Data Mining Descriptive, diagnostic, predictive, and prescriptive analytics, Data mining concepts and tasks, Classification, clustering, and association rules, Time series analysis, Introduction to predictive analytics, Role of machine learning in BI, BI and Big Data analytics	6Hrs.

Textbooks

Sr. no.	Title	Author	Edition/Publication
01	Decision Support and Business Intelligence Systems	Efraim Turban, Ramesh Sharda, Jay Aronson, David King	9th/Pearson Education,
02	Business Intelligence, Analytics, Data Science and AI – A Managerial Perspective	Ramesh Sharda, DursunDelen and Efraim Turban	5th edition, Global Edition / Pearson Education Limited

Reference Books

Sr. no.	Title	Author	Edition/Publication
01	Business Intelligence	David Loshin,	The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers
02	Business Intelligence Strategy and Big Data Analytics - A General Management Perspective	Steve Williams	Morgan Kaufmann (Elsevier)
03	Data Analytics and Business Intelligence - Computational Frameworks, Practices, and Applications,	Vincent Charles, PratibhaGarg, Neha Gupta and Mohini Agarwal	CRC Press

Year and Semester	Third Year B. Tech - Semester VI - Artificial Intelligence and Data Science				
Course Category	Programme Elective Course II (PEC)				
Title of Course	E-commerce and Digital Marketing			Course Code	AI&DS3204
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Fundamentals of C Programming	
Course Objective	1	To get the knowledge about business advantages of the e-commerce and digital marketing and its importance
	2	To develop a digital marketing plan and to make SWOT analysis
	3	To get introduced with various digital channels, business tools in social networking
	4	To understand the optimization of a Web site and SEO optimization
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	To explain the fundamentals of E-Commerce including features, categories, environmental factors, impact, trends, and comparison with traditional commerce.
	CO2	To analyze B2C and B2B business models, process variants, pricing, payment, fulfillment challenges, CRM, and related software systems.
	CO3	To evaluate ethical, social, political, and security issues in E-Commerce including cyber threats, encryption, firewalls, and proxy servers.
	CO4	To explain digital marketing concepts, digital marketing strategy development, multichannel marketing, and relationship marketing.
	CO5	To apply digital marketing tools and techniques including SEO/SEM, email marketing, social media marketing, mobile marketing, and online PR.
	CO6	To develop structured digital marketing strategies and implementation plans for business applications.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1		2					
CO2	3	3	2	2	2	1			1		2
CO3	2	2	1	1	2	2		3			
CO4	3	2	2	1	2	1				2	1
CO5	2	3	3	2	3	1			2	3	1
CO6	2	3	3	2	2	1			2	2	3
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).** • **In Semester Evaluation/ Continuous Assessment has 10 Marks**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to E-commerce** **Ecommerce**: Meaning, Features of E-commerce, Categories of E-commerce, Advantages & Limitations of E-Commerce, Traditional Commerce & E-Commerce **Ecommerce Environmental Factors:** Economic, Technological, Legal , Cultural & Social **Impact :**E-Commerce on Business, Ecommerce in India **Trends :**E-Commerce in Various Sectors: Retail, Banking, Tourism, Government, Education	5 Hrs
2	**B2C Business, B2B Business** **B2C Business:** The process model and its variants, The pricing challenge, The fulfillment challenge, The payment challenge, B2C- business and CRM, B2C software systems **B2B business:** The process model and its variants, B2B software systems	5 Hrs
3	**Issues and Security in E Commerce** **Issues:** Understanding Ethical, Social and Political issues in E-Commerce: A model for Organizing the issues, Basic Ethical Concepts **Security:** Threats in Computer Systems: Virus, Cyber Crime Network Security: Encryption, Protecting Web server with a Firewall, Firewall and the Security Policy, Network Firewalls and Application Firewalls, Proxy Server.	6 Hrs
4	**Introduction to Digital Marketing** How digital technologies transformed marketing? **Definitions-** digital marketing and multichannel marketing **Digital marketing strategy-**key features of digital marketing strategy, applications of digital marketing, benefits of digital marketing, difference between e-commerce and e-business, challenges in developing and managing digital marketing strategy.	7 Hrs
5	**Digital Marketing Strategy and relationship marketing** **Digital Marketing strategy development:** how to structure digital marketing strategy, strategy implementation **Relationship marketing using digital platforms:** Introduction, the challenge of customer engagement, customer lifecycle management.	6 Hrs

6	**Marketing Communications**	**7 Hrs**
	Marketing Communications using digital media channels: Introduction, search engine marketing, online public relations, e-mail marketing and mobile text messaging, social media and viral marketing, offline promotion techniques.	

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Introduction to E-commerce: Combining Business & Information Technology**	**Martin Kutz**	**1st Edition (2016) & bookboon.com**
02	**Digital Marketing: Strategy, Implementation and Practice**	**Dave Chaffey, Fiona Ellis-Chadwik**	**6th Edition, Pearson Education**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**The Beginner's Guide to Digital Marketing. Digital Marketer**	**Pulizzi, J.**	**Epic Content Marketing, McGraw Hill Education (2014)**
02	**Electronic Commerce**	**Jeffrey F Rayport and Bharat Bhasker**	**Tata McGraw Hill**

Year and Semester	Third Year B. Tech - Semester VI–Artificial Intelligence and Data Science				
Course Category	Programme Elective Course III (PEC)				
Title of Course	Data Science Optimization Techniques			Course Code	AI&DS3205
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite		
Course Objective	1	To understand the fundamentals of optimization techniques in data science.
	2	To study classical and modern optimization methods.
	3	To apply optimization algorithms in machine learning and AI problems.
	4	To analyze optimization challenges in large-scale data-driven systems.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Students will be able to explain various optimization problems and solution strategies.
	CO2	Students will be able to apply classical optimization techniques to real-world problems.
	CO3	Students will be able to implement gradient-based and heuristic optimization algorithms.
	CO4	Students will be able to use optimization techniques in machine learning and deep learning models.
	CO5	Students will be able to analyze recent trends in data science optimization.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	1	-	-
CO2	3	2	-	1	-	-	-	-	1	-	-
CO3	3	2	1	1	-	-	-	-	1	-	1
CO4	2	2	-	1	-	-	-	-	1	-	1
CO5	2	1	-	-	-	2	-	-	1	-	-
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Optimization** Definition and importance of optimization, Role of optimization in data science and AI, Types of optimization problems, Objective functions and constraints, Convex	**6 Hrs**
2	**Classical Optimization Techniques** Linear programming problems, Graphical method, Simplex method, Duality theory, Sensitivity analysis, Integer programming, Nonlinear programming basics	**6 Hrs**
3	**Gradient-Based Optimization Methods** Unconstrained optimization, Gradient descent algorithm, Stochastic and mini-batch gradient descent, Newton and quasi-Newton methods, Convergence analysis	**6 Hrs**
4	**Heuristic and Metaheuristic Optimization** Genetic algorithms, Particle swarm optimization, Simulated annealing, Ant colony optimization, Comparison of metaheuristic techniques	**6 Hrs**
5	**Optimization in Machine Learning** Loss functions and optimization, Regularization techniques, Optimization in neural networks, Backpropagation algorithm, Hyperparameter tuning	**6 Hrs**
6	**Advanced Optimization Techniques** Evolutionary optimization strategies, Bayesian optimization, Multi-objective optimization, Distributed and parallel optimization, Recent research trends	**6 Hrs**

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Convex Optimization,	S. Boyd and L. Vanden berghe	Cambridge University Press.
02	Numerical Optimization	J. Nocedal and S. Wright	Springer.

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Optimization for Engineering Design	Kalyanmoy Deb,	PHI Learning.
02	Nonlinear Optimization	Andrzej Ruszczynski	Princeton University Press.

Year and Semester	Third Year B. Tech - Semester VI –Artificial Intelligence and Data Science				
Course Category	Programme Elective Course III (PEC)				
Title of Course	Blockchain Technology			Course Code	AI&DS3205
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Expertise in Programming, Basic Knowledge of Computer Security, Cryptography, Networking, Concurrent or Parallel Programing	
Course Objective	1	Understand how blockchain systems (mainly Bitcoin and Ethereum) work.
	2	To securely interact with bitcoin and ethereum
	3	Design, build, and deploy smart contracts and distributed applications
	4	Integrate ideas from blockchain technology into their own projects
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Interpreted the fundamentals of distributed database and cryptography
	CO2	Explain blockchain system with design principles.
	CO3	Analyse the concept of consensus with reference to distributed consensus
	CO4	To develop smart contracts DAO.
	CO5	Discuss legal aspect of crypto currency exchange
	CO6	To develop distributed applications for different scenarios.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	2			1		1	1		
CO2	1	2		2		1	2	1	1	2	
CO3	1	2	2	2		1	2				2
CO4	1	2	2		3	1	2				
CO5	1	2		2		1		3			2
CO6	1	2	2	2	2			1		2	
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction :** Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete, Cryptography: Hash function, Digital Signature – ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	**5 Hrs**
2	**Blockchain :** Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain	**7Hrs**
3	**Distributed Consensus:** Nakamoto Consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy Utilization and alternate.	**6 Hrs**
4	**Cryptocurrency :** History, Distributed Ledger, Bitcoin Protocols – Mining strategy and rewards, Ethereum – Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin	**7Hrs**
5	**Cryptocurrency Regulation :** Stakeholders, Roots of bitcoin, Legal Aspects – Crypto currency Exchange, Black Market and Global Economy.	**6Hrs**
6	**Cryptocurrency Applications :** Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain	**5Hrs**

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Bitcoin and Cryptocurrency Technologies : A Comprehensive Introduction**	**Arvind Narayanan, Joseph Bonneau Edward Felten, Andrew Miller and Steven Goldfeder**	**Pinceton University Press (July 19, 2016)**
02	**Quantum Computing: A Gentle Introduction**	**Eleanor Rieffel& Wolfgang Polak**	**MIT Press**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**'Blockchain Technology : Cryptocurrency and Applications**	**S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan**	**Oxford University press 2019**
02	**Blockchain : The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming**	**Josh Thompson**	**Create Space Independent Publishing Platform, 201**

Year and Semester	Third Year B. Tech - Semester VI–Artificial Intelligence and Data Science				
Course Category	Programme Elective Course III (PEC)				
Title of Course	Quantum computing			Course Code	AI&DS3205
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite		
Course Objective	1	To introduce the fundamental concepts of Quantum computing
	2	To develop understanding of the mathematical foundations required for quantum computing
	3	To explain the physical realization of qubits
	4	To familiarize students with Quantum algorithms
	5	To provide conceptual knowledge of quantum computing applications in AI and data science
	6	To enable students to apply basic quantum programming skills using Qiskit
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Describe the principles of quantum computing
	CO2	Explain and use mathematical concepts with respect to Quantum states
	CO3	Interpret qubit behaviour and analyse the operation of common quantum gates and measurements
	CO4	Explain the working of basic quantum algorithms
	CO5	Illustrate the role of quantum computing in AI and data science applications
	CO6	Construct and execute simple quantum circuits and algorithms using python and Qiskit

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	2
CO2	3	2	-	1	-	-	-	-	-	-	2
CO3	3	2	1	1	-	-	-	-	-	-	2
CO4	2	2	-	1	-	-	-	-	-	-	2
CO5	2	1	-	-	-	2	-	-	-	-	3
CO6	2	2	2	1	3	-	-	-	1	-	2
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Introduction to Quantum Computing** Introduction and overview of quantum computing, Motivation and need for quantum computing,Global Perspective, Qubit vs. classical bit, Quantum Computing Systems & Architecture, Applications: cryptography, optimization, AI, data science	**5 Hrs**
2	**Mathematical Foundations for Quantum Computing** Basics of complex numbers, vector spaces and linear algebra relevant to quantum computing,Quantum Mechanics Essentials: Fundamental principles of quantum mechanics as applied in quantum computing (State Vector, Hilbert Space, Dirac Notations, Inner Product, Tensor Product, Linear Operators, Observable & Hermitian Operators, Eigenvalues and Eigenstates, Unitary Evolution / Schrödinger Equation, No-Cloning Theorem, Quantum Interference),	**7Hrs**
3	**Qubits and Quantum Gates** Physical realization of qubits, Bloch sphere representation, Single-qubit gates: Pauli-X, Y, Z, Hadamard, Phase gates, multi-qubit systems, Controlled gates: CNOT, Toffoli, Measurement and state collapse	**6 Hrs**
4	**Quantum Circuits and Algorithms** Quantum circuit model, Superposition and entanglement, Quantum parallelism, Basic quantum algorithms: Deutsch–Jozsa Algorithm, Grover's Search Algorithm, Quantum Teleportation (conceptual understanding), Comparison of quantum and classical algorithms	**7Hrs**
5	**Quantum Computing for AI and Data Science** Quantum machine learning: overview, Quantum data encoding techniques, Variational quantum circuits, Quantum optimization algorithms (introductory QAOA), Quantum neural networks (conceptual), Challenges and limitations of quantum AI	**6 Hrs**
6	**Introduction to Quantum Programming**	**5Hrs**

	Quantum simulators and real quantum hardware, Introduction to Qiskit, creating quantum circuits using Python, Implementing simple quantum algorithms, Execution and result analysis	

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Quantum Computation and Quantum Information**	**Nielsen, M. A., & Chuang, I. L.**	**Cambridge University Press.**
02	**Quantum Computing: A Gentle Introduction**	**Eleanor Rieffel & Wolfgang Polak**	**MIT Press**

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	**Quantum Computing for Everyone**	**Chris Bernhardt**	**MIT Press**
02	**Quantum Computing by Practice: Python Programming in the Cloud with Qiskit and IBM-Q**	**Vladimir Silva**	**Apress**

Year and Semester	Third Year B. Tech - Semester VI –Artificial Intelligence and Data Science				
Course Category	Programme Elective Course III (PEC)				
Title of Course	Information Retrieval			Course Code	AI&DS3205
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite		
Course Objective	**1**	To explain the fundamental concepts, processes, and techniques involved in information retrieval, including indexing, classification, and clustering.
	2	To describe file structures and classical information retrieval models used for efficient storage and retrieval of data.
	3	To Introduce performance evaluation measures and user interaction concepts in information retrieval systems.
	4	To explain the architecture, components, and standards of online information retrieval systems and digital libraries.
	5	To describe multimedia information retrieval models, data representations, and indexing techniques.
	6	To explain web search mechanisms and distributed architectures used in large-scale information retrieval systems.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Analyze indexing, term-weighting, and clustering algorithms to organize and retrieve textual information effectively.
	CO2	Compare and apply Boolean, Vector, and Fuzzy IR models along with appropriate search strategies.
	CO3	Evaluate IR systems using precision, recall, TREC collections, and usability principles.
	CO4	Analyze digital library architectures and document representation techniques for information access.
	CO5	Apply multimedia indexing and feature extraction techniques for effective searching of multimedia data.
	CO6	Analyze web search engines and distributed IR techniques for scalable query processing.

CO PO Mapping											
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	2	2	2	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-
CO3	2	3	2	3	2	-	-	1	-	1	-
CO4	3	2	2	2	2	2	1	-	-	-	-
CO5	3	3	2	2	3	-	-	-	-	-	-
CO6	3	3	2	2	3	2	-	1	1	1	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 % • Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units). • No compulsory passing for MSE. • ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).

Unit No.	Title and Content of Unit	Hours
1	**Fundamentals of Information Retrieval and Automatic Text Processing** Basic Concepts of IR, Data Retrival and Information Retrieval, IR system block diagram. Automatic Text Analysis. Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighing, Probabilistic Indexing. Automatic Classification Measures of Assocition, Different Matching Coefficient, Classification Methods, Cluster Hypothesis. Clustering Algorithms, Single Link Algorithm, Rochhio's Algorithm and Dendograms.	**7**
2	**File Structures, Indexing Techniques, and Information Retrieval Models** File Structures, Inverted file, suffix trees and suffix arrays, Signature files, Ring Structure IR Models, Basic concepts, Boolean Model, Vector Model, Fuzzy set Model. Search Strategies-Boolean search , cluster based retrieval, Matching Function. XML Data Model, X Query, Evalution of XML Queries.	**6**
3	**Information Access Process, Query Formulation and IR Evaluation Techniques**	**6**

	Performance Evaluation-precision and recall , alternative measures reference collection (TREC Collection) Users Interface and visualization. HCI Concepts, Information access process, starting point, query specification.	
4	**Digital Libraries and Bibliographic Information Systems**	5
	Libraries and Bibliographical system- Online IR system, OPACs, Digital libraries- Architecture issues, document models, representation and access prototypes, projects and interfaces, standards.	
5	**Multimedia Information Retrieval Models and Indexing Techniques**	**6**
	Multimedia IR models and languages- data modeling, query languages. Indexing and searching – generic multimedia indexing approach, one dimensional time series , two dimensional color images, automatic features extraction.	
6	**Web Search and Distributed Information Retrieval Systems**	**6**
	Searching the Web, Challenges, Characterizing the web, search Engines, Browsing, Meta searchers. Parallel IR- MIMD Architectures. Distibuted IR- Collection Partitioning , Source Selection, Query Processing.	

Textbooks

Sr. no.	Title	Author	Edition/Publication
01	Modern Information Retrieval	Yates & Neto	Pearson education
02	Information Retrieval	C.J.Rijsbergen	-

Reference Books

Sr. no.	Title	Author	Edition/Publication
01	Database Management System	Ramkrishan	Mcgraw-Hill Publication
02	Proceeding of International Symposium on machine translation NLP & TSS	-	-

Year and Semester	**Third Year B. Tech - Semester VI–Artificial Intelligence & Data Science**				
Course Category	**Multi-disciplinary Minor – 04**				
Title of Course	**Deep Learning**			**Course Code**	**AI&DS3206**
Teaching Scheme	**L**	**T**	**P**	**Contact Hrs/Week**	**Credits**
	02	**--**	**--**	**02**	**02**
Examination Scheme	**MSE**	**ISE/CA**	**ESE**	**Total**	
	30	**10**	**60**	**100**	

Course Pre-Requisite		
Course Objective	**1**	**To provide foundational knowledge of Machine Learning and Deep Learning concepts, algorithms, and mathematical principles**
	2	**To enable students to design and implement regression, classification, and neural network models using Python-based frameworks.**
	3	**To develop the ability to analyze datasets, select appropriate learning techniques, and evaluate model performance**
	4	**To familiarize students with modern Machine Learning tools and libraries for real-world problem solving**
Course Outcomes		
	CO1	**Explain core concepts of Machine Learning and Deep Learning including supervised, unsupervised, and neural network–based learning.**
	CO2	**Understand the working principles of Machine Learning algorithms used for regression and classification tasks.**
	CO3	**Implement Machine Learning models such as regression, classification, and deep neural networks using Python.**
	CO4	**Apply suitable algorithms and optimization techniques to solve real-world data analysis and prediction problems.**
	CO5	**Analyze and interpret the performance of Machine Learning models using appropriate evaluation metrics.**
	CO6	**Communicate results and findings of Machine Learning applications effectively in practical scenarios.**

CO PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	-	-	1	-	-	-	-	-	-
CO2	3	2	1	-	1	-	-	-	-	-	-
CO3	2	2	3	2	3	-	-	-	-	-	-
CO4	2	3	3	2	2	-	-	-	-	-	-
CO5	2	3	2	3	2	1	-	-	-	-	-
CO6	-	1	-	1	-	3	-	-		-	-
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 %** • **Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units).** • **No compulsory passing for MSE.** • **ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).**

Unit No.	Title and Content of Unit	Hours
1	**Neural Network and Deep Learning** Neural Network and Deep Learning Introduction to AI, ML and Deep Learning, A brief history, Need of Deep Learning, Basics of neural network, Data representation for neural network, Gradient based optimization, anatomy of neural network	6Hrs.
2	**Introduction to Tensorflow, Keras and hyperparameters Tensorflow:** Introduction, Downloading and installation of Tensorflow, The computation graph, Modelling cyclic dependencies, Building and running visualization, Computing graph and distribution, Simple math operation and distribution, Tensors, Rank of tensors, Tensor math, Numpy and tensors, Tensorflow example	6 Hrs.
3	**Keras** Introduction, Models, Layers, Prerocessing, Deep Learning case studies, Hyperparameters: Learning rate, No of iterations, hidden layers, hidden units, choice of activation function, momentum, mini batch size, Overfitting and underfitting , regularization	6 Hrs
4	**Convolutional Neural Networks** The convolutional operation, The max pooling operation, Training a convnet from scratch on a small dataset, Using pre-trained convnet, Visualizing what convnet learn	6Hrs.
5	**Sequence Models** One hot encoding, Using word embeddings, A recurrent layer in Keras, Understanding the LSTM and GRU layers, Example of LSTM in Keras, Advanced use of Recurrent Neural Network	6Hrs.
6	**Advanced Deep Learning Best Practices** Going beyond the sequential model: The Keras functional API, Inspecting and monitoring deeplearning models using Keras callbacks and Tensor Board, Getting the most out of your models	6Hrs.

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Deep learning with Python	Chollet, F. (2018).	Manning Publications
02	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Géron, A. (2019).	O'Reilly Media.
03	Machine learning	Mitchell, T. M. (1997)	McGraw-Hill.

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Deep learning	Goodfellow, I., Bengio, Y., & Courville, A. (2016).	MIT Press.
02	Pattern recognition and machine learning	Bishop, C. M. (2006).	Springer.
03	Machine learning: A probabilistic perspective.	Murphy, K. P. (2012	MIT Press

Year and Semester	Third Year B. Tech - Semester VI- Computer Science and Engineering				
Course Category	Programme Core Course (PCC)				
Title of Course	Database Management System Lab			Course Code	AI&DS3207
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	04	04	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	50	25	75	

Course Pre-Requisite	Set Theory, Operating System, Data Structures	
Course Objective	1	To understand core concepts and architecture of database systems.
	2	To acquire proficiency in SQL for database creation and manipulation.
	3	To apply database design principles for real-world applications.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Explain the fundamentals and components of DBMS.
	CO2	Design databases using Entity–Relationship modelling.
	CO3	Apply normalization techniques to improve database design.
	CO4	Write SQL queries to manage and retrieve data effectively.
	CO5	Apply transaction management and concurrency control techniques.
	CO6	Implement database recovery mechanisms for failure handling.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1							
CO2	2	3	2	1							
CO3	2	3	3	2	1						
CO4	2	3	3	2	2						
CO5	2	2	2	3	1						
CO6	2	2	2	3							

Marking Scheme
In Semester Evaluation/ Continuous Assessment has50 Marks **Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc.** **Lab File should be prepared and should be assessed continuously during academic.** **End Semester Evaluation has 25 Marks** **External Practical Examination with Performance and Oral Examination**

Guidelines for LabPerformance	
Faculty can create Experiment list based on following listed topics. **Minimum 15 Experiments should get performed.**	
Exp. No.	**Title of Experiment/ Problem Statement**
1	**Draw an E-R Diagram of any organization.**
2	**Reduce above mentioned E-R Diagram into tables.**
3	**Normalize any database from first normal form to Boyce-Codd Normal Form (BCNF).**
4	**Write a program of Database connectivity with any object oriented language.**
5	**Use DDL Queries to create, alter (add, modify, rename, drop) & drop Tables.**
6	**Use DML Queries to insert, delete, update & display records of the tables.**
7	**Create table with integrity constraints like primary key, check, not null and unique.**
8	**Create table with referential integrity constraints with foreign key, on delete cascade and on** **delete set null.**
9	**Display the results of set operations like union, intersections & set difference.**

10	Display the results of Join Operations like cross join, self join, inner join, natural join, left outer join, right outer join and full outer join.
11	Display the records using Aggregate functions like min, max, avg, sum & count. Also use group by, having clauses
12	Display the results using String operations.
13	Create & Update views for any created table.
14	Write java program to implement dense and sparse indexing
15	Write java program to implement B+ tree indexing
16	Write java program to implement static hashing.
17	Study of NoSql.

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Database System Concepts	A. Silberschatz, H.F. Korth, S. Sudarshan	6 th Edition, McGraw Hill Education.
02	Database Systems - A practical approach to Design, Implementation and Management	Thomos Connolly, Carolyn Begg	3rd Edition, Pearson Education

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Database Systems – Design, Implementation and Management	Rob & Coronel	5th Edition Thomson Course Technology
02	Fundamentals of Database Systems code Approach with C	Ramez Elmasri, Shamkant B. Navathe	4 th Edition, Pearson Education

Year and Semester	Third Year B. Tech - Semester VI– Artificial Intelligence And Data Science				
Course Category	Program core course (PCC)				
Title of Course	Deep Learning Lab			Course Code	AI&DS3208
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	25	50	

Course Objective	1	To introduce the fundamentals of Artificial Intelligence, Machine Learning, and Deep Learning along with the evolution and need for deep learning.
	2	To provide a strong foundation in neural network principles, data representation, and gradient-based optimization techniques.
	3	To familiarize students with deep learning frameworks such as TensorFlow and Keras for building, training, and tuning models.
	4	To expose students to advanced deep learning architectures and best practices including CNNs, RNNs, LSTMs, and generative models.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Explain core concepts of neural networks and deep learning including network anatomy, optimization, and data representation.
	CO2	Build and train deep learning models using TensorFlow and Keras for image, text, and sequence data.
	CO3	Analyze model performance and apply hyperparameter tuning, regularization, and best practices to improve generalization.
	CO4	Design and implement advanced deep learning applications such as convolutional networks, recurrent networks, and generative models

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1						
CO2	2	3	3	2	3				2	1	
CO3	2	3	2	3	2						
CO4	3	3	3	2	3	1		1	2	2	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics.	
Exp. No.	**Title of Experiment/ Problem Statement**
1	**Installing of Anaconda and working with Tensorflow and Keras.**
2	**Introduction and working with Google Colab for using GPUs and TPUs for large projects.**
3	**Developing simple perceptron (single layer neural network).**
4	**Developing simple multilayer neural network for different tasks.**
5	**Designing and developing basic CNN for given task.**
6	**Using transfer learning in CNN.**
7	**Designing and developing simple RNN for given task.**
8	**Designing and developing RNN with LSTM for given task.**
9	**Designing and developing RNN with GRU for given task.**
10	**Designing and developing model for Text generation using LSTM.**

Textbooks			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Deep learning with Python	Chollet, F. (2018)	Manning Publications
02	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Géron, A. (2019)	(2nd ed.), O'Reilly Media
03	Machine learning	Mitchell, T. M. (1997)	McGraw-Hill.

Reference Books			
Sr. no.	**Title**	**Author**	**Edition/Publication**
01	Deep learning	Goodfellow, I., Bengio, Y., & Courville, A. (2016)	MIT Press
02	Pattern recognition and machine learning.	Bishop, C. M. (2006)	Springer
03	Machine learning: A probabilistic perspective	Murphy, K. P. (2012)	MIT Press

Year and Semester	Third Year B. Tech - Semester VI - Computer Science and Engineering				
Course Category	Experiential Learning (EL)				
Title of Course	Domain Specific Mini Project			Course Code	AI&DS3209
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	02
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	50	25	75	

Course Pre-Requisite	Software Engineering Concepts, Object Oriented Concepts	
Course Objective	1	To expose the students to use engineering approach to solve domain specific real time problem
	2	To use the appropriate and newer technologies while developing the project.
	3	To learn the skills of team building and team work.
Course Outcomes	After competition of this course Students will be able to ….	
	CO1	Identify specific problem statement from a selected domain.
	CO2	Analyze the problem and design appropriate system architecture and solution methodology.
	CO3	Prepare working prototype or software model by using modern tools & techniques
	CO4	Test & Validate the results of the developed prototype.
	CO5	Demonstrate the project and prepare the detailed project documentation

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1				1		1			1
CO2	2	2	2	2	1			1		1	1
CO3	2	1	2	2	2			1		1	1
CO4	1	1	1	1	2		1	1		1	1
CO5	1		1				1	1	2	1	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
• **Compulsory passing with 40% marks is mandatory in ESE examinations** • **ISE/CA will be evaluated based on different review presentations.**

	Details
	• **The students should form group consisting of 3 to 5 members.** • **Each group must select a specific domain aligned with the Sustainable Development Goals (SDGs), preferably addressing Smart India Hackathon (SIH) problem statements, industry-relevant challenges, or pressing societal needs.** • **Further the group should identify the relevant problem in the selected domain and propose the solution, which can be implemented as a mini-project using suitable technology.** • **The mini-project work should be evaluated by a team of teachers appointed by the department.** • **The evaluation and marking should include In semester Evaluation (ISE/CA) and End Semester Examination (ESE) during which the group should give presentation and demonstration of their work done.** • **Proper project documentation must be maintained.** • **Care should be taken to avoid out-sourcing of the work.**