KOLHAPUR INSTITUTE OF TECHNOLOGY'S COLLEGE OF ENGINEERING

(EMPOWEREDAUTONOMOUS)

GOKUL SHIRGAON, KOLHAPUR

Department of Computer Science and Business Systems

Curriculum Structure and Syllabus for

Final Year B.Tech in

Computer Science and Business Systems

(As Per NEP, 2020)

Department of Computer Science and Business Systems

	Teaching and Evaluation Scheme for Final Year Semester-VII										
Sr. No.	**Course Code**	**Course Category**	**Course**	**Teaching Scheme**				**Evaluation Scheme**			
				L	**T**	**P**	**Credits**	**Components**	**Max**	**Min Marks for Pass**	
1	UCBPC0701	PC	Usability Design of Software Applications	3	0	0	3	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	UCBPC0702	PC	Natural Language Processing	3	0	0	3	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	UCBPC0703	PC	Software Testing	2	0	0	2	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	UCBPE07**	PE	Program Elective-III	2	0	0	2	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
5	UCBOE07**	OE	Open Elective-III	3	0	0	3	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
6	UCBPC0731	PC	Natural Language Processing Laboratory	0	0	2	1	ISE	25	10	
								ESE(POE)	50	20	
7	UCBPC0732	PC	Software Testing Laboratory	0	0	2	1	ISE	25	10	
								ESE (POE)	50	20	
8	UCBPE07**	PE	Program Elective-III Laboratory	0	0	2	1	ISE	25	10	
9	UCBIL0771	OJT	Project -I	0	0	8	4	ISE	25	10	
								ESE(OE)	50	20	
10	UCBMM0741	MM	Services Science and Service Operational Management (MM-V)	3	0	0	3	ESE	100	40	
			Total	**16**	**0**	**14**	**23**	**Total**	**850**		
	Total Contact Hours =30, Total Credits =23										

Program Elective-III		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0711	Image Processing and Pattern Recognition
2	UCBPE0712	Introduction to IoT
3	UCBPE0713	Deep Learning
Program Elective-IV		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0811	Quantum Computation & Quantum Information
2	UCBPE0812	Computational Finance & Modelling
3	UCBPE0813	Big-Data
Program Elective-V		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0814	Behavioural Economics
2	UCBPE0815	Robotics and Embedded Systems
3	UCBPE0816	Advanced Social, Text and Media Analytics
Open Elective-III		
Sr. No.	**Course Code**	**Course Name**
1	UCBOE0721	Generative AI Tools & Techniques
2	UCBOE0722	Marketing Research and Analytics
3	UCBOE0723	Mobile Computing

Program Elective-III Laboratory		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0733	Image Processing and Pattern Recognition Laboratory
2	UCBPE0734	Introduction to IoT Laboratory
3	UCBPE0735	Deep Learning Laboratory

Title of the Course: Usability Design of Software Applications	**L**	**T**	**P**	**Credit**
Course Code: UCBPC0701	3	-	-	3

Course Pre-Requisite: Basic knowledge of HTML, CSS and Javascript. Design Thinking etc.

Course Description: Usability Design of Software Applications deals with the foundation and advances made in the usability principles of software design. The course teaches how to create user-friendly software applications by incorporating the principles of smart design and user experience design.

Course Learning Objectives:

1. To describe the relation between design and evaluation of IT-design projects, especially the relation between usability and experience design.

2. To evaluate the quality of usability evaluations of IT-artifacts from both a theoretical perspective of evaluation methods and one's own experience of evaluation.

3. To independently plan, perform and make a report about both an expert evaluation and an empirical usability evaluation of IT-artifacts for which experience is a central aspect.

4. To actively and independently be able to orientate in and evaluate current research within the subject area of the course.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the user-centered design process to evaluate the different assignments.	II	Understand
CO2	Apply heuristic evaluation techniques to evaluate the websites and applications.	III	Apply
CO3	Explore and learn UX research techniques for analysis the application.	II	Understand
CO4	Analyze the personal and prototype technique for different project.	IV	Analyze

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	3	2	2	2	-	-	-	-	-	-	-	2
CO2	3	2	2	1	1	-	-	-	-	-	-	-	3
CO3	2	1	2	3	2	-	-	-	-	-	-	1	2
CO4	2	3	3	3	3	-	-	-	-	-	-	2	3

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to User Centered Design	**CO1**	**8 Hours**

Basics of User Centered Design, Aspects of User-Centered Design, Product Appreciation Assignment – Evaluating the product from user centered design aspects such as functionality, ease of use, ergonomics, and aesthetics.

Unit 2: Heuristic Evaluation	**CO2**	**7 Hours**

10 Heuristic Principles, Examples of Heuristic Evaluation: Group Assignment initiation (Website and App) Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.

Unit 3: Project design lifecycle	**CO2**	**7 Hours**

Group Project identification such as a website or mobile app to redesign, Redesign project through the design lifecycle steps – Discover, Define, Design, Implement (Design Prototype), Usability Testing.

Unit 4: UX Research	**CO3**	**8 Hours**

Understanding users, their goals, context of use, and environment of use. Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX by using Figma.

Unit 5: Personas and Scenarios	**CO3**	**8 Hours**
Scenarios and Persona Technique – Overview of Design Thinking Technique - Discovery and brainstorming.		
Unit 6: Development and Prototyping	**CO4**	**7 Hours**
Concept Development, Task flow detailing for the Project, Prototyping Techniques - Paper, Electronic, and Prototyping Tools, Project Prototyping Iteration 1, Project Prototyping Iteration 2, Review and feedback, Final presentation.		

Textbooks:

1. Jennifer Preece, Helen Sharp, Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", 2015, 4th Edition, Wiley publications.

References:

1. Alan Cooper and Robert Riemann, "About Face The Essentials of Interaction Design", 2014, 4th Edition, Wiley Publications.
2. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed , " Observing the User Experience - A Practitioner's Guide to User Research" , 2012, Second Edition, Morgan Kaufmann Publications.

Title of the Course: Natural Language Processing	L	T	P	Credit
Course Code: UCBPC0702	3	-	-	3

Course Prerequisite: Linear Algebra, Probability Theory

Course Description: This course insights about natural language processing and its applications.

Course Learning Objectives:

After successful completion of the course students will be able to

1. Understand the fundamentals of natural language processing
2. Gain knowledge on text corpora and raw text processing
3. Access knowledge on text classification and categorization
4. Analyze information extraction and sentence structure

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the fundamentals of natural language processing	II	Understand
CO2	Apply text corpora and raw text processing	III	Apply
CO3	Apply text classification and categorization	III	Apply
CO4	Analyze information extraction and sentence structure	IV	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1			1							1	1
CO2	1	2		2	2							2	2
CO3	1	2		2	2							2	2
CO4	1	2		2	2							2	2

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Basics of Language Processing	**CO1**	**08 Hours**
Computing with language: Texts and Words, A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics, Automatic Natural Language Understanding.		
Unit 2: Accessing Text Corpora and Lexical Resources	**CO2**	**06 Hours**
Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet		
Unit 3: Processing Raw Text	**CO2**	**08 Hours**
Accessing Text from the Web and from Disk: Dealing with HTML, Processing Search Engine Results, Extracting Text from PDF, MSWord, and Other Binary Formats, Regular Expressions for Detecting Word Patterns, Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation		
Unit 4: Categorizing and Tagging Words	**CO3**	**08 Hours**
Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, N-Gram Tagging, How to Determine the Category of a Word		
Unit 5: Classify Text & Extracting Information from Text	**CO3**	**08 Hours**
Supervised Classification, Naive Bayes Classifiers, Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition.		

Unit 6: Analyzing Sentence Structure	**CO4**	**07 Hours**
Some Grammatical Dilemmas, Context-Free Grammar, Parsing with Context-Free Grammar, Grammar Development		

Textbooks:

1. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, Edward Loper, O'Reilly Publication, 2009.

References:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Natural Language Processing in Action Understanding, analyzing, and generating text with Python by Dr. Arwen Griffioen,2019

Title of the Course: Software Testing Course Code: UCBPC0703	L 2	T -	P -	Credits 2

Course Pre-Requisite: Software Engineering

Course Description: This course provides an in-depth understanding of software testing and quality assurance principles, techniques, and tools. It covers various types of testing, test management, automation, and quality assurance processes to ensure the delivery of high-quality software products.

Course Learning Objectives:

1. To Understand the fundamental concepts, principles, and importance of software testing and quality assurance.
2. To Design and develop effective test plans, test cases, and test strategies using various testing techniques.
3. To Use test management practices and automation tools to execute and streamline the testing process.
4. To Apply performance testing, regression testing, and quality standards to ensure reliable and high-quality software.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the fundamental concepts and importance of software testing and quality assurance.	II	Understand
CO2	Build and implement various testing techniques and strategies.	III	Apply
CO3	Manage and execute test plans, test cases, and test scripts.	III	Apply
CO4	Apply quality assurance practices to improve software reliability and performance.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Software Testing Foundations & Techniques	**5 Hrs.**
Software Testing Basics: Definition, objectives, SDLC vs STLC, Principles of Testing: Early defect detection, defect clustering, pesticide paradox,Testing Levels: Unit, Integration, System, Acceptance, Regression, Smoke, Sanity,Testing Types: Functional, Non-functional, Manual, Automation,Testing Techniques: Black Box, White Box, Experience-Based, Case Studies & Real-world Examples	
Unit 2: Test Planning, Management & Metrics	**5 Hrs.**
Test Planning & Strategy: Risk-based, Coverage-based, Context-driven, Test Estimation Techniques: WBS, Function Points, Delphi, Use Case Points,Test Case & Scenario Design, Traceability Matrix,Test Execution & Defect Management: Lifecycle, Severity, Priority,Software Metrics: Defect density, DRE, Code coverage, MTBF/MTTR,Reviews & Audits: Walkthroughs, Inspections, Peer Reviews	
Unit 3: Automation & Frameworks	5 **Hrs.**
Automation Strategy & ROI,Frameworks: Modular, Data-driven, Keyword-driven, Hybrid, BDD/TDD,Selenium WebDriver Advanced Concepts,API Automation: Postman, RestAssured, SoapUI, CI/CD Integration: Jenkins, GitLab, Azure DevOps, Case Studies: Regression Automation	
Unit 4: Specialized Testing	**5 Hrs.**
Performance Testing: Load, Stress, Spike, Endurance, Scalability, Security Testing: OWASP Top 10, Penetration Testing, Mobile Testing: Android/iOS Fragmentation, Device Matrix, Web Application Testing: Cross-browser, Responsiveness, Accessibility, Usability, Accessibility, Localization Testing	

Unit 5: Advanced Testing Concepts & AI/ML	**5 Hrs.**
AI/ML in Testing: Predictive Defects, Self-Healing Tests, Advanced Automation Trends: Visual Testing, Smart Defect Prediction, Test Automation Frameworks: Multi-layered, Cloud Integration, Testing Standards: IEEE 829, ISO/IEC/IEEE 29119, CMMI, Industry Best Practices & Case Studies	
Unit 6: Emerging & DevOps Testing Trends	**5 Hrs.**
Cloud-Based Testing: SaaS/PaaS/IaaS, Multi-tenant Apps, Continuous Testing in DevOps: CI/CD pipelines, Automated Regression, IoT & Embedded System Testing, Blockchain & Smart Contract Testing, DevOps Monitoring & Observability, AI/ML & ,Automation Trends,Case Studies: IoT / Fintech Continuous Testing.	

Textbooks:

1. "Foundations of Software Testing" by Dorothy Graham, Erik van Veenendaal, Isabel Evans, and Rex Black.
2. Software testing: Yogesh Singh, Cambridge University Press, First Edition
3. Software Quality Engineering, Jeff Tian, Wiley India Ltd.

Reference Books:

1. "Software Testing: Principles and Practices" by Srinivasan Desikan and Gopalaswamy Ramesh.
2. Foundations of Software testing: Aditya P. Mathur, Pearson, Second Edition
3. Software Testing: Ron Patton, Pearson (SAMS), Second Edition
4. Software Quality, Mordechai Ben Menachem, Garry S. Marliss, BS Publications

Title of the Course: Image Processing and Pattern Recognition Course Code: UCBPE0711	L	T	P	Credits
	2	-	-	2

Course Pre-Requisite: Basic mathematics, Basic of Computer Graphics, MATLAB.

Course Description: This course explores techniques in image processing and pattern recognition, focusing on methods for analyzing and interpreting visual data.

Course Learning Objectives:

1. To understand and apply basic image processing techniques.
2. To analyze intensity transformations and spatial filtering methods.
3. To perform image segmentation and object detection techniques.
4. To state the color model, image feature extraction and pattern classification.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand and apply basic image processing techniques.	II	Understand
CO2	Identify the intensity transformations and spatial filtering methods.	III	Apply
CO3	Classify the image segmentation and object detection techniques.	IV	Analyze
CO4	Analyze various color models, image feature extraction, and image pattern classifications.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Digital Image Fundamentals **CO1**	**5 Hrs.**
Introduction - Image processing systems and its applications, Basic image file formats, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception.	
Unit 2: Intensity Transformations and Spatial Filtering **CO2**	**6 Hrs.**
Log transformation, Power-law (gamma) transformation, contrast stretching, histogram specification, local contrast enhancement, Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.	
Unit 3: Image Restoration & Segmentation **CO3**	**5 Hrs.**
A Model of the Image Degradation/Restoration Process, Noise Models, Image Segmentation – Image Segmentation Process, Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation.	
Unit 4: Image/Object Features Extraction **CO4**	**6 Hrs.**
Textural features - Gray level co-occurrence matrix, Moments, Connected component analysis, Convex hull, Distance transform, medial axis transform, shape properties. **Registration**: Mono-modal/multimodal image registration, Global/local registration.	

Unit 5: Colour Image Processing **CO4**	**4 Hrs.**
Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab, False colour, Pseudo colour, Enhancement.	
Unit 6: Image Pattern Classification **CO4**	**4 Hrs.**
Introduction, Patterns and Pattern Classes, Pattern classification by prototype matching.	

Textbooks:

1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, Pearson Prentice Hall, Fourth Edition.

Reference Books:

1. Image Processing: The Fundamentals, Maria Petrou and Panagiota Bosdogianni, John Wiley & Sons, Ltd.
2. Digital Image Processing, K. R. Castleman, Prentice Hall, Englewood Cliffs.
3. Visual Reconstruction, A. Blake and A. Zisserman, MIT Press, Cambridge.
4. Digital Pictures, A. N. Netravali and B. G. Haskell, Plenum Press.
5. Digital Images and Human Vision, A. B. Watson, MIT Press, Cambridge.
6. Digital Image Processing Using MATLAB, Rafael C. Gonzalez Richard E. Woods Steven L. Eddins, Pearson Prentice-Hall, Second Edition.

Title of the Course: Introduction to IoT	**L**	**T**	**P**	**Credits**
Course Code: UCBPE0712	**2**	**-**	**-**	**2**

Course Pre-Requisite: Knowledge of Computer Networking, Knowledge of Micro Processors, Micro Controllers, Knowledge of Programming languages such as C, Python, Assembly level.

Course Description: This course introduces the necessary fundamental principles of the Internet of Things. It aims to develop various applications related to smart cities, agriculture etc.

Course Learning Objectives:

1. To learn basic concepts of Internet of Things (IoT) Technology
2. To become familiar with the basics of RFID, sensor and GPS technologies
3. To Build and interface IoT devices.
4. To Analyze and choose different wireless technologies and IoT applications.

Course Outcomes:

COs	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain key concepts and terminologies related to Internet of Things (IoT).	II	Understand
CO2	Built and interface IoT devices.	III	Apply
CO3	Propose IoT solution for real life problems.	III	Apply
CO4	Compare different IoT devices based on its architecture	IV	Analyze

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	-	-	-	2	2	-	-	-	-	2	2	3
CO2	-	-	3	2	3	-	-	1	-	-	-	2	2
CO3	-	-	3	2	2	2	-	-	-	-	2	2	3
CO4	-	2	-	2	2	2	-	-	-	-	2	2	3

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

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MSE: Assessment is based on 50% of course content (Normally first three modules)

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Course Contents:

Unit 1: Introduction to IoT **CO1**	**5 Hrs.**
Introduction to Internet of Things-Definition and Characteristics of IoT, Physical design of IoT-IoT Protocols, Logical design of IoT- IoT Communication Model, IoT Communication APIs, IoT Enabling Technologies, IoT Levels & deployment Templates.	
Unit 2: Fundamental IoT Mechanisms & Key Technologies **CO1, CO2**	**5 Hrs.**
Structural aspects of the IoT: Environment characteristics, Traffic characteristics, scalability, Interoperability, Security and Privacy, Open architecture, **Key IoT Technologies:** Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology. **Evolving IoT Standards:** Constrained Application Protocol (CoAP), REST	
Unit 3: Introduction to IoT Devices **CO2**	4 **Hrs.**
What is an IoT Devices, Rasberry Pi: Architecture, Pin Configuration, Pin Interface, Installation of Raspian OS, Arduino: Architecture, Pin Configuration, Pin Interface Sensors. DTH, Touch Sensor, Humidity Sensor, Soil Mositure Sensor.	
Unit 4: Building IoT with Arduino & Raspberry Pi **CO3**	5 **Hrs.**
Building IOT with Arduino- Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks - Pi - Raspberry Pi Interfaces.	

Unit 5: IoT Physical Servers and Cloud Offerings CO4	**5 Hrs.**
Introduction to Cloud storage models and communication API's, WAMP –AutoBahn for IoT, Amazon web services for IoT	
Unit 6: Case studies Illustrating IoT Design CO3	**4 Hrs.**
Introduction, Home automation, cities, Environment, Agriculture, Productivity applications.	
Textbooks:	
1. Internet of Things: A Hands-On Approach by Arshdeep Bahga, Vijay Madisetti (Unit 1,3,4,5,6) 2. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Daniel Minoli, Wiley Publications.	
Reference Books:	
1.The Internet of Things: Connecting Objects to the Web, Hakima Chaouchi, Wiley Publication	

Title of the Course: Deep Learning	L	T	P	Credits
Course Code: UCBPE0713	2	-	-	2

Course Pre-Requisite: Machine Learning

Course Description: This course gives theoretical and practical knowledge on deep learning concepts and its algorithms.

Course Learning Objectives:

After successful completion of the course students will be able to

1. Understand the basic building blocks of deep learning
2. Analyze the mathematical intuition of the neural network working process.
3. Analyze the deep learning algorithms to solve real world problems
4. Gain knowledge of advanced usages of deep learning

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the basic building blocks of deep learning	II	Understand
CO2	Apply the mathematical intuition of the neural network working process.	III	Apply
CO3	Analyze the deep learning algorithms to solve real world problems	IV	Analyze
CO4	Analyze the use of generative deep learning	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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ISE-1	10
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ESE	50

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Course Contents:

Unit 1: Understanding Deep Learning	**CO1**	**04 Hrs.**
Artificial Intelligence, Machine Learning, Learning representation from data, Understanding how deep learning works, Early Neural Networks, what makes deep learning different, Hardware, Data, Algorithms.		
Unit 2: Mathematical Intuition of Neural Networks	**CO2**	**05 Hrs.**
Data Representation of Neural networks: Scalar, vectors, matrices, Real world examples of tensor data, image data, video data. **Tensor operations:** Elementwise operation, Geometric representation of tensor operations. **Optimization of neural network:** derivative of tensor operations, stochastic gradient descent and backpropagation algorithm.		
Unit 3: Working with Neural Network	**CO3**	**05 Hrs.**
Anatomy of a neural network, Introduction to keras, Binary classification example, Multiclass classification example, Regression example.		
Unit 4: Deep Learning for Computer Vision	**CO3**	**05 Hrs.**
Architecture of CNN: Convolution operations, max pooling. **Working with deep learning problems:** Building your CNN network, Data preprocessing, Data Augmentation, Feature Extraction, Fine tuning, Visualize the intermediate activations.		

Unit 5: Deep Learning for Text and Sequences **CO3**	**05 Hrs.**
Working with text data, **Understanding RNN:** recurrent layers in RNN, understand LSTM, GRU. **Advanced use of RNN:** Fight overfitting, stacking recurrent layers, using bidirectional RNN. **Sequence processing with converts.**	
Unit 6: Generative Deep Learning **CO4**	**04 Hrs.**
Text generation with LSTM, Generating images with variational autoencoders, generative adversarial networks (GAN).	

Textbooks:

1. "Deep Learning with Python" By Francois Chollet, Manning Publication, 2017.

Reference Books:

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press,2016
2. "Grokking Deep Learning" by Andrew W. Trask, Manning Publication, 2019
3. "Deep Learning from Scratch Building with Python from First Principles" by Seth Weidman, O'Reilly Media, 2019

Title of the Course: Generative AI Tools & Techniques Course Code: UCBOE0721	L	T	P	Credits
	3	-	-	3

Course Pre-Requisite: Prior knowledge of Calculus, Linear Algebra, Probability Theory, and Python programming, Introduction to Generative AI, AI models are essential.

Course Description: Students will be introduced to the fundamentals and practical applications of Generative AI and Large Language Models, covering GPT, BERT, GANs, VAEs, and modern text-generation techniques to equip learners with skills for building intelligent NLP and image-generation systems.

Course Learning Objectives:

1. Explain the fundamentals of Generative AI, large language models, and Transformer-based architecture, including attention and pre-training techniques.
2. Implement GPT, BERT, and other Transformer models for various NLP tasks, including text generation, dialogue systems, and downstream applications.
3. Apply and optimize Generative AI techniques for multimodal tasks, including GANs/ VAEs for image generation and sequence models for text generation.
4. Analyze real-world applications, limitations, and emerging trends in Generative AI to evaluate future research and industry directions.

Course Outcomes:

COs	After the completion of the course, the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To understand large language models' architecture and pre-training techniques.	II	Understand
CO2	To apply the GPT model and the BERT model for natural language processing tasks.	III	Apply
CO3	To analyze the performance and limitations of large language models.	IV	Analyze
CO4	To apply generative AI concepts by implementing GANs for image generation and using word embedding for effective text representation.	III	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	3	1	–	–	–	–	2	3	1
CO2	3	2	2	1	3	–	–	–	–	–	2	3	2
CO3	2	3	2	3	3	1	–	–	–	–	3	3	2
CO4	3	2	3	2	3	–	–	1	–	–	2	3	3

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignments /declared tests/quizzes/seminars/Group Discussions etc.

MSE: Assessment is based on 50% of the course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Large Language Models	**07 Hrs.**
Overview of Generative AI and Large Language Models. Basics of attention mechanisms and Transformer architecture. Pre-training techniques and transfer learning strategies.	
Unit 2: GPT Models and Applications	**08 Hrs.**
Study of GPT architecture and variants. Applications of GPT models in text generation and dialogue systems. Case study based implementation of GPT-based tasks. GPT-based chatbot enhances E-Shop's customer support service	
Unit 3: BERT and Advanced Techniques	**07 Hrs.**
Understanding BERT architecture and pre-training objectives. Fine-tuning BERT for downstream NLP tasks. Exploration of advanced Transformer architectures and techniques	
Unit 4: Applications and Future Directions	**08 Hrs.**
Real-world applications of large language models. Challenges and limitations of current approaches. Emerging trends and future directions in Generative AI.	
Unit 5: Image Generation with Generative AI	**08 Hrs.**
Introduction to Image Generation, Implementing GANs for Image Generation Training and Fine-Tuning GANs , Generating Images with VAEs, Advanced Techniques in Image Generation, and Image and Video Generation Applications. Reinforcement Learning (Overview)	

Unit 6: Text Generation with Generative AI	**07 Hrs.**
Introduction to Text Generation, LSTM-based Text Generation, Transformer-based Text Generation, Fine-Tuning Language Models, and Text Generation Applications, Introduction to Agentic AI	

Textbooks:

1. Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology". Altaf Rehmani .
2. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal
3. Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models" , Joseph Babcock and Raghav Bali , 2024

Reference Books:

1. "Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin.
2. "Generative AI in Software Development: Beyond the Limitations of Traditional Coding" Jesse Sprinter, 2024.

Title of the Course: Market Research and Analytics	L	T	P	Credits
Course Code: UCBOE0722	3	-	-	3

Course Pre-Requisite: Basics of Marketing Management and Marketing research

Course Description: To understand the basics of marketing research and marketing analytics

Course Learning Objectives:

1. To understand the basic concepts of Marketing Analytics
2. To study various tools to have marketing insights in various marketing areas through empirical data
3. To interpret the marketing data for effective marketing decision making
4. To draw inferences from data in order to answer descriptive, predictive, and prescriptive questions relevant to marketing managers

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Students will be able to illustrate & classify the steps & process of marketing research	II	Understand
CO2	Students will be acquainted with better understanding of real-life marketing data and its analysis	II	Understand
CO3	Students will develop the skill in marketing analytics	III	Apply
CO4	Students will develop analytical skill for effective market decision making in real life environment	IV	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	2	2	1			1		1	1	2
CO2	2	3	1	3	3				1		2	3	3
CO3	2	3	1	3	3				1	1	2	3	3
CO4	2	3	2	2	3	1		1	2	2	2	2	3

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: MARKETING RESEARCH CO1	**Hrs. 8**
Steps in conducting marketing research -Methods of collecting Market Information - Primary data – Questionnaire design - Administration and analysis considerations in design - scaling techniques. Secondary data – sources – problems of fit and accuracy; Concept of MKIS - Components of a Marketing Information System -Marketing Intelligence System - Marketing Research in India	
Unit2: INTRODUCTION TO MARKETING ANALYTICS CO3	**Hrs. 8**
Meaning, characteristics, advantages and disadvantages of marketing analytics, Market Data Sources (Primary and Secondary). Market Sizing: Stakeholders, Applications & Approaches (Top down and Bottom-up), PESTLE Market Analysis, Porter Five Force Analysis	
Unit3: PRICING ANALYTICS CO2	**Hrs. 7**
Pricing Policy and Objectives, Estimating Demand: Price Elasticity, Estimating Linear and Power Demand Curves, Optimize Pricing, Incorporating Complementary Products, Pricing using Subjective Demand Curve, Pricing Multiple Products, Price Bundling & Nonlinear Pricing: Pure Bundling & Mixed Bundling, Determine Optimal Bundling Pricing, Profit Maximizing strategies using Nonlinear Pricing Strategies, Price Skimming & Sales, Revenue Management: Markdown Pricing and Handling Uncertainty	

Unit 4: SALES FORECASTING **CO3**	**Hrs. 7**
Introduction, Simple Linear Regression & Multiple Regression model to forecast sales, Forecasting in Presence of Special Events, Modeling trend and seasonality; Ratio to moving average forecasting method, Using S curves to Forecast Sales of a New Product	
Unit 5: CUSTOMER ANALYTICS **CO4**	**Hrs. 8**
Customer Lifetime Value: Concept, Basic Customer Value, Measuring Customer Lifetime value, Estimating Chance that customer is still active, Using Customer Value to value a business Market Segmentation: The segmentation-targeting-positioning (STP) framework, Segmentation, the concept of market segmentation, managing the segmentation process, deriving market segments and describing the segments using Cluster analysis	
Unit 6: RETAILING & ADVERTISING ANALYSIS **CO4**	**Hrs. 7**
Market Basket analysis: Computing two way and three-way lift, RFM Analysis, Allocating Retail Space and Sales Resources: Identifying the sales to marketing effort relationship & its modelling, optimizing sales effort Advertising Analysis: Measuring the Effectiveness of Advertising, Pay per Click (PPC) Online Advertising	
Textbooks:	
1. Marketing Analytics: Data-Driven Techniques with Microsoft Excel by Wayne L Winston, Wiley India Pvt. Ltd. 2. Marketing Analytics: Strategic Models and Metrics by Stephan Sorger, Create Space Publishing	
Reference Books:	
1. Marketing Engineering and Analytics by Gary Lilen, Arvind Rangaswamy, and Arnaud De Bruyn, Decision Pro, Inc. 4. Marketing Metrics by Dugar Anurag, SAGE Publishing India	

Title of the Course: Mobile Computing	L	T	P	Credits
Course Code: UCBOE0723	3	-	-	3

Course Pre-Requisite: Data Communication & Networking TCP/IP Protocol Suite

Course Description: Mobile Computing mainly deals with the science of mobile communication. It covers a layered approach of mobile communication covering layers such as – data link, network and transport layer. It also introduces the 5G technology.

Course Learning Objectives:

1. Mobile Computing basics & GSM architecture
2. Network Layer & Transport Layer of Mobile communication
3. Mobile Adhoc network basics and routing.
4. Fundamentals of the 5G Mobile Network

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the basic physical and technical functioning of mobile communications systems	II	Understand
CO2	Describe the basic principles of mobile communication system and summarize the working of network and transport layer in the context of mobility	II	Understand
CO3	Compare principles of modern mobile and wireless communication systems such as 5G with 3G/4G	IV	Analyze
CO4	Infer the principles and applications of wireless systems and standards	II	Understand

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2										1		
CO2	1	2									1		
CO3	1	2		2							2		
CO4	1		2								2	2	1

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction **CO1**	**08 Hrs.**
Introduction to Wireless Networks, Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, Types of hand off and their characteristics.	
Unit 2: Medium Access Control (MAC) & GSM Telecommunication System CO1	**08 Hrs.**
MAC, Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture, Location tracking and call setup, Mobility management, Handover, Security, GSM SMS, International roaming for GSM, call recording functions, subscriber and service data management.	
Unit 3: Mobile Network Layer **CO2**	**07 Hrs.**
IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP.	
Unit 4: Mobile Transport Layer **CO2**	**08 Hrs.**
Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit / Fast recovery, Transmission / Timeout freezing, Selective retransmission, Transaction Oriented TCP.	
Unit 5: Mobile Ad hoc Networks (MANETs) **CO3**	**07 Hrs.**
Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc., Mobile Agents, Service Discovery.	
Unit 6: 5G Mobile Network – Future of Mobile Communication **CO4**	**07 Hrs.**
10 Pillars of 5G, concept of small cell, Cognitive radio -overview, spectrum optimization literature, key requirements and challenges for 5G cognitive terminal. Wireless spectrum white spaces – Background, TV white space technology, white space spectrum opportunities and challenges.	

Textbooks:
1. “Mobile Communication”, Jochen Schiller, Pearson Education. **2.** “Wireless Communications and Networks", William Stallings, Pearson Education. **3.** “Fundamentals of 5G Mobile Networks”, Jonathan Rodriguez, First Edition 2015 John Wiley & Sons, Ltd Publication.
Reference Books:
1. Wireless telecommunications systems and networks, Gary J. Mullett. Cengage Publication.

Title of the Course: Natural Language Processing Laboratory Course Code: UCBPC0731	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Machine Learning Algorithms and Python Programming

Course Description: This course provides practical knowledge on NLP concepts to solve real time problems.

Course Learning Objectives:

1. To describe briefly a fundamental technique for processing language for several subtasks, such as morphological processing
2. To implement parsing, word sense disambiguation and etc
3. To implement TD-IDF method and Ngram models and Part of speech tagger
4. To classify the text based on part of speech tagger and implement several NLP applications.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Implement LSI, NER,TD-IDF and Ngram models	6	Create
CO2	Implement parsing, word sense disambiguation	6	Create
CO3	Classify the text based on part of speech tagger and implement several NLP applications	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2		2	3		2			2	2	2	3
CO2	1	2		2	3		2			2	2	3	3
CO3	1	2		2	3		2			2	2	3	3

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) having 30% and ESE(POE) having 70%

Assessment	Marks
ISE	25
ESE(POE)	50

ISE are based on practical performance/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:	**02 Hrs.**

a) Write a python program to perform tokenization by word and sentence using nltk.
b) Write a python program to eliminate stopwords using nltk.
c) Write a python program to perform stemming using nltk.

Experiment No. 2:	**02 Hrs.**

a) Write a python program to perform Parts of Speech tagging using nltk.
b) Write a python program to perform lemmatization using nltk.

Experiment No.3:	**02 Hrs.**

a) Write a python program for chunking using nltk.
b) Write a python program to perform Named Entity Recognition using nltk.

Experiment No. 4:	**02 Hrs.**

a) Write a python program to find Term Frequency and Inverse Document Frequency (TF-IDF).

Experiment No. 5:	**02 Hrs.**

a) Write a python program to find all unigrams, bigrams and trigrams present in the given corpus.
b) Write a python program to find the probability of the given statement “This is my cat” by taking the an exmple corpus into consideration.

Experiment No. 6:	**02 Hrs.**

a) Use the Stanford named Entity recognizer to extract entities from the documents. Use it programmatically and output for each document which named entities it contains and of which type.

Experiment No. 7:	**02 Hrs.**
a) Choose any corpus available on the internet freely. For the corpus, for each document, count how many times each stop word occurs and find out which are the most frequently occurring stop words. Further, calculate the term frequency and inverse document frequency as The motivation behind this is basically to find out how important a document is to a given query. For e.g.: If the query is say: "The brown crow". "The" is less important. "Brown" and "crow" are relatively more important. Since "the" is a more common word, its tf will be high. Hence we multiply it by idf, by knowing how common it is to reduce its weight.	
Experiment No. 8:	**02 Hrs.**
a) Write the python code to perform sentiment analysis using NLP for twiter data	
Experiment No. 9:	**02 Hrs.**
a) Write the python code to develop Spam Filter using NLP for emails	
Experiment No. 10:	**02 Hrs.**
a) Write the python code to detect Fake News using NLP for news data	
Experiment No. 11:	**02 Hrs.**
a) Write a python program to develop text classification for any application	
Textbooks:	
1. **"Natural Language Processing with Python",Steve Bird, Euan Klein and Edvard Loper, O'RELLY,2017**	
References:	
1. Speech and Language Processing, Dan Jurafsky and James H. Martin, Pearson,2025	

Title of the Course: Software Testing Laboratory	L	T	P	Credit
Course Code: UCBPC0732	-	-	2	1

Course Pre-Requisite: Software Engineering

Course Description: This course provides practical knowledge on Software Testing concepts to test real time software.

Course Learning Objectives:

1. To describe briefly a fundamental technique for processing language for several subtasks, such as morphological processing
2. To implement parsing, word sense disambiguation and etc
3. To implement TD-IDF method and Ngram models and Part of speech tagger
4. To classify the text based on part of speech tagger and implement several NLP applications.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply Selenium WebDriver to automate web applications using various element locators and browser navigation techniques.	III	Apply
CO2	Perform API testing using different HTTP methods and validate responses including negative test scenarios.	III	Apply
CO3	Design and execute automated unit test cases using JUnit to validate application logic.	III	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2		2	3		2			2	2	2	3
CO2	1	2		2	3		2			2	2	3	3
CO3	1	2		2	3		2			2	2	3	3

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) having 30% and ESE(POE) having 70%

Assessment	Marks
ISE	25
ESE(POE)	50

ISE are based on practical performance/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:	**02 Hrs.**
Write a program to initialize the WebDriver interface and launch a website across **multiple browsers** (Chrome, Firefox, and Edge) using a configuration file.	
Experiment No. 2:	**02 Hrs.**
Write a program to automate a **User Login** flow by locating elements using basic attributes like id, name, and tagName.	
Experiment No.3:	**02 Hrs.**
Write a program to identify and print all **Hyperlinks** on a webpage using tagName ("a") and filter them using linkText and partialLinkText.	
Experiment No. 4:	**02 Hrs.**
Write a program to interact with a **Search Bar and Button** on an e-commerce site using advanced **CSS Selectors** (e.g., child combinators and attribute matches).	
Experiment No. 5:	**02 Hrs.**
Write a program to perform **Complex Navigation** (e.g., selecting a sub-category from a hover-menu) using **Absolute and Relative XPath**.	
Experiment No. 6:	**02 Hrs.**
Write a program to demonstrate **Browser History Management** using the Maps() methods: to(), back(), forward(), and refresh()	
Experiment No. 7:	**02 Hrs.**
Write a program to fetch a collection of all **Radio Buttons** on a page and verify their "Selected" status using findElements.	
Experiment No. 8:	**02 Hrs.**
Write a program to identify all **Checkboxes**, count them, and programmatically select only those that are currently unchecked.	
Experiment No. 9:	**02 Hrs.**

Write a program using REST Assured to validate a full CRUD cycle by sending GET, POST, PUT, and DELETE requests to a mock API server	
Experiment No. 10:	**02 Hrs.**
Use an open-source AI recorder or **BlinqIO** (Free Tier) to create an automation script by writing test steps in **Plain English** (NLP).	
Experiment No. 11:	**02Hrs.**
Use **EvoMaster** (Open Source) to automatically generate "fuzz" test cases for a REST API to discover potential crashes or security vulnerabilities.	
Textbooks:	
Textbooks: 1. "Foundations of Software Testing" by Dorothy Graham, Erik van Veenendaal, Isabel Evans, and Rex Black. 2. Software testing: Yogesh Singh, Cambridge University Press, First Edition 3. Software Quality Engineering, Jeff Tian, Wiley India Ltd.	
References:	
Reference Books: **1. "Software Testing: Principles and Practices" by Srinivasan Desikan and Gopalaswamy Ramesh.** **2. Foundations of Software testing: Aditya P. Mathur, Pearson, Second Edition** **3. Software Testing: Ron Patton, Pearson (SAMS), Second Edition** **4. Software Quality, Mordechai Ben Menachem, Garry S. Marliss, BS Publications**	

Title of the Course: Image Processing and Pattern Recognition Laboratory Course Code: UCBE0733	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: MATLAB, Programming skills, Basic of Data Structures.

Course Description: This course provides practical knowledge on digital image fundamentals, enhancement techniques, and restoration methods. It also covers pattern recognition, which involves extracting features from images and using them to classify objects or data.

Course Learning Objectives:

1. To understand the digital image representation, acquisition, and the basic principles of pattern recognition.
2. To apply and evaluate image enhancement, segmentation, and restoration techniques.
3. To apply feature extraction and pattern recognition techniques to transform raw data into a usable, informative format.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply various image processing techniques to enhance the quality of the image.	III	Apply
CO2	Demonstrate the techniques for image enhancement, segmentation, and restoration.	III	Apply
CO3	Implement the techniques of image compression, feature extraction, and pattern matching.	III	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1			2							3	1
CO2	2	3	1	2	2						1	3	1
CO3	2	2	2	2	2						1	3	1

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) having 100%.

Assessment	Marks
ISE	25

ISE are based on practical performance/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:	**02 Hrs.**
Implement a MATLAB program for comprehensive understanding of grayscale image representation and manipulation.	
Experiment No. 2:	**02 Hrs.**
Implement a MATLAB program to perform histogram equalization on a grayscale image to improve its contrast.	
Experiment No.3:	**02 Hrs.**
Implement a MATLAB program that takes an input image and applies a series of enhancement techniques to improve its visual quality.	
Experiment No. 4:	**02 Hrs.**
Implement a MATLAB program that restores an original image from a degraded image using the Wiener filter technique.	
Experiment No. 5:	**02 Hrs.**
Implement an image segmentation program in MATLAB that can accurately isolate and identify specific objects like cars in a street scene from the background objects in a digital image.	
Experiment No. 6:	**02 Hrs.**
Implement an image segmentation program that can accurately isolate and identify specific objects, like cars in a street scene, from the background objects in a digital image.	
Experiment No. 7:	**02 Hrs.**
Implement the program to identify object boundaries within an image by detecting sharp changes in pixel intensity using edge detection techniques.	

Experiment No. 8:	**02 Hrs.**
Implement a program to perform different operations for color image processing, such as image loading, color enhancement, filtering, and visualizing the results.	
Experiment No. 9:	**02 Hrs.**
Implement a program that can effectively extract and utilize quantitative textural features from a set of input images to perform a specific task, such as classifying different types of materials.	
Experiment No. 10:	**02 Hrs.**
Implement a program to classify unknown image patterns by comparing them to a set of predefined prototype patterns using the Sum of Squared Differences (SSD) image pattern classification.	
Experiment No. 11:	**02 Hrs.**
Implement a program to locate and identify specific patterns or objects within a larger image using the template matching technique.	

Textbooks:

1. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson Prentice-Hall, Second Edition.
2. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, Pearson Prentice Hall, Fourth Edition.

References:

1. Digital Image Processing. K. R. Castleman, Prentice Hall, Englewood Cliffs.
2. Image Processing: The Fundamentals, Maria Petrou and Panagiota Bosdogianni, John Wiley & Sons, Ltd.
3. Visual Reconstruction, A. Blake and A. Zisserman, MIT Press, Cambridge.

Title of the Course: Introduction to IoT Laboratory **Course Code:** UCBPE0734	**L**	**T**	**P**	**Credit**
	-	-	1	1

Course Pre-Requisite: Knowledge of Computer Networking, Knowledge of Micro Processors, Micro Controllers, Knowledge of Programming languages such as C, Python, Assembly level.

Course Description: This course introduces the necessary fundamental principles of the Internet of Things. It aims to develop various applications related to smart cities, agriculture etc.

Course Learning Objectives:

1. To learn basic concepts of Internet of Things (IoT) Technology.
2. To become familiar with the basics of RFID, sensor and GPS technologies.
3. To Analyze and choose different wireless technologies and IoT applications.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain key concepts and terminologies related to Internet of Things (IoT).	II	Understand
CO2	Propose IoT solution for real life problems	III	Apply
CO3	Compare different IoT devices based on its architecture.	III	Apply

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	3									2	2
CO2	-	-	-	-	2	-	-	-	-	-	-	2	2
CO3	2	3	3	-	2	-	-	-	-	-	-	2	

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) having 100%.

Assessment	Marks
ISE	25

ISE are based on practical performance/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:	**02 Hrs.**
Cold Storage Monitoring Using DHT11, ESP32, and Thing Speak.	
Experiment No. 2:	**02 Hrs.**
Weather Monitoring System Using DHT11, Rain Sensor and Thing Speak.	
Experiment No.3:	**02 Hrs.**
Air Quality Monitoring System Using DHT11, LPG Sensor and CO2 Sensor.	
Experiment No. 4:	**02 Hrs.**
Security System for Bank Lockers Using Flame Sensor, PIR Sensor, Buzzer and Thing Speak.	
Experiment No. 5:	**02 Hrs.**
Flame Detection and Notification System Using IoT (ESP32, Flame Sensor, Blynk App)	
Experiment No. 6:	**02 Hrs.**
Smoke Detection and Notification System Using IoT (MQ2 Sensor, ESP32, and Blynk)	
Experiment No. 7:	**02 Hrs.**
Conference Hall Monitoring System Using IR Sensors, Light Sensor, Flame Sensor and Buzzer.	
Experiment No. 8:	**02 Hrs.**
Home Automation System Using Blynk App, Relay, and Touch Sensor.	
Experiment No. 9:	**02 Hrs.**
Water Level Monitoring System Using Ultrasonic Sensor and Blynk App.	

Experiment No. 10:	**02 Hrs.**
Smart Gas Leakage Detection and Alert System Using LPG Gas Sensor, Smoke Sensor, Buzzer, and Blynk App.	
Experiment No. 11:	**02 Hrs.**
Elderly People Activity Monitoring System Using MPU6050 and Blynk App.	

Textbooks:

1. Internet of Things: A Hands-On Approach by Arshdeep Bahga, Vijay Madisetti

2. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Daniel Minoli, Wiley Publications

References:

1. The Internet of Things: Connecting Objects to the Web, Hakima Chaouchi, Wiley Publication.

Title of the Course: Deep Learning Laboratory Course Code: UCBPE0735	L	T	P	Credit
	-	-	1	1

Course Pre-Requisite: Machine Learning Algorithms and Python Programming

Course Description: This course provides practical knowledge on deep learning concepts to solve real-time problems.

Course Learning Objectives:

1. Apply basic neural network algorithms to solve the real-world application
2. Apply CNN based algorithms to solve applications
3. Apply optimization techniques to enhance the quality of results

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply basic neural network algorithms to solve the real-world application	III	Apply
CO2	Apply CNN based algorithms to solve applications	III	Apply
CO3	Apply optimization techniques to enhance the quality of results	III	Apply

CO-PO Mapping:

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

Assessments:

Teacher Assessment:

One component of In Semester Evaluation (ISE) having 100%.

Assessment	Marks
ISE	25

ISE are based on practical performance/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:	**CO1, CO2, CO3**	**02 Hrs.**
Build a deep neural network model with linear regression using a single and multiple variable.		
Experiment No. 2:	**CO1, CO2, CO3**	**02 Hrs.**
Build a deep neural network model to perform AND, OR, XOR operations,		
Experiment No.3:	**CO1, CO2, CO3**	**02 Hrs.**
Build a deep neural network model for movie review classification (Binary Classification).		
Experiment No. 4:	**CO1, CO2, CO3**	**02 Hrs.**
Build a deep neural network model for classifying images into clothing categories (Multiclass Classification).		
Experiment No. 5:	**CO1, CO2, CO3**	**02 Hrs.**
Build a deep neural network model for image segmentation using the Oxford-IIIT Pet dataset.		
Experiment No. 6:	**CO1, CO2, CO3**	**02 Hrs.**
Build a CNN (with 2 layers of convolutions) model for MNIST, CIFAR-10 datasets.		
Experiment No. 7:	**CO1, CO2, CO3**	**02 Hrs.**
Write a program to implement Bi-directional LSTM for sentiment analysis on movie reviews.		
Experiment No. 8:	**CO1, CO2, CO3**	**02 Hrs.**
Write a program for character recognition using RNN and compare it with CNN.		
Experiment No. 9:	**CO1, CO2, CO3**	**02 Hrs.**
Write a program to detect Dog image using YOLO Algorithm.		

Experiment No. 10:	**CO1, CO2, CO3**	**02 Hrs.**
Implement Auto encoders for image denoising on MNIST dataset		
Experiment No. 11:	**CO1, CO2, CO3**	**02 Hrs.**
Write a program to develop a GAN to generate realistic images using MNIST, Fashion MNIST or any human face datasets.		

Textbooks:

1. "Deep Learning with Python" by Francois Chollet, Manning,2017

References:

1. Josh Patterson and Adam Gibson, "Deep learning: A practitioner's approach", O'Reilly Media, First Edition, 2017.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016.

Title of the Course: Services Science and Service Operational Management **Course Code: UCBMM0741**	**L**	**T**	**P**	**Credits**
	3	**-**	**-**	**3**

Course Pre-Requisite: Fundamental understanding of management principles, marketing concepts, organizational behavior, business processes and IT fundamentals.

Course Description: This course introduces students to the concepts, processes, and management practices essential for delivering effective services in various industries. It integrates principles of service science, operations management, quality, technology, and innovation, enabling students to design, manage, and evaluate service systems efficiently.

Course Learning Objectives:

1. Understand the nature, characteristics and components of service systems.
2. Explain service strategy, process design and quality management concepts.
3. Analyze service operations, performance metrics and technology-enabled processes for improvement.
4. Apply tools and techniques to design, optimize and innovate customer-centric service solutions.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the fundamental concepts of service science, including characteristics of services, service systems and service process models.	II	Understand
CO2	Analyze and design service processes using appropriate tools to improve operational efficiency.	IV	Analyze
CO3	Understand service quality and customer experience using models and identify strategies for improvement.	II	Understand
CO4	Apply concepts of capacity management, technology integration and service performance measurement to solve real-world service operation problems.	III	Apply

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1		2										2	
CO2		2	2		2							2	2
CO3		2		2									2
CO4			2		2					2		2	2

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Service Science	**6 Hrs.**
Emergence and Evolution of Services; Nature, Importance and Characteristics of Services; Classification of Services, Components of service systems, Service process: Components and types, Service process model, Current Trends in Service Science	
Unit 2: Service Processes and Operations	**7 Hrs.**
Components of Service Processes; Types of Service Processes; Service Process Design Principles; Service blueprinting: symbols, components, and applications; Service Operations Strategy; Service Process Performance Metrics; Service Process Design, Reengineering and continuous improvement	
Unit 3: Service Quality and Customer Experience	**7 Hrs.**
Definition and importance of service quality; Service quality dimensions; SERVQUAL model: measurement and application; Gaps model of service quality; Measuring service quality; Tools and techniques for service quality improvement; Customer experience mapping and management; Customer satisfaction, loyalty, and retention strategies	
Unit 4: Capacity and Demand Management in Services	**7 Hrs.**
Concept of service capacity and demand; Challenges in matching capacity with demand; Techniques for demand forecasting in services; Capacity planning strategies; Managing queues and waiting lines; Yield management and revenue optimization; Service level agreements (SLAs) and performance targets	
Unit 5: Technology and Innovation in Services	**7 Hrs.**
Role of technology in service operations; Service automation and self-service technologies; Digital platforms and service ecosystems; Emerging technologies: AI, IoT, and cloud in services; Innovation in services: process, product, and delivery innovation	
Unit 6: Service Performance and Metrics	**6 Hrs.**
Measuring service performance: KPIs and metrics; Productivity in service operations; Balanced scorecard for service organizations; Benchmarking and best practices	

Textbooks:

1. **Service Operations Management, 5th Edition** — Robert Johnston, Graham Clark, Nigel Slack, Michael Shulver
2. **Service Operations Management: A Strategic Perspective — John McManus, Mats Winroth & Jannis Angelis**
3. **Service Operations Management by Robert Johnston, Graham Clark, Nigel Slack & Michael Shulver**

Reference Books:

1. Fitzsimmons, J. A., & Fitzsimmons, M. J. *Service Management: Operations, Strategy, Information Technology*, 9th Edition, McGraw-Hill.
2. Johnston, R., & Clark, G. *Service Operations Management*, 4th Edition, Pearson.
3. Spohrer, J., & Maglio, P. *Handbook of Service Science*, Springer.
4. Haksever, C., Render, B., Russell, R., & Murdick, R. *Service Management and Operations*, Pearson.

	Teaching and Evaluation Scheme for Final Year Semester-VIII										
Sr. No.	Course Code	Course Category	Course	Teaching Scheme				Evaluation Scheme			
				L	T	P	Credits	Components	Max	Min Marks for Pass	
1	UCBPE08**	PE	Program Elective-IV	3	0	0	3	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	UCBPE08**	PE	Program Elective-V	3	0	0	3	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	UCBIL0871	OJT	Project -II	0	0	8	4	ISE	50	20	
								ESE(OE)	50	20	
4	UCBIL0872	OJT	Internship	0	0	12	6	ISE-I	75	30	
								(ISE-II)	75	30	
5	UCBCC0831	CC	Co-Curricular Course-IV	0	0	2	1	ISE	50	20	20
			Total	**06**	**0**	**22**	**17**	**Total 500**			
	Total Contact Hours=28, Total Credits=17										

Program Elective-III		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0711	Image Processing and Pattern Recognition
2	UCBPE0712	Introduction to IoT
3	UCBPE0713	Deep Learning
Program Elective-IV		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0811	Quantum Computation & Quantum Information
2	UCBPE0812	Computational Finance & Modelling
3	UCBPE0813	Big-Data
Program Elective-V		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0814	Behavioural Economics
2	UCBPE0815	Robotics and Embedded Systems
3	UCBPE0816	Advanced Social, Text and Media Analytics
Open Elective-III		
Sr. No.	**Course Code**	**Course Name**
1	UCBOE0721	Generative AI Tools & Techniques
2	UCBOE0722	Marketing Research and Analytics
3	UCBOE0723	Mobile Computing

Program Elective-III Laboratory		
Sr. No.	**Course Code**	**Course Name**
1	UCBPE0733	Image Processing and Pattern Recognition Laboratory
2	UCBPE0734	Introduction to IoT Laboratory
3	UCBPE0735	Deep Learning Laboratory

Title of the Course: Quantum Computation and Quantum Information **Course Code: UCBPE0811**	**L**	**T**	**P**	**Credits**
	3	**-**	**-**	**3**

Course Pre-Requisite: Linear Algebra, Algorithms, Data Structures and physics(quantum mechanics)

Course Description: Quantum computing is potentially helps to efficiently solve certain challenging problems which cannot be solved efficiently in a classical setting. This course will provide introduction to Quantum Computation, starting with basic concepts such as superposition and entanglement, to discussing the quantum circuit model of computation and basic Quantum algorithms that demonstrate the power of computing with quantum bits.

Course Learning Objectives:

1. Understand the basics of quantum mechanics
2. Understand the quantum circuits and its design
3. Understand quantum computer and search algorithms
4. Understand quantum operations and information theory

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the basics of quantum mechanics	II	Understand
CO2	Understand the quantum circuits and its design	II	Understand
CO3	Understand quantum computer and search algorithms	II	Understand
CO4	Understand quantum operations and information theory	II	Understand

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2									1		2	2
CO2	2	2	2							1		2	2
CO3	2	1	2		1					1		2	2
CO4	2	1	2		1					1		2	2

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Quantum Overview and mechanics	**Hrs.06**
Quantum computation, Quantum algorithms, Quantum information, The postulates of quantum mechanics, Application: superdense coding	
Unit 2: Quantum Circuits and Quantum Fourier Transform	**Hrs.08**
Quantum algorithms, Single qubit operations, Controlled operations, Measurement, Universal quantum gates, The quantum Fourier transform, General applications of the quantum Fourier transform.	
Unit 3: Quantum Search Algorithms	**Hrs.08**
The quantum search algorithm, Quantum search as a quantum simulation, Quantum counting, Quantum search of an unstructured database, Optimality of the search algorithm	
Unit 4: Quantum Computers	**Hrs.08**
Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer, Optical cavity quantum electrodynamics	
Unit 5: Quantum Noise and Quantum Operations	**Hrs.07**
Quantum operations, Examples of quantum noise, Quantum operations, Applications of quantum operations, Distance measures for classical information	
Unit 6: Quantum Information Theory	**Hrs.08**
Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels, Quantum cryptography	

Textbooks:
1. “Quantum Computation and Quantum Information”, Michael A. Nielsen and Isaac L. Chuang,10th Edition, Cambridge University Press
Reference Books:
1. Quantum Computation and Quantum Information Theory Reprint Volume with Introductory Notes for ISI TMR Network School, 12-23 July 1999, Villa Gualino, Torino, Italy 2000.

Title of the Course: Computational Finance & Modeling	L	T	P	Credits
Course Code: UCBE0812	3	-	-	3

Course Pre-Requisite: Basic knowledge of Finance

Course Description: This course helps to understand the various statistical methods to analyses the financial data.

Course Learning Objectives:

1. This course will enable the students to understand how the techniques in computational finance applied in risk hedging and pricing of options.
2. Student will be able to understand existing financial models in a quantitative and mathematical and apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering.
3. To learn approaches required to calculate the price of options.
4. Students will be able to learn the methods required to analyse information from financial data and trading

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	identify the financial markets and products which are traded	1	Remember
CO2	explore fundamentals of mathematical finances through basic concepts and some important theories.	2	Understanding
CO3	analyze empirical distribution of financial dataset and evaluate portfolios with the help of mathematical modelling	5	Evaluating
CO4	propose financial models with the application of econometrics	6	Creating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1												2
CO2		1											2
CO3		3		3	3							1	
CO4			4		4							1	

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Financial Products and Markets	**CO1**	**07 Hours**
Introduction to the financial markets and the products which are traded in them: equities, indices, foreign exchange, and commodities. Options, contracts and strategies for speculation and hedging.		
Unit 2: Asset Pricing in Continuous Time	**CO2**	**08 Hours**
Fundamental concepts of important financial notions such as returns, arbitrage, reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. Concept of one period model, securities and their Par-Offs, concept of no-arbitrage, Options contracts and strategies for speculation and hedging		
Unit 3: Interest Rates and Credit Modelling	**CO2**	**08 Hours**
Basic notions on interest rates and bond markets. Short-rate models. Black-Scholes-Merton model: Solution of the Black–Scholes Equation, Derivatives of Black–Scholes Option Prices. Hazard function approach: hazard function and hazard rate		
Unit 4: Statistics for Finance	**CO3**	**07 Hours**
Probability Distribution models in Finance, Statistical Finance concepts, Analyzing empirical financial distributions, Factor Models		
Unit 5: Mathematics for Portfolio Modeling	**CO3**	**08 Hours**
Portfolio Mathematics, Portfolio Risk Calculations, Portfolio/Basket Correlation, Transition Matrix Calculations, Default Probability Mathematics, Portfolio Value-at-Risk		

Unit 6: Essential Financial Econometrics	**07 Hours**
Modeling Asset Returns and Volatility, Term Structure Modeling, Multiple Regression in Financial Models, Problems and Solutions, Principal Component Analysis	
Textbooks:	
1. Carol Alexander: Market Risk Analysis, Quantitative Methods in Finance (Volume 1), John Wiley & Sons 2. P. Glasserman: Monte Carlo Methods in Financial Engineering, Springer-Verlag, New York, 2004. 3. W. Press, S. Teukolsky, W. Vetterling and B. Flannery, Numerical Recipes in C: The Art of Scientific Computing, 1997. Cambridge University Press, Cambridge, UK. Available on-line at: http://www.nr.com/ 4. A. Lewis: Option Valuation under Stochastic Volatility, Finance Press, Newport Beach, California, 2000. 5. A. Pelsser: Efficient Methods for Valuing Interest Rate Derivatives, Springer-Verlag, New York, 2000.	
Reference Books:	
1. D. Ruppert, Statistics and Data Analysis for Financial Engineering 2. R. Carmona: Statistical Analysis of Financial Data in S-Plus 3. N. H. Chan, Time Series: Applications to Finance	

Title of the Course: Big-Data	L	T	P	Credits
Course Code: UCBPE0813	3	-	-	3

Course Pre-Requisite: Distributed Systems, Database Management Systems

Course Description: This course is intended to give the knowledge of Big Data evolving in every real-time application and how they are manipulated using emerging technologies. This course describes Hadoop architecture and how to work with the Hadoop Distributed File System (HDFS) and HBase. It also demonstrates the use of MongoDB to store document-oriented data.

Course Learning Objectives:

After compilation of this course, students will be able to:

Understand Big Data Fundamentals

1. Explore the Hadoop Ecosystem, gain hands-on knowledge of Hadoop Distributed File System (HDFS).
2. Work with Document-Oriented Databases & Apply MongoDB for managing unstructured and semi-structured data.
3. Process and Analyze Large-Scale Data & Implement techniques for storing, processing, and analyzing massive datasets.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the fundamentals of big data analysis	II	Understanding
CO2	Outline Apache Hadoop for reliable, scalable and distributed file systems.	II	Understanding
CO3	Make use of Map-Reduce, HIVEQL, PIG etc. to solve big data queries.	III	Analyzing
CO4	Demonstrate use of MongoDB to store and manage document-oriented data	II	Understanding

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1											1	
CO2		2	2	1	3							3	1
CO3		3	3	2	3							3	2
CO4		2	2	1	3							3	1

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction	**CO1**	**8 Hrs**
Introduction to Big Data: Distributed file system– Big data and its importance, Data sets, Data analysis, Data analytics, Business intelligence, KPI, Big data characteristics, Different types of data, Drivers for big data adoption. Big Data Analysis Techniques: Quantitative analysis, Qualitative analysis, Data mining, Statistical analysis, Machine learning, Semantic analysis, Visual analysis, Case studies		
Unit 2: Configuration of Hadoop	**CO2**	**7 Hrs**
Hadoop Architecture: Hadoop eco-system, Hadoop core components, Hadoop distributions, Developing enterprise applications with Hadoop		
Unit 3: Storing Data in Hadoop	**CO2**	**8 Hrs.**
Moving data in and out of Hadoop, HDFS architecture, HDFS files, Hadoop specific file types, HDFS federation and high availability, Fundamentals of HBASE, Zookeeper concepts and methods to build applications with zookeeper.		
Unit 4 : Processing Data with Map-Reduce:	**CO3**	**7 Hrs.**
Knowing map-reduce, Map-reduce execution pipeline, Runtime coordination and task management in map-reduce, Word count map- reduce application, Building and executing map-reduce programs, Designing map-reduce implementations		
Unit 5: HIVE, HIVQL and PIG	**CO3**	**8 Hrs.**
HIVE architecture and installation, Comparison with traditional database, HIVQL querying data, Sorting and aggregating, Joins & sub queries, HIVE Vs PIG Types of NoSQL databases, Advantages of NoSQL, Use of NoSQL in industry, SQL vs NoSQL Buffer Headers, Structure of the Buffer Pool, Scenarios for Retrieval of a Buffer, Reading and Writing		

Unit 6: Database for the Modern Web **CO4**	**7 Hrs.**
Core Server tools, MongoDB through the JavaScript's shell, Creating and querying through indexes, Document-Oriented, Principles of schema design, Constructing queries on databases, Collections and documents, MongoDB Query language	

Textbooks:

1. Erl, T., Khattak, W., & Buhler, P. (2016). *Big Data Fundamentals: Concepts, Drivers & Techniques*. Pearson

2. Lublinsky, B., Smith, K. T., & Yakubovich, A. (2015). *Professional Hadoop Solutions*. Wiley.

3. Banker, K., Bakkum, P., Verch, S., Garrett, D., & Hawkins, T. (2016). *MongoDB in Action* (2nd ed.). Dreamtech Press

Reference Books:

1. White, T. (2015). *Hadoop: The Definitive Guide* (4th ed.). O'Reilly Media.

2. Turkington, G. (2013). *Hadoop Beginner's Guide*. Packt Publishing.

Title of the Course: Behavioural Economics	**L**	**T**	**P**	**Credits**
Course Code: UCBPE0814	**3**	**-**	**-**	**3**

Course Pre-Requisite: Basic understanding of economics, decision theory, analytical reasoning and statistics is required.

Course Description: This course introduces the psychological foundations of economic decision-making and explains why individuals deviate from rational choices. Students will explore behavioural models such as heuristics, prospect theory, and nudging, with applications in digital products, marketing, AI, and policy design.

Course Learning Objectives:

1. To introduce psychological foundations of economic decision-making.
2. To understand biases, heuristics, and bounded rationality in consumer and managerial decisions.
3. To apply behavioural insights in technology product design, AI systems, digital marketing, and policy.
4. To explore experiments, modelling, and data interpretation in behavioural economics.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand and explain the fundamental concepts of behavioural economics, including rationality, prospect theory, heuristics, and biases.	II	Understand
CO2	Analyze cognitive biases and decision anomalies in consumer and managerial decision-making situations.	IV	Analyze
CO3	Apply behavioural economic principles such as nudging, choice architecture, and behavioural game theory to real-world business and technology contexts.	III	Apply
CO4	Understand behavioural game theory concepts and their applications in digital platforms, AI systems, and online interactions.	II	Understand

CO PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1		2									2	2	
CO2		2		2									2
CO3			2		2					2		2	2
CO4		2			2							2	2

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Behavioural Economics	**8 Hrs.**
Meaning, nature, scope and evolution; Traditional vs Behavioural economics; Expected Utility Theory and Rational Choice Theory; Prospect Theory (Kahneman & Tversky)	
Unit 2: Heuristics & Cognitive Biases	**8 Hrs.**
Bounded rationality; Types of heuristics: Availability, Representativeness, Anchoring; Confirmation bias, Overconfidence, Hindsight bias, Status-quo bias; Behavioural anomalies in consumer & managerial decisions; Choice overload and decision fatigue	
Unit 3: Mental Accounting:	**8 Hrs.**
Introduction; Hedonic Editing Hypothesis; Hedonic Framing; Acquisition and transaction utility; Applications of mental accounting; Payment decoupling & budgeting; Behavioral & classical life-cycle theories; Choice bracketing; Dynamic mental accounting; Policy implications of mental accounting	
Unit 4: Behavioural Game Theory	**7 Hrs.**
Game theory vs behavioural game theory; Social preferences: fairness, reciprocity, altruism.	
Unit 5: Strategic Interaction:	**7 Hrs.**
Introduction; Analytical Game Theory; Sequential game & types of games; Problems with classical game theory; Introduction to behavioral games; Ultimatum & dictator Games; Ultimatum & public goods games; Trust games	
Unit 6: Choice Architecture & Nudging	**7 Hrs.**
Thaler & Sunstein: Nudge Theory; Libertarian paternalism; Types of nudges; Default options, framing, feedback, salience, social norms	

Textbooks:

1. An Introduction to Behavioral Economics, by N. Wilkinson and M. Klaes
2. Kahneman, Daniel – *Thinking, Fast and Slow*
3. Thaler, Richard H. & Sunstein, Cass – *Nudge: Improving Decisions About Health, Wealth and Happiness*
4. Camerer, Colin – *Behavioural Game Theory*

Reference Books:

1. Ariely, Dan – *Predictably Irrational*
2. Dhami, Sanjit – *Behavioural Economics: Foundations and Applications*
3. Morgan, Milena – *Behavioural Data Science*
4. Prakash Sharma – *Behavioural Economics for India* (NITI Aayog recommended)

Title of the Course: Robotics and embedded system **Course Code:** UCBPE0815	**L**	**T**	**P**	**Credits**
	3	**-**	**-**	**3**

Course Pre-Requisite: Basic knowledge of electronics, digital circuits, C programming fundamentals, and microprocessor basics

Course Description: This course introduces the fundamentals of **embedded systems and robotics** with emphasis on their integration in real-world applications. The course covers embedded system concepts, microcontroller architectures, and embedded C programming for sensor and actuator interfacing. Students are exposed to robotic system components, sensors, actuators, motors, and basic robotic mechanisms.

Course Learning Objectives:

1. Understand embedded system architecture and microcontroller design.
2. Learn Arduino programming, IDE usage, and sensor interfacing.
3. Develop actuator control and communication interfacing skills.
4. Understand robotics components, mechanisms, and basic kinematics

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain fundamentals of embedded systems and microcontroller architectures used in robotics applications	II	understand
CO2	Apply concepts of sensors, actuators, and motors for basic robotic system design and interfacing.	III	Apply
CO3	Demonstrate microcontroller and embedded C programming techniques for motor and peripheral interfacing.	III	Apply
CO4	Describe robotic components, open-source hardware platforms, basic kinematics, and real-life robotic applications.	II	Understand

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2								1		1	
CO2	1	1	3		3				1	1	1		
CO3	1	1		3	3			1	1	1	2		
CO4	2	3	1	1	1		1	1	1	1			1

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction of Embedded Systems	**CO1**	**7 Hrs.**
What is an embedded system,Classification of embedded system,Basic components of embedded System,Characteristics of embedded system,,Embedded system-Bases IOT,Advances in Embedded Systems in Robotics		
Unit 2: Introduction to Robotics	**CO2**	**8 Hrs.**
History of Robotics, Laws of Robotics,Terminologies like Degree of freedom etc. and Basic Concepts,Basic components of robot,Applications of Robots,Different types of motor used in Robotics		
Unit 3: Sensors, Actuators, and Circuits in Robotics	**CO2**	**8 Hrs.**
Basic Concepts of Sensors,Sensors Used in Robotics(Infrared Sensor,Ultrasonic Sensors,Light Sensor,Touch Sensor,Pressure Sensor,Thermal Sensor,Position Sensor etc), Basic Concepts of Actuator,Types of Actuators,Actuators Used in Robotics		
Unit 4: Microcontrollers in Robotics	**CO3**	**8 Hrs.**
What Is a Microcontroller,Classification of Microcontrollers,The Structure of an Embedded C Program,Pre-processor Directives, Commonly Used Microcontrollers in Robotics.(AT89C51, ATMEGA Microcontroller)		
Unit 5: Open Source Hardware	**CO4**	**7 Hrs.**
Arduino UNO,Raspberry Pi ,Main components of raspberry pi,Examples of Open-source Software Products(Linux Ubuntu,Scilab,Digikam for image editing and processing),Interfacing of temperature sensor with Arduino,igus Robot Control software		
Unit 6: Case Studies	**CO4**	**7 Hrs.**
Home Automation System,Three Servo Ant Robot,Automated Plant-Watering System		

Textbooks:

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, McGraw-Hill.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson.
3. R.K. Mittal & I.J. Nagrath, Robotics and Control, Tata McGraw-Hill.

Reference Books:

1. Embedded Systems and Robotics with Open Source Tools ,Nilanjan Dey,Amartya Mukherjee.
2. Introduction to Embedded Systems and Robotics, Nayan M.kakoty,Rupam Goswami.Ramana Vinjamuri.

Title of the Course: Advanced Social, Text and Media Analytics	**L**	**T**	**P**	**Credits**
Course Code: UCBPE0816	**3**	**-**	**-**	**3**

Course Pre-Requisite: Basic Knowledge of Machine learning.

Course Description: To introduce the fundamental concepts in social media analytics and web analytics Tools. To understand various social media Models.

Course Learning Objectives:

1. To understand Data Mining methods and Probabilistic models for information extraction
2. To understand the use of social network analysis to understand the growing connectivity and complexity in the world.
3. To Analyse social network to identify important social actors, subgroups (i.e., clusters), and network properties in social media
4. To Apply state of the art mining tools and libraries on realistic data sets as a basis for business decisions and applications

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand Data Mining methods and Probabilistic models for information extraction	II	Understand
CO2	Understand the use of social network analysis to understand the growing connectivity and complexity in the world	II	Understand
CO3	Apply state of the art mining tools and libraries on realistic data sets as a basis for business decisions and applications	III	Analyse
CO4	Analyse social network to identify important social actors, subgroups (i.e., clusters), and network properties in social media	IV	Apply

CO-PO Mapping:

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

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

ISE-1 and ISE-2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Text Mining	**Hrs.06**
Text Mining: Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction	
Unit 2: Web Analytics	**Hrs.08**
Web Analytics: Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models	
Unit 3: Social Media Analytics	**Hrs.08**
Social Media Analytics: Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization	
Unit 4: Making Connections	**Hrs.07**
Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis	
Unit 5: Advanced Social Analytics and its Application	**Hrs.08**
Communities and Interactions-Community Analysis - Community Detection - Community Evolution - Community Evaluation-Information Diffusion in social media - Herd Behavior - Information Cascades - Diffusion of Innovations - Epidemics-Recommendation in social media - Challenges - Classical Recommendation Algorithms - Recommendation Using Social Context - Evaluating Recommendations -Behavior Analytics - Individual Behavior - Collective Behavior	

Unit 6: - Media Analytics	**Hrs.08**
The four dimensions of analysis taxonomy - Depth of Analysis- Machine capacity- Domain of analysis- Data Integrity - Ad-Hoc Analysis-Responding to leads identified in social media-support for deep analytics in analytics software-Enterprise social network-visualisation as an aid to analytics	

Textbooks:

1. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006
2. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011 Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 304

Reference Books:

1. Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: Cambridge University Press.
2. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press. http://nosh.northwestern.edu/vita.html

Youtube Links:

Unit 1:

1. https://www.youtube.com/watch?v=Uqs0GewlMkQ
   https://www.youtube.com/watch?v=tUNwSH7671Y&t=2s
   https://www.youtube.com/watch?v=zz1CFBS4NaY

Unit 2:

1. https://www.youtube.com/watch?v=KjWu1-dZn00

Unit 3:

1. https://www.youtube.com/watch?v=ntOaoW0T604

Unit 4:

1. https://www.youtube.com/watch?v=otoXeVPhT7Q&list=PL34t5iLfZddt0tt5GdDy3ny6X5RQvwrp6&index=2