Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours Degree Programs in Technology

(with effect from 2024-25)

1. Artificial Intelligence and Machine Learning
2. Augmented Reality and Virtual Reality
3. Blockchain
4. Cyber Security
5. Data Science
6. Internet of Things

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours Degree Programs in Technology

(with effect from 2024-25)

Artificial Intelligence & Machine Learning

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

CURRICULUM STRUCTURE UG: B.Tech.

Honours/Minors Degree Program

Artificial Intelligence and Machine Learning

REVISION: R0-V0-2024-25

Effective from Academic Year 2024-25 onwards

Approved by Board of Studies on 18/05/2024

Approved by Academic Council on 25/05/2024

Dr. T.P Vinutha
I/C HOD

Shah & Anchor Kutchhi Engg. College Autonomous Institute Mumbai - 88

Dr. Bhavesh Patel
Principal

Dr. Bhavesh Patel
Chairman
Academic Council
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Chairman BoS
Department of Electronics & Telecommunication Engg.
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

PREAMBLE

Shah and Anchor Kutchhi Engineering College was established in 1985 for the purpose of imparting quality technical education. The college is managed by Mahavir Education Trust. The college is approved by AICTE, New Delhi and DTE, Government of Maharashtra and has been conferred autonomous status by University Grants Commission (UGC) and University of Mumbai for a period of 10 Years with effect from the academic year 2024-25. It also has an ISO 9001:2015 Certification. The institute offers eight under graduate courses, three post-graduate courses and one PhD research Centre in IT.

The Honours Program in Artificial Intelligence and Machine Learning (AI-ML), offered by Shah and Anchor Kutchhi Engineering College, is designed to provide students with a robust foundation in the principles and practices of AI and ML. The program integrates rigorous coursework, hands-on laboratory experiences, and real-world applications to equip students with the skills needed to excel in the rapidly evolving field of artificial intelligence and machine learning.

Over the course of two years, students will engage in an interdisciplinary curriculum that covers advanced mathematical techniques, strategic decision-making models, and innovative applications of AI and ML in various domains, including healthcare and natural language processing. The program is structured to ensure a comprehensive understanding of both theoretical concepts and practical implementations, preparing graduates to tackle complex challenges and drive innovation in AI-ML.

Key features of our autonomous syllabus include:

1. Interdisciplinary Learning: Foster an interdisciplinary approach by integrating mathematical, technical, and application-oriented courses.
2. Practical Expertise: Provide extensive hands-on laboratory experiences to bridge the gap between theoretical knowledge and real-world application.
3. Innovation and Research: Encourage innovative thinking and research through project-based learning and exposure to cutting-edge AI and ML technologies.
4. Ethical Considerations: Instill a deep understanding of the ethical, societal, and privacy implications of AI and ML technologies.

Graduates of the AI-ML Honours Program will be well-prepared for careers in various sectors, including technology, healthcare, finance, and academia. They will possess the skills required to develop innovative AI solutions, conduct advanced research, and contribute to the growing field of artificial intelligence and machine learning.

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

Program Structure for Honours Degree in Artificial Intelligence and Machine Learning
(With Effect from 2024-2025)

		Scheme of Instruction				Scheme of Examination					
			Hours per Week		Total Credits	Duration in Hours	Maximum Marks				Total Marks
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM V	HNAMCR0501	**Mathematics for AI & ML**	4	-	4	3	20	20	40	60	100
	TOTAL		4	-	4	3	20	20	40	60	100
SEM VI	HNAMCR0601	**Game Theory using AI & ML**	4	-	4	3	20	20	40	60	100
	TOTAL		4	-	4	3	20	20	40	60	100
SEM VII	HNAMCR0701	**AI & ML in Healthcare**	4	-	4	3	20	20	40	60	100
PRACTICAL							**CIAP**			**ESEP**	
SEM VII	HNAMLR0701	**AI & ML in Healthcare Laboratory**	-	4	2	3	40			60	100
	TOTAL		4	4	6	6	80			120	200
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM VIII	HNAMCR0801	**Natural Language Processing and Generative AI**	4	-	4	3	20	20	40	60	100
	TOTAL		4	-	4	3	20	20	40	60	100
Honours TOTAL			**16**	**04**	**18**		**200**			**300**	**500**
Total Credits for Semesters V,VI, VII & VIII = 04+04+06+04=18											

*All ESE & ESEP (Theory & Practical) will be conducted for 100 marks and converted as per appropriate Teaching and Examination scheme

CIA = Continuous Internal Assessment ESE = End Semester Examination MSE = Mid Semester Examination
CIAP = Continuous Internal Assessment Practical ESEP = End Semester Examination Practical CCE = Continuous Comprehensive Evaluation

SEMESTER V

Program: Honours Degree in Artificial Intelligence and Machine Learning Semester: V		L	P	C
Mathematics for AI & ML	**Course Code: HNAMCR0501**	**4**	**0**	**4**

Course Objectives:	
1	To build an intuitive understanding of Mathematics and relating it to Artificial Intelligence, Machine Learning.
2	To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3	To focus on exploring the data with the help of graphical representation and drawing conclusions.
4	To explore optimization and dimensionality reduction techniques.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Apply linear algebra and probability distributions and sampling distributions concepts to model, solve, and analyze real-world problems.
CO 2:	Select an appropriate graph representation and Apply exploratory data analysis to some real data sets and provide interpretations via relevant visualization
CO 3:	Analyze various optimization techniques.
CO 4:	Evaluate Dimension Reduction Algorithms

Pre-requisite courses: Applied Mathematics

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/ Design Thinking/Innovation/Creativity. 3. End Semester Examination (Theory and Lab components)
INDIRECT
1. Course-end survey 2. Activity based survey (if any)
Topics covered:

Module 1 Fundamentals of Probability and Statistics	**16 Hours**
1.1 Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces 1.2 Eigenvalues and Eigen Vectors, The Singular Value Decomposition (SVD). 1.3 Introduction, Random Variables and their probability Distribution 1.4 Random Sampling, Sample Characteristics and their Distributions 1.5 Chi-Square, t-Distribution, and F-Distributions: Exact Sampling Distributions 1.6 Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.	
Module 2 Exploratory Data Analysis	**18 Hours**
2.1. Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data 2.2. Plotting data using Bar graph, Pie chart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph. 2.3. Need of exploratory data analysis, cleaning and preparing data 2.4. Feature engineering, Missing values, understand dataset through various plots and graphs, drawing conclusions, deciding appropriate machine learning models	
Module 3 Optimization Techniques	**10 Hours**
3.1 Types of optimization-Constrained and Unconstrained optimization, Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Positions Method Newton's method, Steepest descent method	

Module 4 Dimension Reduction Algorithms	8 Hours
4.1 Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Linear Discriminant Analysis (LDA) 4.2 Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial	
Lecture: 4 Hrs/Week	**Total Hours: 52 Hrs**

Textbooks:

1. Linear Algebra for Everyone, Gilbert Strang, Wellesley Cambridge Press.
2. An Introduction to Probability and Statistics, Vijay Rohatgi, Wiley Publication
3. An introduction to Optimization, Second Edition, Wiley-Edwin Chong, Stainslaw Zak.
4. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press.
5. Exploratory Data Analysis, John Tukey, Princeton University and Bell Laboratories.

Reference Books:

1. Introduction to Linear Algebra, Gilbert Strang.
2. Advanced Engineering Mathematics, Erwin Kreyszig
3. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of Machine Learning. MIT Press, 2018.
4. Shai Shalev-Shwartz and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014
5. Mathematics and Programming for Machine Learning with R, William B. Claster, CRC Press,2020

Useful Links:

1. https://math.mit.edu/~gs/linearalgebra/
2. https://www.coursera.org/learn/probability-theory-statistics
3. https://nptel.ac.in/courses/111/105/111105090/
4. https://onlinecourses.nptel.ac.in/noc21_ma01/preview
5. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

SEMESTER VI

Program: Honours Degree in Artificial Intelligence and Machine Learning Semester: VI		L	P	C
Game Theory using AI & ML	**Course Code: HNAMCR0601**	**4**	**0**	**4**

Course Objectives:	
1	To acquire the knowledge of game theory.
2	To understand the basic concept of AI, strength and weakness of problem solving and search
3	To study about various heuristic and game search algorithms
4	To optimize the different linear methods of regression and classification
5	To acquire the knowledge of different generative models through unsupervised learning

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand basic concept of game theory
CO 2:	Evaluate Artificial Intelligence (AI) methods and describe their foundations
CO 3:	Analyze and illustrate how search algorithms play vital role in problem solving, inference, perception, knowledge representation and learning
CO 4:	Demonstrate knowledge of reasoning and knowledge representation for solving real world problems

Pre-requisite courses: Mathematics for AI & ML,
Basics of Artificial Intelligence,
Basics of Machine Learning

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/ Design Thinking/Innovation/Creativity. 3. End Semester Examination (Theory and Lab components)
INDIRECT
1. Course-end survey 2. Activity based survey (if any)
Topics covered:

Module 1 Fundamentals of Probability and Statistics	**14 Hours**
1.1 Introduction, The theory of rational choice, Games with Perfect Information, Nash equilibrium theory, Prisoners Dilemma, stag hunt, matching pennies, BOS, Multi NE, Cooperative and Competitive Games, Strict and Non Strict NE, Best response functions for NE 1.2 Nash Equilibrium Illustrations, Cournot's model of oligopoly, Bertrand's model of oligopoly Electoral competition, The War of Attrition, Auctions, Mixed Strategy Equilibrium, Strategic games in which players may randomize, Dominated actions, Extensive Games with Perfect Information	
Module 2 Games with Imperfect Information	**18 Hours**
2.1. Bayesian Games, Introduction, Motivational examples, General definitions, two examples concerning information, Strictly Competitive Games and Maxminimization, Rationalizability 2.2. Evolutionary Equilibrium, Monomorphic pure strategy equilibrium, Mixed strategies repeated games, Strategies and polymorphic equilibrium, Repeaters Games: Prisoners Dilemma, Strategies, General Results	

Module 3 Introduction to AI & Problem Solving	12 Hours
3.1. Definitions Foundation and History of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment. Artificial Intelligence vs Machine learning 3.2. Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best first Search; Problem Reduction. Beyond Classical Search: Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action	
Module 4 Knowledge and Reasoning	**8 Hours**
4.1 Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order Logic, situation calculus. Theorem Proving in First Order Logic, Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities 4.2 Bayesian Networks. Probabilistic reasoning over time: time and uncertainty, hidden Markova models, Kalman filter, dynamic bayesian network, keeping track of many objects	
Lecture: 4 Hrs/Week	**Total Hours: 52 Hrs**

Textbooks:

1. Martin Osborne, An Introduction to Game Theory, Oxford University Press.
2. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition,Prentice Hall
3. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

Reference Books:

1. Thomas Ferguson, Game Theory, World Scientific, 2018.
2. Stef Tijs. Introduction to Game Theory, Hindustan Book Agency

Useful Links:

1. https://www.javatpoint.com/automata-and-game-theory
2. https://www.analyticsvidhya.com/blog/2019/11/game-theory-ai/
3. https://www.kdnuggets.com/2020/03/crash-course-game-theory-machine-learning.html

SEMESTER VII

Program: Honours Degree in Artificial Intelligence and Machine Learning Semester: VII		L	P	C
AI & ML in Healthcare	Course Code: HNAMCR0701	4	0	4
AI & ML in Healthcare Lab	Lab Code: HNAMLR0701	0	4	2
		4	4	6

Course Objectives:	
1	To understand the need and significance of AI and ML for Healthcare.
2	To study advanced AI algorithms for Healthcare.
3	To learn various NLP algorithms and their application in Healthcare,
4	To investigate the current scope, implications of AI and ML for developing futuristic Healthcare Applications.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand the role of AI and ML for handling Healthcare data.
CO 2:	Apply Advanced AI algorithms for Healthcare Problems.
CO 3:	Evaluate various NLP Techniques used for healthcare applications
CO 4:	Develop AI and ML algorithms for building Healthcare Applications

Pre-requisite courses: Mathematics for AI & ML,
Basics of Artificial Intelligence,
Basics of Machine Learning

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/ Design Thinking/Innovation/Creativity. 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments /Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Lab Component) 4. End Semester Examination (Theory and Lab components)
INDIRECT
1. Course-end survey 2. Lab-end survey 3. Activity based survey (if any)
Topics covered:

Module 1 Overview of AI and ML in Healthcare	**14 Hours**
1.1 Overview of AI and ML in Healthcare, A Multifaceted Discipline, Applications of AI in Healthcare -Prediction, Diagnosis, personalized treatment and behavior modification, drug discovery, followup care etc, Realizing potential of AI and ML in healthcare, Healthcare Data - Use Cases. 1.2 Evaluating learning for Intelligence Model development and workflow, evaluation metrics, Parameters and Hyperparameters, Hyperparameter tuning algorithms, multivariate testing, Concept of federated learning. 1.3 AI, ML, Deep Learning and Data Mining Methods for Healthcare, Knowledge discovery and Data Mining, Multi classifier Decision Fusion, Ensemble Learning, Meta-Learning and other Abstract Methods. Evolutionary Algorithms, Computational Intelligence Techniques, Unsupervised learning.	

Module 2 Illustrative Medical Application	**14 Hours**
2.1. Introduction to Medical Imaging-X-ray, CT, MRI, and PET scans, radiology, Medical image processing in cancer diagnosis, diabetic Retinopathy detection, Tumor Segmentation in Brain MRI, Multiagent Infectious Disease, Propagation and Outbreak Prediction, Automated Amblyopia Screening System etc. 2.2. Reinforcement Learning in Treatment Planning, Design and deployment of AI solutions in health care	
Module 3 Natural Language Processing in Healthcare	**14 Hours**
3.1 NLP tasks in Medicine, Low-level NLP components, High level NLP components, NLP Methods. Web-Scraping approaches in Healthcare 3.2 Clinical NLP resources and Tools, NLP Applications in Healthcare. Model Interpretability using Explainable AI for NLP applications 3.3 Definition and Scope of Telemedicine, Telehealth vs. Telemedicine, Telemedicine Technologies, health-insurance claims processing 3.4 Intelligent personal Health Record Introduction, Key Components of EHR (Electronic Health Record), Guided Search for Disease Information, Recommending SCA's. Recommending HHP's , Continuous User Monitoring	
Module 4 Future of Healthcare using AI and ML	**10 Hours**
4.1 Evidence based medicine, Personalized Medicine, Connected Medicine, Digital Health and Therapeutics, Conversational AI, Virtual and Augmented Reality, Blockchain for verifying supply chain, patient record access, Robot - Assisted Surgery, Smart Hospitals, Internet of Medical Things (IoMT) 4.2 Case Studies on use of AI and ML for Disease Risk Diagnosis from patient data, Augmented reality applications for Junior doctors. Blockchain for verifying supply chain, patient record access, Robot - Assisted Surgery 4.3 Smart Hospitals, cloud services in healthcare Case Studies on use of AI and ML for Disease Risk Diagnosis from patient data, Augmented reality applications for Junior doctors	
Lecture: 4 Hrs/Week	**Total Hours: 52 Hrs**

LAB COMPONENT CONTENTS:

Suggested Topic of Experiments (Minimum 8 Experiments)

1. Collect, Clean, Integrate and Transform Healthcare Data based on specific disease.
2. Perform Exploratory data analysis of Healthcare Data.
3. AI for medical diagnosis based on MRI/X-ray data.
4. AI for medical prognosis .
5. Natural language Entity Extraction from medical reports.
6. Predict disease risk from Patient data.
7. Medical Reviews Analysis from social media data.
8. Explainable AI in healthcare for model interpretation.
9. Mini Project-Design and implement innovative web/mobile based AI application using Healthcare Data.
10. Documentation and Presentation of Mini Project.

One beyond curriculum experiment may be conducted (To be decided by the Subject Teacher)

Practical: 4 Hrs/Week	**Total Hours : 52 Hrs**

Textbooks:

1. Arjun Panesar, “Machine Learning and AI for Healthcare”, A Press
2. Arvin Agah, "Medical applications of Artificial Systems ", CRC Press

Reference Books:

1. Erik R. Ranschaert , Sergey Morozov, Paul R. Algra, Artificial Intelligence in Medical Imaging: Opportunities, Applications and Riskst, 2019
2. Dac-Nhuong Le , Chung Van Le, Jolanda G. Tromp, Gia Nhu Nguyen, Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0, 2018
3. Guoguang Rong, Arnaldo Mendez, Elie Bou Assi, Bo Zhao, Mohamad Sawan, Artificial Intelligence in Healthcare: Review and Prediction Case Studies, Engineering, Volume 6, Issue 3, 2020, Pages 291-301, ISSN 2095-8099, https://doi.org/10.1016/j.eng.2019.08.015.

Useful Links:

1. https://ocw.mit.edu/courses/6-s897-machine-learning-for-healthcare-spring-2019/pages/lecture-notes/
2. https://www.coursera.org/learn/introduction-tensorflow?specialization=tensorflow-in-practice
3. https://www.coursera.org/learn/convolutional-neural-networks-tensorflow?specialization=tensorflow-in-practice
4. https://datarade.ai/data-categories/electronic-health-record-ehr-data
5. https://www.cms.gov/Medicare/E-Health/EHealthRecords
6. https://www.coursera.org/learn/tensorflow-sequences-time-series-and-prediction?specialization=tensorflow-in-practice

SEMESTER VIII

Program: Honours Degree in Artificial Intelligence and Machine Learning Semester: VIII		L	P	C
Natural Language Processing and Generative AI	Course Code: HNAMCR0801	4	0	4

Course Objectives:	
1	To develop a solid foundation in text mining techniques and applications.
2	To gain hands-on experience with clustering, classification, and text modeling algorithms.
3	To understand and implement advanced generative models for text generation.
4	To apply social network analysis techniques to extract and analyze data from social media platforms.
5	To enhance their ability to critically assess and develop AI solutions for processing and generating textual data in various domains, including healthcare, social media, and beyond.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Demonstrate a comprehensive understanding of fundamental concepts in Natural Language Processing (NLP)
CO 2:	Apply NLP techniques to solve real-world problems
CO 3:	Implement generative models to create synthetic data, with a focus on practical applications in image generation, text generation, or other relevant domains.
CO 4:	Explore advanced techniques such as aspect-based opinion mining for a more granular analysis.

Pre-requisite courses: Mathematics for AI & ML,
Basics of Artificial Intelligence,
Basics of Machine Learning

Course Assessment Methods:

DIRECT	
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/ Design Thinking/Innovation/Creativity. 3. End Semester Examination (Theory and Lab components)	
INDIRECT	
1. Course-end survey 2. Activity based survey (if any)	
Topics covered:	
Module 1 Introduction to Text Mining	**13 Hours**
1.1 Introduction to Text Mining: Introduction, Algorithms for Text Mining, Future Directions 1.2 Information Extraction from Text: Named Entity Recognition, Part-of-Speech (POS) Tagging, Relation Extraction, Unsupervised Information Extraction 1.3 Text Representation: Word2Vec, GloVe, and FastText Embeddings in NLP Applications tokenization, stemming, stop words, NER, N-gram modelling	

Module 2 Text Clustering, Classification and Modeling	**13 Hours**
2.1. Text Clustering: Feature Selection and Transformation Methods, distance based Clustering Algorithms, Word and Phrase based Clustering, Probabilistic document Clustering 2.2. Text Classification: Feature Selection, Decision tree Classifiers, Rule-based Classifiers, Probabilistic based Classifiers, Proximity based Classifiers 2.3. Text Modelling: Bayesian Networks, Hidden Markovian Models, Markov random Fields, Conditional Random Fields	
Module 3 Generative Models	**13 Hours**
3.1 Introduction to Generative Models, Overview of Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) 3.2 Text Generation with GPT (Generative Pre-trained Transformer), Understanding Transformer Architecture, Fine-tuning GPT for Specific Tasks, Applications of Generative AI	
Module 4 Social Network Analysis	**13 Hours**
4.1 Web Scraping for Data Collection, Techniques for Extracting Text from Websites, Meta Search, web spamming, Legal and Ethical Considerations 4.2 Sentiment Analysis and Opinion Mining: Analyzing Public Sentiments on Social Media, Case Studies in Opinion Mining 4.3 Opinion Spam Detection: Information Retrieval and Search Engines: Introduction to Search Algorithms, Building a Basic Search Engine Social Network Analysis: Analyzing Social Media Networks, Identifying Influencers and Trends	
Lecture: 4 Hrs/Week	**Total Hours: 52 Hrs**

Textbooks:

1. Charu. C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer Science and Business Media, 2012.
2. Dan Jurafsky and James H. Martin, Speech and Language Processing, Pearson, 2019
3. Lane, Howard, and Hapke, Natural Language Processing in Action, Manning Publications, 2019
4. Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1999
5. Palash Goyal, Sumit Pandey, and Karan Jain, Deep Learning for Natural Language Processing, Packt Publishing, 2018
6. David Foster, Generative Deep Learning, O'Reilly Media, 2019
7. Nitin Hardeniya, Natural Language Processing: Python and NLTK, Apress, 2017

Reference Books:

1. Daniel Jurafsky, James H. Martin, and James R. Glass. "Speech and Language Processing" Pearson, 2021
2. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python" O'Reilly Media, 2009

Online Resources:

1. Natural Language Toolkit (NLTK) Documentation https://www.nltk.org/
2. spaCy - Industrial-Strength Natural Language Processing in Python https://spacy.io/
3. OpenAI GPT-3 Documentation https://platform.openai.com/docs/introduction
4. TensorFlow - Text Classification Guide https://www.tensorflow.org/tutorials/keras/text_classification

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Address
Mahavir Education Chowk,
W.T. Patil Marg, Chembur
Mumbai- 400 088

विद्याधनं सर्वधनेषु प्रधानम्॥

www.sakec.ac.in

info@sakec.ac.in

@sakectweets

www.facebook.com/shahanchor

09136400555

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours Degree Programs in Technology

(with effect from 2024-25)

Augmented Reality & Virtual Reality

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

CURRICULUM STRUCTURE UG: B.Tech.

Honours/Minors Degree Program

Augmented Reality and Virtual Reality

REVISION: R0-V0-2024-25

Effective from Academic Year 2024-25 onwards

Approved by Board of Studies on 18/05/2024

Approved by Academic Council on 25/05/2024

Dr.Pravin V.Shinde
I/C HOD

Chairman BoS
Department of Artifical Intelligence & Data Science
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Shah & Anchor Kutchhi Engg. College Autonomous Institute Mumbai - 88

Dr. Bhavesh Patel
Principal
Dr. Bhavesh Patel
Chairman
Academic Council
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Preamble

In an era where technological disruptions occur at an unprecedented pace, academic autonomy is a significant advantage for the Engineering Institute. It allows Institutions to swiftly adapt and innovate in their curriculum to meet the evolving demands of society and industry. This newly designed syllabus for the Honors Degree in AR-VR Engineering at Shah and Anchor Kutchhi Engineering College, Mumbai exemplifies the benefits of such autonomy. Starting at semester V the students will go through the well designed courses for four semesters transforming them from a curious learner to proficient AR-VR developer. Following are a few features of the honours degree course in AR-VR:

1. **Strong Foundations**: The curriculum is meticulously crafted to ensure that students build a robust foundation in mathematical and scientific principles. This foundation is crucial as it equips students with the essential knowledge and analytical skills required to understand and innovate in the rapidly advancing field of AR-VR technology.
2. **Industry-Relevant Skills**: The syllabus is designed with a keen focus on the latest technologies and industry trends. By integrating contemporary topics and hands-on projects, we prepare our students to seamlessly transition from academic learning to professional practice. The theoretical subjects provide deep insights into foundational and advanced concepts, while the practical sessions in the AR-VR Application Development Lab enable students to apply these concepts in real-world scenarios.
3. **Skill Development**: Practical sessions are integral to our curriculum, ensuring that students do not just learn about AR-VR technologies but also develop the skills to implement and innovate with them. This hands-on experience is invaluable, providing students with the competence and confidence needed to excel in the industry.
4. **Clear Objectives and Outcomes**: Our syllabus is designed with clearly defined course objectives and outcomes, providing students with a transparent and structured learning path. This clarity helps students understand the specific skills and knowledge they will acquire throughout the course, allowing them to focus their efforts and measure their progress effectively.

In conclusion, the Honors Degree in AR-VR Engineering at our Institute is a comprehensive program that combines strong theoretical foundations with practical skill development. It prepares students to become proficient and innovative professionals in the AR-VR industry, ready to meet the challenges of a rapidly evolving technological landscape.

Honours Degree in Augmented Reality and Virtual Reality

Program Structure for Honours Degree In Augmented Reality and Virtual Reality
(With Effect from 2024-2025)

Scheme of Instruction						Scheme of Examination					
			Hours per Week		Total Credits	Duration in Hours	Maximum Marks				Total Marks
Year sem	Course Code	Name of the Course	L	P			CIA			ESE	
							MSE	CCE	Total		
TE SEM V	HNAVCR0501	**Foundations of AR-VR**	4	-	4	3	20	20	40	60	100
Total			**4**	**-**	**4**		**20**	**20**	**40**	**60**	**100**
TE SEM VI	HNAVCR0601	**AR & Mixed Reality**	4	-	4	3	20	20	40	60	100
Total			**4**	**-**	**4**		**20**	**20**	**40**	**60**	**100**
BE SEM VII	HNAVCR0701	**AR-VR Application Development**	4	-	4	3	20	20	40	60	100
PRACTICAL							**CIAP**			**ESP**	
BE SEM VII	HNAVLR0701	**AR-VR Application Development Lab**	-	4	2	3	40			60	100
Total			**4**	**4**	**6**		**80**			**120**	**200**
BE SEM VIII	HNAVCR0801	**Game Development with VR**	4	-	4	3	20	20	40	60	100
Total			**4**	**-**	**4**		**20**	**20**	**40**	**60**	**100**
Honours TOTAL			**16**	**04**	**18**		**100**	**100**	**200**	**300**	**500**

*All ESE & ESEP (Theory & Practical) will be conducted for 100 marks and converted as per appropriate Teaching and Examination scheme

CIA=Continuous Internal Assessment MSE=Mid Semester Examination CIAP=Continuous Internal Assessment Practical
ESEP=End Semester Examination Practical CCE= Continuous Comprehensive Evaluation ESE=End Semester Examination

SEMESTER V

Program: Honours Degree in Augmented Reality and Virtual Reality	Semester: V	L	P	C
Foundations of AR-VR	Course Code: HNAVCR0501	4	0	4

Course Objectives:	
1	To create a technical and mathematical foundation for the students for learning the advanced courses on Virtual and Augmented reality.
2	To introduce the students to the spectrum of AR-VR technologies.
3	To introduce the students how the human sensory organs work and the psychology of AR-VR.
4	To understand the fundamentals of human-computer interaction which is necessary for developing AR-AR applications.

Course Outcomes:	
After successful completion of this course, the students will be able to	
CO 1:	Describe the spectrum of AR-VR technologies and its applications in different fields.
CO 2:	Apply the different 2D and 3D transformations to demonstrate the effect of different actions on the objects.
CO 3:	Describe how human sense organs work and how it can be used in developing AR-VR systems.
CO 4:	Describe the basic concepts of human-computer interaction.

Pre-requisite courses: Computer Graphics.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components).
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1 : Introduction to AR and VR	**12 Hours**
1.1 Introduction to AR and VR : AR-VR technology spectrum, comparison of the technologies in this spectrum, hardware associated with them, evolution of AR-VR technologies, VR system architecture, applications. 1.2 Sensory organs of human beings and psychology of VR : Physiology of human vision, how human vision works, audio, how auditory perception works.	
Module 2 : Computer Graphics and 3D Modelling	**15 Hours**
2.1 Computer Graphics and 3D Modelling: Homogeneous coordinate system, 2D and 3D basic and composite transformations, viewing and clipping.	
Module 3 : Human-computer interaction	**15 Hours**
3.1 Human-computer interaction : Fundamentals of HCI, such as human factors, user interface design, user interface software and tools, user interface evaluation, and user interface standards.	
Module 4 : Latest Trends, Startup and research Opportunities in AR-VR	**10 Hours**
4.1 Latest Trends, Startup and research Opportunities in AR-VR : AI powered AR-VR, Metaverse, Mobile AR, - Games, Business Tools, WebAR, Wearable AR, Teleportation. 4.2 Research and Startup Opportunities : Tourism, VR Concerts and festivals, Interactive Theater, Theme parks, Immersive Cinema. VR Social Casinos, AR Game Studios, AR tournaments and events, Virtual Showrooms, Real Estate Visualization, Telemedicine Platforms, Physical therapy Apps, AR Interior Design Tools Architectural Visualisations, AR Educational Apps, Business Opportunities in Metaverse. 4.3 Blockchain : Introduction to blockchain. Using blockchain for Metaverse related startups.	

Lecture:4 hrs/week **Total Hours :52 Hrs**

Textbooks:

1. Hearn and Baker, “Computer Graphics- C version”, 2nd edition, Pearson, 2002.
2. R. K Maurya, “Computer Graphics with Virtual Reality”, 3rd Edition, Wiley India, 2018.
3. Steven M. LaVelle,” Virtual Reality”, Cambridge University press, 2019.
4. Vince, “Virtual Reality Systems”, 1st Edition, Pearson Education, 2002

Reference Books:

1. George Mather, “Foundations of Sensation and Perception”, Psychology Press book; 3rd Edition, 2016
2. Tony Parisi, “Learning Virtual Reality”, 1st edition, O’Reilly, 2015
3. Alan Craig and William Sherman,” Understanding virtual reality: Interface, application and design”, 2nd Edition, Morgan Kaufmann Publisher, 2019
4. Peter Shirley, Michael Ashikhmin, and Steve Marschner, “Fundamentals of Computer Graphics”, A K Peters/CRC Press; 4th Edition, 2016.

SEMESTER VI

Program: Honours Degree in Augmented Reality and Virtual Reality	Semester: VI	L	P	C
Augmented and Mixed Reality	Course Code: HNAVCR0601	4	0	4

Course Objectives:	
1	To understand the concept of Augmented Reality and the other technologies associated with it.
2	To understand the tracking and different techniques used for it.
3	To introduce the architecture of the AR application.
4	To introduce the concepts of modelling annotation and authoring.

Course Outcomes:	
After successful completion of this course, the students will be able to	
CO 1:	Describe how AR systems work.
CO 2:	Explain the concept of tracking, registration and calibration.
CO 3:	Apply the software engineering concepts for developing the AR application.
CO 4:	Explain the concepts of modelling, annotation and authoring in AR.

Pre-requisite courses: Computer Graphics.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components).
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1 : Introduction to AR & Mix Reality and Mobile AR	**12 Hours**
1.1 Introduction to AR & Mix Reality and Mobile AR : Definitions of AR and MR, evolution of AR and MR technologies, architecture of the AR system, applications.	
Module 2 : Tracking, Registration and Calibration	**14 Hours**
2.1 Tracking, Registration and Calibration : Concept of tracking, characteristics of tracking technology, navigation, stationary tracking system, tracking techniques. 2.2 Registration : Concept, techniques. 2.3 Calibration : Concept, techniques.	
Module 3 : Software Architectures	**12 Hours**
3.1 Software Architectures : AR application requirements, software engineering requirements, distributed object system, dataflow, scene graph.	
Module 4 : Modelling, Annotation and Authoring	**14 Hours**
4.1 Modelling : Concept, need of modelling, specifying Geometry, specifying appearance, semi-automatic reconstruction, free-for modelling. 4.2 Annotation : Concept, need of annotation, 4.3 Authoring : Requirements of AR authoring, its elements, stand alone authoring solution, plug-in approach.	

Lecture: 4 hrs/week **Total Hours : 52 Hrs**

Textbooks:

1. Hearn and Baker, “Computer Graphics- C version”, 2nd edition, Pearson, 2002.
2. Dieter Schmalsteig and Tobias Hollerer, “Augmented Reality- Principles and Practice”, Pearson Education, Inc. 2016 Edition.
3. R. K Maurya, “Computer Graphics with Virtual Reality”, 3rd Edition, Wiley India, 2018.
4. Steven M. LaVelle,” Virtual Reality”, Cambridge University press, 2019.
5. Vince, “Virtual Reality Systems”, 1st Edition, Pearson Education, 2002

Reference Books:

1. George Mather, “Foundations of Sensation and Perception”, Psychology Press book; 3rd Edition, 2016
2. Tony Parisi, “Learning Virtual Reality”, 1st edition, O’Reilly, 2015
3. Alan Craig and William Sherman,” Understanding virtual reality: Interface, application and design”, 2nd Edition, Morgan Kaufmann Publisher, 2019
4. Peter Shirley, Michael Ashikhmin, and Steve Marschner, “Fundamentals of Computer Graphics”, A K Peters/CRC Press; 4th Edition, 2016.

SEMESTER VII

Program: Honours Degree in Augmented Reality and Virtual Reality Semester: VII		L	P	C
AR-VR Application Development	Course Code: HNAVCR0701	4	0	4
AR-VR Application Development Lab	Lab Code: HNAVLR0701	0	4	2
		4	4	6

Course Objectives:	
1	To understand the AR-VR application development process, software engineering practices associated with it.
2	To familiarise the students to the concept of prototyping.
3	To make the students able to develop a user interface for AR-VR application.
4	To make the students aware of issues and challenges in the AR-VR application development process.

Course Outcomes:	
After successful completion of this course, the students will be able to	
CO 1:	Describe software engineering requirements of developing AR-VR applications.
CO 2:	Apply the techniques of prototyping to create an AR-VR application with the basic functionality.
CO 3:	Apply the principles of interaction design to create a user interface for the AR-VR application.
CO 4:	Analyse physical, ethical and social implications of AR-VR.

Pre-requisite courses: Computer Graphics.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components).
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1 : Software Architectures in AR	**14 Hours**
1.1 Software Architectures in AR : AR-VR Application Requirement, Software Engineering Requirements, Distributed Objects System, Data Flow, Scene Graph.	
Module 2 : XR Application Design	**13 Hours**
2.1 XR Application Design : Principles of AR and VR design, Physical and Digital Prototyping of AR and VR application, XR development approach, XR Design Process.	
Module 3 : 3D Interaction inVR	**13 Hours**
3.1 3D Interaction inVR : Interaction overview, types, Navigation in VR, Object Interaction, GUI using VR, Challenges in VR interaction.	
Module 4 : Applications issues and Challenges	**12 Hours**
4.1 Applications issues and Challenges : Applications of AR-MR, Issues, Challenges and Physical, ethical and social Implications of AR-VR technology.	

Lecture:4 hrs/week **Total Hours : 52 Hrs**

LAB COMPONENT:

List of experiments

Students are required to complete all experiments from the list given below.

1. Introduction to VR Hardware (Meta Quest 2):
    a. Understanding the Meta Quest 2 headset.
    b. Explain its components, controls, and setup process.
    c. Demonstrate how to wear and adjust the headset.
2. Unity Installation and Initial Setup:
    a. Install Unity
    b. Set up a new Unity project.
    c. Introduce the Unity interface, including the Scene view, Hierarchy, Inspector, and Project panels.
3. Creating a Simple 3D Scene:
    a. Add basic 3D objects (e.g., cubes, spheres) to the scene.
    b. Manipulate their position, rotation, and scale.
    c. Apply materials and textures.
4. Understanding Unity Toolbars and Menus:
    a. Explore the main Unity toolbar (File, Edit, Assets, GameObject, etc.).
    b. Explain common menu options (e.g., File > Save, Edit > Undo).
    c. Introduce keyboard shortcuts
5. Building a VR Environment:
    a. Set up a basic VR environment (e.g., room, landscape).
    b. Add terrain, lighting, and skyboxes.
    c. Test the scene in VR mode.
6. User Interaction with VR Objects:
    a. Implement basic interactions (grabbing, throwing) using Unity's XR Interaction Toolkit.
    b. Attach colliders and rigidbodies to objects.
    c. Create interactive buttons or switches.
7. Physics in VR:
    a. Explore physics simulations (gravity, collisions) in VR.
    b. Create a simple physics-based game (e.g., rolling ball, falling blocks).
8. UI Elements in VR:
    a. Design UI elements (buttons, sliders) for VR.
    b. Use Unity's Canvas system to create VR menus.
    c. Implement gaze-based interaction.
9. Spatial Audio and Ambisonics:
    a. Introduce spatial audio principles.
    b. Add 3D sound sources to the scene.
    c. Discuss ambisonics for immersive audio.
10. Introduction to Scripting in Unity:
    a. Create basic C# scripts.
    b. Attach scripts to objects for simple behaviours (e.g., rotation, movement).
    c. Explain the MonoBehaviour lifecycle.

Practical: 4 hrs/week **Total Hours :52 Hrs**

Textbooks:

1. Hearn and Baker, “Computer Graphics- C version”, 2nd edition, Pearson, 2002.
2. R. K Maurya, “Computer Graphics with Virtual Reality”, 3rd Edition, Wiley India, 2018.
3. Steven M. LaVelle,” Virtual Reality”, Cambridge University press, 2019.
4. Vince, “Virtual Reality Systems”, 1st Edition, Pearson Education, 2002

Reference Books:

1. George Mather, “Foundations of Sensation and Perception”, Psychology Press book; 3rd Edition, 2016
2. Tony Parisi, “Learning Virtual Reality”, 1st edition, O’Reilly, 2015
3. Alan Craig and William Sherman,” Understanding virtual reality: Interface, application and design”, 2nd Edition, Morgan Kaufmann Publisher, 2019
4. Peter Shirley, Michael Ashikhmin, and Steve Marschner, “Fundamentals of Computer Graphics”, A K Peters/CRC Press; 4th Edition, 2016.

SEMESTER VIII

Program: Honours Degree in Augmented Reality and Virtual Reality Semester: VIII		L	P	C
Game Development with VR	Course Code: HNAVCR0801	4	0	4

Course Objectives:	
1	To introduce the students to the software engineering approach for the development of advanced, professional AR-VR applications.
2	To make the students able to create a high level design of the application.
3	To make the students able to use different tools available in Unity.
4	To make the students able to design scripts.

Course Outcomes:	
After successful completion of this course, the students will be able to	
CO 1:	Apply software engineering principles for developing a game in VR.
CO 2:	Implement various components of game development on Unity.
CO 3:	Implementing scripts for various functionalities of the game in C#.
CO 4:	Demonstrate performance enhancement using different optimization techniques.

Pre-requisite courses: Basic knowledge of object oriented programming language, Knowledge of AR-VR and Computer Graphics.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components).
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1 : Software Engineering for Developing AR-VR Applications	**14 Hours**
1.1 Software Engineering for Developing AR-VR Applications : AR-VR Application Development Process, Software Engineering approach to the AR-VR Application Development - Requirement gathering and analysis - identifying project goals, target audience and use cases. Defining functional and nonfunctional requirements specific to AR-VR experience, Identifying hardware platforms (e.g. headsets, mobile devices) and software dependencies.	
Module 2 : Design and Architecture of the application	**12 Hours**
2.1 Design and Architecture of the application : Create a high level design that outlines the system components, Decide interaction model (gestures, voice commands etc.), Design the user interface.	
Module 3 : AR App Development using Unity	**13 Hours**
3.1 AR App Development using Unity : Detecting surfaces, identifying the feature points, tracking virtual objects in real world, face and object tracking. AR Algorithms - Simultaneous Localization and Mapping. Unity AR concepts - Pose tracking , environmental detection, Ray Casting and Physics for AR, Light estimation, Occlusion, Experimenting with ARCore and ARKit.	
Module 4 : Programming Languages for AR-VR Applications	**13 Hours**
4.1 Programming Languages for AR-VR Applications : Unity with C#, Syntax and Data Types, Control Structures, Functions and Methods, Object-Oriented Programming (OOP), Unity-Specific Concepts, Unity API, Coroutines, Unity UI, Event Handling, Debugging and Error Handling, Memory Management Performance Optimization, Scriptable Objects, Serialization and Data Persistence.	

Lecture: 4 hrs/week **Total Hours :52 Hrs**

Textbooks:

1. Hearn and Baker, “Computer Graphics- C version”, 2nd edition, Pearson, 2002.
2. Dieter Schmalsteig and Tobias Hollerer, “Augmented Reality- Principles and Practice”, Pearson Education, Inc. 2016 Edition.
3. R. K Maurya, “Computer Graphics with Virtual Reality”, 3rd Edition, Wiley India, 2018.
4. Steven M. LaVelle,” Virtual Reality”, Cambridge University press, 2019.
5. Vince, “Virtual Reality Systems”, 1st Edition, Pearson Education, 2002

Reference Books:

1. George Mather, “Foundations of Sensation and Perception”, Psychology Press book; 3rd Edition, 2016
2. Tony Parisi, “Learning Virtual Reality”, 1st edition, O’Reilly, 2015
3. Alan Craig and William Sherman,” Understanding virtual reality: Interface, application and design”, 2nd Edition, Morgan Kaufmann Publisher, 2019
4. Peter Shirley, Michael Ashikhmin, and Steve Marschner, “Fundamentals of Computer Graphics”, A K Peters/CRC Press; 4th Edition, 2016.

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Address
Mahavir Education Chowk,
W.T. Patil Marg, Chembur
Mumbai- 400 088

विद्याधनं सर्वधनेषु प्रधानम्॥

www.sakec.ac.in

info@sakec.ac.in

@sakectweets

www.facebook.com/shahanchor

09136400555

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours Degree Programs in Technology

(with effect from 2024-25)

Blockchain

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

CURRICULUM STRUCTURE UG: B.Tech.

Honours/Minors Degree Program

Blockchain

REVISION: R0-V0-2024-25

Effective from Academic Year 2024-25 onwards

Approved by Board of Studies on 18/05/2024

Approved by Academic Council on 25/05/2024

Prof. Uday Bhave
I/C HOD

Chairman BoS
Department of Computer Engineering
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Shah & Anchor Kutchhi Engg. College
Autonomous Institute
Mumbai - 88

Dr. Bhavesh Patel
Principal

Dr. Bhavesh Patel
Chairman
Academic Council
Shah & Anchor Kutchhi Engineering Colleg
Chembur, Mumbai - 400088

PREAMBLE

Shah and Anchor Kutchli Engineering College was established in 1985 for the purpose of imparting quality technical education. The college is managed by Mahavir Education Trust. The college is approved by AICTE, New Delhi and DTE, Government of Maharashtra and has been conferred autonomous status by University Grants Commission (UGC) and University of Mumbai for a period of 10 Years with effect from the academic year 2024-25. It also has an ISO 9001:2015 Certification. The institute offers eight undergraduate courses, three post-graduate courses and one PhD research Center in IT

The Honours Program in Blockchain, offered by Shah and Anchor Kutchhi Engineering College, is designed to equip students with comprehensive knowledge and practical skills in blockchain technology. The program integrates rigorous coursework, hands-on laboratory experiences, and real-world applications to prepare them for successful careers in this rapidly evolving field in Blockchain.

Over the course of two years, students will engage in an interdisciplinary curriculum that covers exploring Blockchain foundational principles, the underlying cryptographic mechanisms, deployment of different Blockchain platforms and its diverse applications. By examining both theoretical frameworks and practical implementations, this program seeks to provide a comprehensive understanding of how blockchain technology can enhance transparency, security, and efficiency in various sectors. This program aspires to contribute to the ongoing discourse in the field of blockchain technology, underscoring its significance and potential impact on the digital landscape.

Key features of our autonomous syllabus include:

1 Interdisciplinary Learning: Foster an interdisciplinary approach by integrating technical, and application-oriented courses.

2. Practical Expertise: Provide extensive hands-on laboratory experiences to bridge the gap between theoretical knowledge and real world application.

3 Innovation and Research: Encourage innovative thinking and research through project-based learning and exposure to cutting-edge Blockchain technologies.

4 Ethical Considerations: Ensuring ethical awareness and responsibility in blockchain development, deployment, and use to mitigate risks and promote fair and transparent practices.

Graduates of the Blockchain Honours Program will be well-prepared for careers in various sectors, including technology, healthcare, finance, and academia. They will possess the skills required to develop innovative Blockchain solutions, conduct advanced research, and contribute to the growing field of Blockchain Technology.

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

Program Structure for Honours Degree in Blockchain
(With Effect from 2024-2025)

		Scheme of Instruction				Scheme of Examination				
			Hours per Week		Total Credits	Duration in Hours	Maximum Marks			Total Marks
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM V	HNBKCR0501	**Fundamentals of Blockchain Technology**	4	-	4	3	20	20	40	60	100
TOTAL			4	-	4	3	20	20	40	60	100
SEM VI	HNBKCR0601	**Blockchain Platform I**	4	-	4	3	20	20	40	60	100
TOTAL			4	-	4	3	20	20	40	60	100
SEM VII	HNBKCR0701	**Blockchain Development**	4	-	4	3	20	20	40	60	100
PRACTICAL							**CIAP**			**ESEP**	
SEM VII	HNBKLR0701	**Private Blockchain Setup Lab**	-	4	2	3	40			60	100
TOTAL			4	4	6	6	80			120	200
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM VIII	HNBKCR0801	**DeFi (Decentralized Finance)**	4	-	4	3	20	20	40	60	100
TOTAL			4	-	4	3	20	20	40	60	100
Honours TOTAL			**16**	**04**	**18**		**200**			**300**	**500**
Total Credits for Semesters V,VI, VII & VIII = 04+04+06+04=18											

*All ESE & ESEP (Theory & Practical) will be conducted for 100 marks and converted as per appropriate Teaching and Examination scheme

CIA=Continuous Internal Assessment ESE=End Semester Examination MSE=Mid Semester Examination

CIAP=Continuous Internal Assessment Practical ESEP=End Semester Examination Practical CCE= Continuous Comprehensive Evaluation

SEMESTER V

Program: Honours Degree in Blockchain	Semester: V	L	P	C
Fundamentals of Blockchain Technology	Course Code: HNBKCR0501	4	0	4

Course Objectives:	
1	To understand the foundational concepts of blockchain technology, including decentralized ledgers, cryptographic hash functions, and consensus mechanisms.
2	To learn about different types of blockchain networks, and understand their respective advantages and limitations.
3	To discuss basics of Solidity programming language.
4	To gain insight into the potential applications of blockchain technology across diverse sectors.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Discuss the concept of blockchain
CO 2:	Use and apply Smart Contracts by using Solidity Programming.
CO 3:	Discuss public and private blockchain platforms.
CO 4:	Design and develop blockchain applications

Pre-requisite courses: Cryptography

CourseAssessmentMethods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to day Experiments /Assignments/Tutorials/Power-point-presentation/Group discussion/Quiz/seminar/ Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components)
INDIRECT
1.Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS

Module 1: Introduction to Blockchain	**14 Hours**

1.1 Prerequisite: Hash functions, Public key cryptography, Digital Signature (ECDSA).
1.2 Introduction, Evolution of Blockchain, Working of Blockchain Technology, Components of Blockchain, Block in a Blockchain, Structure of a Block, Block Header, Block Identifiers: Block Header Hash and Block Height, Genesis Block, Linking Blocks in the Blockchain, Merkle Trees.
1.3 Distributed Ledger Technology (DLT), Benefits of DLT, Types of Blockchain- Public, Private, Consortium, Hybrid, advantages and limitations, Consensus mechanism- PoW, PoS, PoET.
1.4 Cryptocurrency basics, Characteristics, Wallets, Types of Cryptocurrency- Bitcoin, Altcoin and Token, Cryptocurrency Usage, Bitcoin and the Cryptocurrency, ICO
1.5 Blockchain Applications: FinTech, Internet of Things, Industrial and Manufacturing, Energy, Supply chain & Logistics, Records & Identities, Healthcare

Module 2 : Smart Contracts and Solidity Programming	**14 Hours**

2.1 Introduction to Smart Contracts, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contract Approaches, and Limitations of Smart Contracts
2.2 Introduction to Programming: Solidity Programming – Basics, functions, Visibility and Activity Qualifiers, Address and Address Payable, Bytes and Enums, Arrays-Fixed and Dynamic Arrays, Special Arrays-Bytes and strings, Struct, Mapping, Inheritance, Error handling, Application Binary Interface (ABI).

Module 3 : Public Blockchain	**14 Hours**

3.1 Introduction to Public Blockchain, Bitcoin Blockchain, Common Terminologies, Ethereum and its Components, Mining in Ethereum, Ethereum Virtual Machine (EVM), Ether, Gas, Accounts, Architecture and Workflow, Comparison between Bitcoin and Ethereum
3.2 Types of test-networks used in Ethereum, Transferring Ethers using Metamask, Mist Wallet, Ethereum frameworks, Case study of Ganache for Ethereum blockchain.

Module 4: Private Blockchain	**10 Hours**

4.1 Introduction to Private Blockchain, Key characteristics, Need of Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Commands in E-commerce Blockchain
4.2 Smart Contract in a Private Environment, State Machine Replication, Consensus Algorithms for Private Blockchain - PAXOS and RAFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT

Lecture: 4 Hrs/Week		**Total Hours : 52 Hrs.**

Textbooks:

1. Chandramouli Subramanian, Asha A. George, Abhilash K. A and Meena Karthikeyan, Blockchain Technology, Universities Press.
2. Andreas M. Antonopoulos, June 2017, Mastering Bitcoin, Programming the Open Blockchain, 2nd Edition, O'Reilly Media
3. Andreas M. Antonopoulos Dr. Gavin Wood, Mastering Ethereum, Building Smart Contract and Dapps, O'reilly.
4. ArshdeepBahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach, Paperback

Reference Books:

1. Imran Bashir, Mastering Blockchain,Packt Publishing,Third Edition,
2. Yathish R and Tejaswini N, Blockchain for Beginners, SPD

SEMESTER VI

3.

Program: Honours Degree in Blockchain	Semester: VI	L	P	C
Blockchain Platform I	Course Code: HNBKCR0601	4	0	4

Course Objectives:	
1	To understand the functionalities and characteristics of Ethereum clients
2	To analyze the structure and components of Ethereum transactions
3	To explore the consensus mechanisms used by the Ethereum network
4	To explore the creation and deployment of Ethereum-based tokens and DApps.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Demonstrate a foundational understanding of Ethereum
CO 2:	Differentiate between various Ethereum client implementations and Identify the essential components of Ethereum transactions
CO 3:	Describe PoW and PoS consensus mechanisms.
CO 4:	Explore the decentralized applications (DApps) on the Ethereum platform, including smart contract development.

Pre-requisite courses: Cryptography, Blockchain Fundamentals

CourseAssessmentMethods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to day Experiments /Assignments/Tutorials/Power-point-presentation/Group discussion/Quiz/seminar/ Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components)
INDIRECT
1.Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1: Ethereum Basics	**10 Hours**
1.1 Ethereum's Four Stages of Development, Ethereum's Components, Decentralized Applications (DApps), Web 3.0. 1.2 Ether Currency Units, Ethereum Wallet, MetaMask, Switching Networks, Getting Test Ethers, Sending Ether from MetaMask, Exploring the Transaction History of an Address, Externally Owned Accounts (EOAs) and Contracts, Compiling the Faucet Contract, Creating the Contract on the Blockchain, Interacting with the Contract.	
Module 2 : Ethereum Clients and Transactions	**16 Hours**
2.1 Full Node , Running an Ethereum Client, Parity, Go-Ethereum (Geth), Remote Ethereum Clients - Mobile (Smartphone) Wallets, Browser Wallets , Keys and Addresses, Public Key Cryptography, Private Keys, Public Keys, Elliptic Curve Cryptography, Cryptographic Hash Functions, Ethereum's Cryptographic Hash Function: Keccak-256, Ethereum Addresses, and Inter Exchange Client Address Protocol 2.2 Transactions - Structure of a Transaction, Transaction Nonce , Transaction Gas, Transaction Recipient, Transaction Value and Data, Transmitting Value to EOAs and Contracts, Transmitting a Data Payload to an EOA or Contract, Contract Creation, Elliptic Curve Digital Signature Algorithm, ECDSA Math, Separating Signing and Transmission (Offline Signing), Transaction Propagation, and Multiple-Signature (Multisig) Transactions	
Module 3 : Ethereum Virtual Machine and Consensus	**14 Hours**
3.1 EVM architecture and execution context, EVM Instruction Set, Ethereum State, Contract Deployment Code, Turing Completeness and Gas, Gas Accounting ,Gas Cost Versus Gas Price, Block Gas Limit 3.2 Consensus via Proof of Work, Consensus via Proof of Stake (PoS), Ethash, Casper, Principles of Consensus, Ethereum Classic (ETC), Decentralized Autonomous Organization (DAO), DAO Soft fork and Hard Fork	
Module 4: Tokens, Oracles and DApps	**12 Hours**
4.1 Tokens on Ethereum, ERC20 Token Standard, ERC223, ERC777, ERC721: Non-fungible Token, Token Standards, Extensions to Token Interface Standards, Tokens and ICOsDraft Syllabus 4.2 Oracles, Oracle Use Cases, Oracle Design Patterns, request–response, publish-, subscribe, and immediate-read, Data Authentication 4.3 Decentralized Applications (DApps), Backend (Smart Contract), Frontend (Web User Interface), Data Storage-IPFS, Swarm, Decentralized Message Communications Protocols, Auction DApp, Ethereum Name Service	

Lecture: 4 Hrs/Week		**Total Hours : 52 Hrs.**

Textbooks:

1. Andreas M. Antonopoulos Dr. Gavin Wood, Mastering Ethereum, Building Smart Contract and Dapps, O'reilly.
2. Xun (Brian) Wu, Zhihong Zou, Learn Ethereum: A practical guide to help developers set up and run decentralized applications with Ethereum 2.0, Second Edition
3. Chandramouli Subramanian, Asha A George, Abhilash K. A and Meena Karthikeyan, Blockchain Technology, Universities press

Reference Books:

1. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus Protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing
2. Yathish R and Tejaswini N, Blockchain for Beginners, , SPD
3. Daniel Drescher, Blockchain Basics, A non Technical Introduction in 25 Steps, Apress.

SEMESTER VII

Program: Honours Degree in Blockchain	Semester: VII	L	P	C
Blockchain Development	**Course Code:** HNBKCR0701	**4**	**0**	**4**
Private Blockchain Setup Lab	**Lab Code:** HNBKLR0701	**0**	**4**	**2**
		4	**4**	**6**

Course Objectives:	
1	To understand aspects of different programming languages and use the solidity programming language to develop a smart contract for blockchain.
2	To use ethereum components and learn design, implementation, and managing blockchain solutions
3	To explore the structure of a Hyperledger Fabric network
4	To explore real-world applications and use cases of Blockchain across diverse industries.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Use and apply Smart Contracts by using Solidity Programming.
CO 2:	Explore the development lifecycle of decentralized applications (DApps) on the Ethereum platform using smart contract development.
CO 3:	Develop a deep understanding of Hyperledger Fabric, including its core principles, modular architecture, and role as a permissioned blockchain framework
CO 4:	Analyze real-world applications and use cases of blockchain across various industries.

Pre-requisite courses: Cryptography, Blockchain Fundamentals

CourseAssessmentMethods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to day Experiments /Assignments/Tutorials/Power-point-presentation/Group discussion/Quiz/seminar/ Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) (Laboratory Component) 4. End Semester Examination (Theory and Laboratory components)
INDIRECT
1.Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS

Module 1: Blockchain Programming and Smart Contract	**12 Hours**
1.1 Types of Blockchain Programming, Solidity, GoLang, Vyper, Java, Simplicity, Rholang, Comparative study of different blockchain programming languages, Decentralized file system-IPFS. 1.2 Solidity programming, Smart Contract programming using solidity, mapper function, ERC20 and ERC721 Tokens, comparison between ERC20 & ERC721, ICO, STO. Metamask (Ethereum Wallet), setting up a development environment. 1.3 Use cases of smart contract, smart Contracts: Opportunities, Risks.	
Module 2 : Blockchain Deployment	**14 Hours**
2.1 Ethereum client, Ethereum Network, Introduction to Go Ethereum (Geth), Geth Installation and Geth CLI, Setting up a Private Ethereum Blockchain. Introduction to Truffle, Smart Contract deployment on a Private Blockchain. Introduction to Ganache. 2.2 Introduction to Dapp,Dapp architecture, Daaps Scalability,testing. Connecting to the Blockchain and Smart Contract,Web3js, Deployment.	
Module 3 : Hyperledger Application Development	**16 Hours**
3.1 Creating the sample network, Certificate Authorities, Join nodes to the channel, Install, approve, and commit a chaincode, Using an application on the channel, Joining components to multiple channels, Creating the new channel configuration. 3.2 Identity, Root CAs, Intermediate CAs and Chains of Trust, Fabric CA, Certificate Revocation Lists. Membership Service Provider(MSP), MSP domains, Organizational Units (OUs), Node OU Roles -Client, peer, admin, orderer, MSP Structure. 3.4 Policies, Smart contract endorsement policies, Modification policies, Signature policies, Implicit Meta policies. Peers, Ledgers and Chaincode, Multiple Ledgers, Multiple Chaincodes, Applications and Peers, Peers and Channels, Peers and Organizations, Peers and Identity, Peers and Orderers	
Module 4: Blockchain integration and Use Cases	**10 Hours**
4.1 Integrating Blockchain with cloud, IoT, AI, ERP, End to end blockchain integration, Risks and Limitations of Blockchain: Privacy & Security. Criminal Use of Payment Blockchains, The “Dark” Side of Blockchain 4.2 Use Cases: Blockchain for Health Insurance, Blockchain in Supply chain management, Blockchain & PropTech, Blockchain in Banking.	

Lecture: 4 Hrs/Week		**Total Hours : 52 Hrs.**

LAB COMPONENT CONTENTS:

A. Suggested List of Experiments (Minimum 7 Experiments)

1. Cryptography and mining in Blockchain
2. Creating merkle tree using cryptography toolkit
3. Configuring Metamask wallet
4. Sending/receiving ethers from Test Network
5. Creating Smart Contract using Solidity and Remix IDE
6. Creating and issuing smart contracts on the Ethereum blockchain using ERC20
7. Ganache for Ethereum Blockchain
8. Install and configure an Ethereum client such as Geth or Parity
9. Decentralized Voting System using Blockchain.

One beyond curriculum experiment may be conducted (To be decided by the Subject Teacher)

B. Mini Project (Group Activity)

Practical: 4 hrs/Week	**Total Hours : 52 Hrs.**

Textbooks:

1. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
2. Nitin Gaur, Blockchain with Hyperledger Fabric, Second Edition
3. Nitin Gaur, Luc Desrosiers, Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric and Composer
4. Chandramouli Subramanian, Asha A George, Abhilash K. A and Meena Karthikeyan, Blockchain Technology, Universities press

Reference Books:

1. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing
2. Daniel Drescher, Blockchain Basics, A non Technical Introduction in 25 Steps, Apress.

SEMESTER VIII

Program: Honours Degree in Blockchain	Semester: VIII	L	P	C
DeFi (Decentralized Finance)	Course Code: HNBKCR0801	4	0	4

Course Objectives:	
1	To understand the basic concepts of Centralized and Decentralized Finance.
2	To get familiar with DeFi architecture and Ecosystem.
3	To get a comprehensive understanding of different DeFi protocols.
4	To analyze and explore real-time use cases of Decentralized Finance.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Describe the DeFi System and its key categories.
CO 2:	Explain the DeFi primitives and EcoSystem.
CO 3:	Develop a deep understanding of DeFi protocols.
CO 4:	Discuss the real time use cases of DeFi.

Pre-requisite courses: Cryptography, Blockchain Fundamentals

CourseAssessmentMethods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to day Experiments /Assignments/Tutorials/Power-point-presentation/Group discussion/Quiz/seminar/ Case studies/Design Thinking/Innovation/Creativity (Blog writing/Vlogging, etc)(Laboratory Component) 4. End Semester Examination (Theory and Laboratory components)
INDIRECT
1.Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1: Introduction to Decentralized Finance	**10 Hours**
1.1 Traditional Financial Institution- Banks: Payment and Clearance systems, Accessibility, Centralization and Transparency, Decentralized Finance Vs Traditional Finance 1.2 Defi key Categories:-Stablecoins, Stablecoin and pegging, Lending and Borrowing, Exchanges, Derivations, Fund Management, Lottery, Payments, Insurance. 1.3 DeFi Architecture: Consumer Layer: Blockchains, Cross-Blockchain networks, Oracles, Digital Asset Layer: Cryptocurrencies, Infrastructure Layer: Wallets and Asset Management, DEXes and Liquidity, Lending and Borrowing, Prediction Markets, Synthetic Assets, Insurance.	
Module 2: DeFi Primitives and Ecosystem	**16 Hours**
2.1 DeFi Primitives: Transactions Fungible Token: Equity Tokens, Utility Tokens and Governance TokensNFT: NFT Standard, Multi-token standard Custody Supply Adjustment: Burn-Reduce Supply, Mint-Increase Supply, Bonding Curve-Pricing Supply. Incentives: Staking Rewards, Slashing, Direct Rewards and Keepers, Fees. Swap: Order Book Matching, Automated Market Makers, Collaterlized Loans Flash Loans (Uncollateralized Loans) 2.2 DeFi Key Metrics: Total Value Locked, Daily Active Users, Market Cap 2.3 DeFi EcoSystem and Protocols: On-chain Asset Exchange, Loanable Fund Markets on-chain assets, Stablecoins, Portfolio Management, Derivatives, Privacy-preserving mixers 2.4 DeFi Risk and Challenges: Technical Risks, Usability Risks, Centralization Risks, Liquidity Risks, Regulation Risk.	
Module 3: DeFi Deep Dive	**14 Hours**
5.1.Maker DAO:Maker Protocol: Dai Stablecoins, Maker Vaults, Maker Protocol Auctions. Maker Actors: Keepers, Price Oracles, Emergency Oracles, DAO Teams, Dai Savings Rate. Dai Use case Benefits and Examples 5.2.UniSwap:UniSwap Protocol Overview: How UniSwap Works, EcoSystem Participants, Smart Contracts. UniSwap Core Concepts: Swaps, Pools, Flash Swaps, Oracles 5.3. Compound: Compound Protocol: Supplying Assets, Borrowing Assets, Interest Rate Model Compound Implementation and Architecture: cToken Contracts, Interest Rate Mechanics, Borrowing, Liquidation, Price Feeds, Comptroller, Governance 5.4. wBTC:Need for wBTC: Tokenization and common Issues. wBTC Implementation and Technology: Users, Custodian Wallet Setup, Minting, Burning wBTC Governance, wBTC vs Atomic Swaps, Fees, Legal Binding, Trust Model and Transparency.	
Module 4: Use Cases	**12 Hours**
4.1 Decentralized Exchanges, Decentralized Stablecoins, Decentralized Money Markets 4.2 Decentralized Synthetix, Decentralized Insurance, Decentralized Autonomous Organization (DAO)	

Lecture: 4 Hrs/Week		**Total Hours : 52 Hrs.**

Textbooks:

1. Darren Lau, Daryl Lau, Teh Sze Jin, Kristian Kho, Erina Azmi, TM Lee, How to DeFi, Bobby Ong-1st Edition, March 2020
2. Campbell R. Harvey - DeFi and the Future of Finance
3. Defi Adoption 2020 A Definitive Guide to Entering the Industry
4. Sam M. Werner, Daniel Perez, Lewis Gudgeon, Ariah Klages-Mundt,Dominik, Harz, William J. Knottenbelt, SoK: Decentralized Finance (DeFi)

Reference Links:

1. https://makerdao.com/da/whitepaper/
2. https://uniswap.org/
3. https://compound.finance/documents/Compound.Whitepaper.pdf
4. https://wbtc.network/assets/wrapped-tokens-whitepaper.pdf
5. https://defiprime.com/exchanges
6. https://defirate.com/stablecoins/
7. https://academy.ivanontech.com/blog/decentralized-money-markets-and-makerdao
8. https://www.gemini.com/cryptopedia/nexus-mutual-blockchain-insurance-nxm-crypto
9. https://consensys.net/blockchain-use-cases/decentralized-finance/
10. https://tokenlon.zendesk.com/hc/en-us/articles/360041114431-DeFi-Explained-Synthetic-Assets,
11. https://www.blockchain-council.org/synthetix/synthetix-snx-the-biggest-ecosystem-in-decentralized-finance/

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Address
Mahavir Education Chowk,
W.T. Patil Marg, Chembur
Mumbai- 400 088

विद्याधनं सर्वधनेषु प्रधानम्॥

www.sakec.ac.in

info@sakec.ac.in

@sakectweets

www.facebook.com/shahanchor

09136400555

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours Degree Programs in Technology

(with effect from 2024-25)

Cyber Security

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

CURRICULUM STRUCTURE UG: B.Tech.

Honours/Minors Degree Program

Cyber Security

REVISION: R0-V0-2024-25

Effective from Academic Year 2024-25 onwards

Approved by Board of Studies on 18/05/2024

Approved by Academic Council on 25/05/2024

Dr. Nilakshi Jain
I/C HOD
Chairman BoS
Department of Cyber Security
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Shah & Anchor Kutchhi Engg. College Autonomous Institute Mumbai - 88

Dr. Bhavesh Patel
Principal
Dr. Bhavesh Patel
Chairman
Academic Council
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Preamble

Shah and Anchor Kutchhi Engineering College was established in 1985 for the purpose of imparting quality technical education. The college is managed by Mahavir Education Trust. The college is approved by AICTE, New Delhi and DTE, Government of Maharashtra and has been conferred autonomous status by University Grants Commission (UGC) and University of Mumbai for a period of 10 Years with effect from the academic year 2024-25.It also has an ISO 9001:2015 Certification. The institute offers eight undergraduate courses, three post-graduate courses and one PhD research Center in IT.

The Honours Degree program is designed for students who are passionate about understanding and mastering the technologies and techniques vital to the field of Cyber Security. This curriculum covers foundational to advanced concepts, equipping students to protect computers, operating systems, networks, and data from cyber-attacks and unauthorized access. Total credits of the entire program will be of 18, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning.

The program emphasizes the identification and mitigation of vulnerabilities across computing systems, preparing students to effectively safeguard sensitive information. Through hands-on projects, simulated cyber-attacks, and real-world scenarios, students gain practical experience and confidence in combating cyber threats.

This program is the result of invaluable contributions from both academia and industry, with special recognition to the Members of the Board of Studies and Academic Council for their critical input in shaping the curriculum. We believe this curriculum not only meets but exceeds the expectations of all stakeholders.

Embark on a journey where your passion for cybersecurity transforms into expertise, and together, let's safeguard the integrity of tomorrow's digital frontiers.

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

Program Structure for Honours Degree in Cyber Security
(With Effect from 2024-2025)

		Scheme of Instruction				Scheme of Examination					
			Hours per Week		Total Credits	Duration in Hours	Maximum Marks				Total Marks
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM V	HNCSCR0501	Computer Network	4	-	4	3	20	20	40	60	100
	TOTAL		4	-	4	3	20	20	40	60	100
SEM VI	HNCSCR0601	Ethical Hacking	4	-	4	3	20	20	40	60	100
	TOTAL		4	-	4	3	20	20	40	60	100
SEM VII	HNCSCR0701	Advanced Digital Forensics	4	-	4	3	20	20	40	60	100
			PRACTICAL				**CIAP**			**ESEP**	
SEM VII	HNCSLR0701	Advanced Digital Forensics Lab	-	4	2	3	40			60	100
	TOTAL		4	4	6	6	80			120	200
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM VIII	HNCSCR0801	Penetration Testing (PENT)	4	-	4	3	20	20	40	60	100
	TOTAL		4	-	4	3	20	20	40	60	100
	Honours TOTAL		**16**	**4**	**18**	**-**	**200**			**300**	**500**
Total Credits for Semesters V,VI, VII & VIII = 04+04+06+04=18											

*All ESE (Theory/Practical) will be conducted for 100 marks and converted as per appropriate Teaching and Examination scheme

CIA = Continuous Internal Assessment ESE = End Semester Examination MSE = Mid Semester Examination

CIAP = Continuous Internal Assessment Practical ESEP = End Semester Examination Practical CCE = Continuous Comprehensive Evaluation

SEMESTER V

Program: Honours Degree in Cyber Security	Semester: V	L	P	C
Computer Network	Course Code: HNCSCR0501	4	0	4

Course Objectives:	
1	To introduce concepts and fundamentals of data communication, computer networks and OSI model.
2	To explore the issues and challenges of protocol design while delving into TCP/IP protocol suite.
3	To acquire knowledge of Transport layer and Application layer paradigms and protocols.
4	To explain the network troubleshooting methodology.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Demonstrate the concepts of data communication at the physical layer and compare ISO - OSI model with TCP/IP model.
CO 2:	Design a network using error control, flow control and routing protocols.
CO 3:	Explain the purposes and uses of higher layer ports and protocols.
CO 4:	Analyze and troubleshoot common network service issues.

Pre-requisite courses: Nil

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments /Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Lab Component) 4. End Semester Examination (Theory and Lab component)
INDIRECT
1. Course Exit Survey, Lab Exit Survey. 2. Activity based survey (if any).

DETAILED SYLLABUS	
Module 1: Basics of Networking & Infrastructure	**14 Hours**
1.1 Network topologies, types and technologies. Devices and services at their appropriate OSI layers. 1.2 Purposes and uses of ports and protocols, TCP/IP models. 1.3 Media types: Copper, UTP, STP, Coaxial, Fiber, Single-mode, Multimode, Plenum vs. PVC, Connector types, Copper cable standards, Copper termination standards. 1.4 Ethernet deployment standards, Virtual networking components.	
Module 2: Switching & Routing Concepts	**14 Hours**
2.1 DLL Design Issues (Services, Framing, Error Control, Flow Control). 2.2 Error Detection and Correction (Hamming Code, CRC, Checksum), Elementary Data Link protocols Stop and Wait, Sliding Window(Go Back N, Selective Repeat), CSMA/CD. 2.3 IPv4 Addressing (classful and classless), Subnetting, Supernetting design problems ,IPv4 Protocol, 2.4 Network Address Translation (NAT), IPv6, Routing algorithms : Shortest Path (Dijkstra's), Link state routing, Distance Vector Routing, Protocols - ARP,RARP, ICMP, IGMP.	
Module 3: Higher Layer Protocols	**12 Hours**
3.1 The Transport Service: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers TCP Flow control (sliding Window), TCP Congestion Control. 3.2 Application Layer: DNS: Name Space, Resource Record and Types of Name Server.HTTP,SMTP, 3.3 DHCP, remote access methods: SSH, VNC, Telnet, FTP/FTPS.	
Module 4: Network Operations, Troubleshooting and Tools	**12 Hours**
4.1 Diagram symbols, Standard operating procedures/ work instructions, Logical vs. physical diagrams, Rack diagrams, disaster recovery concepts, scanning, monitoring and patching processes. 4.2 Network troubleshooting methodology, Hardware tools, Software tools, wired/wireless connectivity and performance issues. 4.3 Common network service issues.	

Lecture: 4 Hrs/ Week		**Total Hours: 52 Hrs**

Textbooks:

1. A.S. Tanenbaum, "Computer Networks",4th edition, Pearson Education.
2. B.A. Forouzan, "Data Communications and Networking", 5th edition, TMH.
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 6th edition, Addison Wesley.

Reference Books:

1. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education, 1997.
2. Natalia Olifer & Victor Olifer, "Computer Networks: Principles, Technologies & Protocols for Network Design", Wiley India.
3. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Second Edition, The Morgan Kaufmann Series in Networking.

SEMESTER VI

Program: Honours Degree in Cyber Security	Semester: VI	L	P	C
Ethical Hacking	Course Code: HNCSCR0601	4	0	4

Course Objectives:	
1	To understand the role of ethical hacking in the cybersecurity landscape.
2	To identify vulnerabilities in systems and networks.
3	To analyze different types of malwares, attacks and security weaknesses.
4	To understand DoS attacks and analyze unauthorized access to a user's session.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Develop a foundational understanding of ethical hacking principles and practices.
CO 2:	Prioritize vulnerabilities by severity, and apply techniques for securing systems against unauthorized access.
CO 3:	Identify, analyze, and counteract different types of malwares, threats and attacks.
CO 4:	Understand the impact of DoS attacks and measures to secure user sessions.

Pre-requisite courses: Computer Networks, Databases, System Security

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments /Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Lab Component) 4. End Semester Examination (Theory and Lab component)
INDIRECT
1. Course Exit Survey, Lab Exit Survey 2. Activity based Survey (if any)

DETAILED SYLLABUS

Module 1: Introduction to Ethical Hacking	**12 Hours**

1.1 Information Security Overview, Cyber Kill Chain Concepts, Hacking Concepts,Ethical Hacking Concepts, Information Security Controls, Information Security Laws and Standards.

1.2 Footprinting and Reconnaissance: Footprinting Concepts, Footprinting through Search Engines Footprinting through Web Services,Footprinting through Social Networking Sites, Website Footprinting, Email Footprinting, Whois Footprinting.

1.3 Scanning Networks: Network Scanning Concepts Scanning Tools Host Discovery Port and Service

1.4 Discovery, OS Discovery (Banner Grabbing/OS Fingerprinting).

Module 2: Enumeration, Vulnerability & System Hacking	**12 Hours**

2.1 Enumeration: Enumeration Concepts, NetBIOS Enumeration,SNMP Enumeration,LDAP Enumeration, NTP and NFS Enumeration, SMTP and DNS Enumeration, Enumeration Countermeasures.

2.2 Vulnerability Analysis: Vulnerability Assessment Concepts, Vulnerability Classification and Assessment Types, Vulnerability Assessment Solutions and Tools, Vulnerability Assessment Reports

2.3 System Hacking: System Hacking Concepts, Gaining Access, Escalating Privileges, Maintaining Access, Clearing Logs, Password Cracking, Password Attacks, steganography, Steganography Tools, Steganalysis, Steganography Detection Tools.

Module 3: Threats & Attacks	**14 Hours**

3.1 Malware Threats: Malware Concepts,Components of Malware, APT Concepts, Trojan Concepts, Virus and Worm Concepts, Fileless Malware Concepts, Malware Analysis, Countermeasures, Anti-Malware Software.

3.2 Sniffing: Sniffing Concepts, Sniffing Technique: MAC Attacks, DHCP Attacks,ARP Poisoning, Spoofing Attacks,DNS Poisoning,Sniffing Tools,Countermeasures

3.3 Social Engineering: Social Engineering Concepts, Social Engineering Techniques,Insider Threats Impersonation on Social Networking Sites, Identity Theft, Countermeasures

3.4 SQL Injection: Basics of SQL Injection attack, Types of SQL injection, Blind SQL Injection, SQL

3.5 Injection Methodology, SQL Injection Tools, Signature Evasion Techniques, SQL Injection Detection Tools.

Module 4: DoS, Session Hijacking & Cryptography	**14 Hours**

4.1 Denial-of-Service: DoS/DDoS Concepts, DoS/DDoS Attack Techniques, Botnets, DDoS Case Study,DoS/DDoS Attack Tools, Countermeasures, DoS/DDoS Protection Tools

4.2 Session Hijacking: Session Hijacking Concepts, Application Level Session Hijacking, Network Level Session Hijacking, Session Hijacking Tools, Countermeasures

Lecture: 4 Hrs/Week		**Total Hours: 52 Hrs**

Textbooks:

1. Hoffman, Andrew. Web application security. " O'Reilly Media, Inc.", 2024.
2. Baloch, Rafay. Ethical hacking and penetration testing guide. CRC Press, 2017.
3. Toro-Alvarez, Marlon Mike. "18. Hacking." Handbook on Crime and Technology (2023): 334
4. "Cyber Security & Cyber Laws" by Nilakshi Jain & Ramesh Menon.
5. Messier, Ric. CEH v11: Certified Ethical Hacker Version 11 Practice Tests. John Wiley & Sons, 2021.
6. Digital Forensic: The Fascinating world of Digital Evidence

Reference Books:

1. Gupta, Brij B., Gregorio Martinez Perez, Dharma P. Agrawal, and Deepak Gupta. "Handbook of computer networks and cyber security." Springer 10 (2020): 978-3.
2. Thomas, Ciza, Paula Fraga-Lamas, and Tiago M. Fernández-Caramés, eds. Computer Security Threats. BoD–Books on Demand, 2020.
3. Whitman, Michael E., and Herbert J. Mattord. Principles of information security. Cengage learning, 2021.
4. Khan, Inam Ullah Khan Ullah, Mariya Ouaissa, Mariyam Ouaissa, Zakaria Abou El Houda, and Muhammad Fazal Ijaz, eds. Cyber Security for Next-Generation Computing Technologies. CRC Press, 2024.

SEMESTER VII

Program: Honours Degree in Cyber Security	Semester: VII	L	P	C
Advanced Digital Forensics	Course Code: HNCSCR0701	4	0	4
Advanced Digital Forensics Lab	Lab Code: HNCSLR0701	0	4	2
		4	4	6

Course Objectives:	
1	To Understand the legal and ethical considerations in digital forensics.
2	To Develop skills in identifying, collecting, and preserving digital evidence.
3	To Explore techniques for recovering deleted and hidden files.
4	To Understand the role of forensics in identifying security incidents.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand the basic principles, legal aspects, and ethical considerations in digital forensics.
CO 2:	Develop skills in conducting forensic analysis on different types of digital devices, such as computers, mobile devices, and storage media.
CO 3:	Understand the chain of custody and its significance in maintaining the admissibility of evidence.
CO 4:	Gain knowledge of network protocols with the ability to analyze network traffic and data from mobile devices.

Pre-requisite courses: Computer Networks, File System, Information System

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments /Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Lab Component) 4. End Semester Examination (Theory and Lab component)
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module 1 Digital Forensics & Investigative Procedures	**14 Hours**
1.1 Digital Forensics: Introduction to Digital Forensics, Digital forensic and Computer Forensics, why digital forensic experts are needed, Understand digital forensics as a science, professional ethics and confidentiality requirements, role NIST plays in digital forensics, Investigate a file's metadata, Calculate your digital footprint. 1.2 Digital forensic investigation, Phases of digital forensic investigation, importance of authorizations,surveying a crime scene, documenting,"bag and tag" procedure, chain of custody for evidence. 1.3 Procedure for preserving and transporting evidence, digital forensics toolkit, creating reports for investigations, search and seizure rules of electronic evidence.	
Module 2 Storage Media	**12 Hours**
2.1 Architecture of a hard disk drive and the file management systems, Bits, bytes, ASCII and Unicode, components in hard disk drivers, types of formatting techniques, carving techniques, Methods of recovering deleted files. 2.2 Volatile and non-volatile storage, magnetic media, solid state storage, removable flash memory or optical storage, storage devices' storage capacity and data transfer rates, potential evidential value of storage devices and storage media.	
Module 3 Passwords & Forensics Tools	**14 Hours**
3.1 Introduction to Passwords, strong and weak passwords, techniques to crack passwords, Bypass BIOS passwords, Operating system passwords Cracking, Windows password management, password hashes,consequences of unauthorized password cracking. 3.2 forensics investigations Tool, admissibility of digital forensic tools in court, SysInternals utilities, graphical and command-line interfaces, forensic image, .Decompress files, Decrypt files, forensic software applications, forensics workstation requirements, imaging devices and applications, Write blockers.	
Module 4 Mobile and Network Forensics	**12 Hours**
4.1 Introduction to Mobile Forensics, Common smartphone platforms. GSM and CDMA cellular networks, triangulation and trilateration, identifiers on mobile devices, data extraction on a mobile device, tools needed in a mobile device investigation. 4.2 Introduction to Network forensics, data branches and attacks on network, classification of malware, DoS and a DDoS attacks.common network devices, wireless networks and devices, preventive measures and best practices associated with network forensics.	

Lecture: 4 Hrs/Week		**Total Hours: 52 Hrs**

LAB COMPONENT CONTENTS:

Suggested Topic/List of Experiments (Minimum 12 Experiments)

1. Perform footprinting on the target network using search engines, web services, and social networking sites.
2. Use different file carving tools on a variety of storage media (USB drives, memory cards) to recover deleted or corrupted files. Tools: PhotoRec, Foremost, Scalpel
3. Recover deleted files by using data recovery software to retrieve them.
4. Open a file in a hex editor, identify specific file signatures, and manually edit some bytes to observe the impact on the file structure. Hex editor software (e.g., HxD, Hex Fiend, Bless).
5. Identify file signatures using a hex editor and then use this information to validate file types and recover files without relying on file extensions.
6. Provide a real-world case study involving file recovery and analysis.
   Apply the techniques learned, and present their findings, including challenges faced and solutions implemented.
7. Perform static data acquisition from Windows OS Recommended Tool: FTK Imager
8. Acquire live data from Windows OS Recommended Tool: FTK Imager, TCP Dump
9. Perform the password recovery using Password cracking tool like John the Ripper/Cain.
10. Use password cracking tools to attempt to recover the original passwords from the hashes.
11. Use a set of hashed passwords (MD5, SHA-256, etc.) Recommended Tools: John the Ripper, Hashcat, or Cain and Abel.
12. Encrypting a sample file or folder using the chosen encryption software. Recommended Tools: VeraCrypt, BitLocker, or GPG (GNU Privacy Guard).
13. Use tools like Wireshark or Kismet to analyze Wi-Fi traffic and track the movement of a suspect based on their connection to different hotspots.
14. Use Autopsy to conduct a forensic examination, including file analysis, timeline analysis, and keyword searches. Document your findings and prepare a forensic report.
15. Use command-line tools commonly used for network analysis (e.g., ping, tracert, netstat) of target networks.

One beyond curriculum experiment may be conducted (To be decided by the Subject Teacher)

Practical: 4 Hrs/Week		**Total Hours: 52 Hrs**

Textbooks:

1. Holt, T. J., Bossler, A. M., & Seigfried-Spellar, K. C. (2022). Cybercrime and digital forensics: An introduction. Routledge.
2. Jones, G. M., & Winster, S. G. (2022). An Insight into Digital Forensics: History, Frameworks, Types and Tools. Cyber Security and Digital Forensics, 105-125.
3. Dutta, N., Jadav, N., Tanwar, S., Sarma, H. K. D., Pricop, E., Dutta, N., ... & Pricop, E. (2022). Introduction to Digital Forensics. Cyber Security: Issues and Current Trends, 71-100.
4. "Cyber Security & Cyber Laws" by Nilakshi Jain & Ramesh Menon.
5. Digital Forensic: The Fascinating world of Digital Evidences

Reference Books:

1. Sammons, J. (2012). The basics of digital forensics: the primer for getting started in digital forensics. Elsevier.
2. Digital Forensics Basics: A Practical Guide Using Windows OS
3. Hacking: The Art of Exploitation" by Jon Erickson:
4. Digital Forensic: The Fascinating world of Digital Evidences

SEMESTER VIII

Program: Honours Degree in Cyber Security	Semester: VIII	L	P	C
Penetration Testing (PENT)	Course Code: HNCSR0801	4	0	4

Course Objectives:	
1	To earn advanced penetration testing methodologies, tools, and techniques to simulate real-world cyberattacks.
2	To learn and apply social engineering tactics to assess human vulnerabilities, including phishing, pretexting, and other manipulation techniques
3	To develop proficiency in assessing the security of network infrastructure, identifying vulnerabilities, and conducting penetration tests.
4	To understand and test the security of Internet of Things (IoT) devices, communication protocols, and Cloud.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Develop advanced skills in penetration testing methodologies, tools, and techniques used to simulate real-world cyberattacks.
CO 2:	Expertise in social engineering strategies, encompassing techniques like phishing, pretexting, and other forms of manipulation.
CO 3:	Analyze the security of network infrastructure, identifying vulnerabilities, and conducting thorough penetration tests.
CO 4:	Apply security assessment techniques for Internet of Things (IoT) devices and Cloud computing.

Pre-requisite courses: Basics of Security, Computer Networks.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/DesignThinking/Innovation/Creativity(Blog writing/Vlogging, etc) 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity(Blog writing/Vlogging, etc) (Lab Component) 4. End Semester Examination (Theory and Lab component)
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS

Module 1: Introduction to Penetration Testing, Scoping and Management	**12 Hours**

1.1 Penetration Testing: Penetration Testing, Penetration Testing Service Delivery Models, ROI for Penetration Testing, Types of Penetration Assessment, Strategies of Penetration Testing, Selection of Appropriate Testing Type, Different Methods of Penetration Testing, Common Areas of Penetration Testing, Penetration Testing Process, Penetration Testing Phases, Penetration Testing Methodologies, Characteristics of a Good Penetration Test, Ethics of a Penetration Tester; Risks Associated with Penetration Testing.

1.2 Penetration Testing Scoping and Engagement: Initiation of a Pen Testing Engagement Process, Penetration Testing "Rules of Behavior,", Identifying the Security Tools Required for the Penetration Test.

Module 2: OSINT & Social Engineering PenTest	**14 Hours**

2.1 Open-Source Intelligence (OSINT): Introduction to OSINT, OSINT through the WWW, OSINT through Website Analysis, OSINT through DNS Interrogation, Whois Lookups, Reverse Lookups, DNS Zone Transfer, Traceroute Analysis, Automating the OSINT Process using Tools/Frameworks/Scripts

2.2 Social Engineering PenTest: Introduction, Social Engineering Penetration Testing Modes, Social Engineering Penetration Testing Process, Social Engineering Penetration Testing using Email, Phishing, Phone (Vishing), SMishing (SMS phishing), Piggybacking, Eavesdropping, Social Engineering Countermeasures and Recommendations.

Module 3: External & Internal Network Penetration Testing	**14 Hours**

3.1 External Network Penetration Testing: Network Penetration Testing, External vs. Internal Penetration Testing, External Network Penetration Testing, Internal Network Penetration Testing. Network Penetration Testing Process, Port Scanning, Fingerprinting the OS,Fingerprinting the services,

3.2 Internal Network Penetration Testing: Footprinting, Network Scanning, Scanning Analysis, Scanning Methodology, OS and Service Fingerprinting, Identifying the OS, Manual Banner Grabbing, Enumeration, Internal Vulnerability Assessment, Network Vulnerability Scanning, Host Vulnerability Scanner, Vulnerability Assessment Reports, Scan Analysis Process, Windows Exploitation.

Module 4: IoT and Cloud PenTest	**12 Hours**

4.1 IoT PenTest: IoT, Popular IoT Hacks, IoT Challenges, IoT Penetration Testing, Abstract IoT Testing Methodology, Attack Surface Mapping, IoT Architecture, Typical IoT Vulnerabilities, Steps to Analyzing the IoT Hardware, Firmware Attacks, Attack Surface Map.

4.2 Cloud PenTest: Cloud Computing Security and Concerns, Security Risks Involved in Cloud Computing, Role of Penetration Testing in Cloud Computing,Scope of Cloud Pen Testing, Penetration Testing Process, Tools for Penetration Testing.

Lecture: 4 Hrs/Week		**Total Hours: 52 Hrs**

Textbooks:

1. Baloch, Rafay. Ethical hacking and penetration testing guide. CRC Press, 2017.
2. Cardwell, Kevin. Building Virtual Pentesting Labs for Advanced Penetration Testing. Packt Publishing Ltd, 2016.
3. Rahalkar, Sagar, Rahalkar, and Karkal. Quick Start Guide to Penetration Testing. Berkeley, CA, USA: Apress, 2019.
4. Allsopp, Wil. "Advanced penetration testing." (2020): 1-1.
5. Brunton, Finn. "Hacking." In Routledge Handbook of Digital Media and Communication, pp. 75-86. Routledge, 2020.
6. Nilakshi Jain & Ramesh Menon, "Cyber Security & Cyber Laws" by

Reference Books:

1. Hickey, Matthew, and Jennifer Arcuri. Hands on Hacking: Become an Expert at Next Gen Penetration Testing and Purple Teaming. John Wiley & Sons, 2020.
2. Wylie, Phillip L., and Kim Crawley. The Pentester Blueprint: Starting a career as an ethical hacker. John Wiley & Sons, 2020.
3. Holt, Thomas J., Adam M. Bossler, and Kathryn C. Seigfried-Spellar. Cybercrime and digital forensics: An introduction. Routledge, 2022.

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Address
Mahavir Education Chowk,
W.T. Patil Marg, Chembur
Mumbai- 400 088

विद्याधनं सर्वधनेषु प्रधानम्॥

www.sakec.ac.in

info@sakec.ac.in

@sakectweets

www.facebook.com/shahanchor

09136400555

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours Degree Programs in Technology

(with effect from 2024-25)

Data Science

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

CURRICULUM STRUCTURE UG:B.Tech.

Honours/Minors Degree Program

Data Science

REVISION: R0-V0-2024-25

Effective from Academic Year 2024-25 onwards

Approved by Board of Studies on 18/05/2024

Approved by Academic Councill on 25/05/2024

Ms.Swati Nadkarni
I/C HOD

Chairman BoS
Department of Information Technology
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Shah & Anchor Kutchhi Engg. College
Autonomous Institute
Mumbai - 88

Dr. Bhavesh Patel
Principal

Dr. Bhavesh Patel
Chairman
Academic Council
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

PREAMBLE

Shah and Anchor Kutchhi Engineering College was established in 1985 for the purpose of imparting quality technical education. The college is managed by Mahavir Education Trust. The college is approved by AICTE, New Delhi and DTE, Government of Maharashtra and has been conferred autonomous status by University Grants Commission (UGC) and University of Mumbai for a period of 10 Years with effect from the academic year 2024-25. It also has an ISO 9001:2015 Certification. The institute offers eight undergraduate courses, three post-graduate courses and one PhD Research Center in IT.

The Honours Program in Data Science, offered by Shah and Anchor Kutchhi Engineering College, is designed to provide students with a strong knowledge in the upcoming field of data science. The program combines extensive coursework, hands-on laboratory experiments and recent applications to equip students with the skills needed to excel in the rapidly evolving field of data science.

The Honours degree program is two years duration spanning four semesters. Learners will begin with a course on mathematical concepts necessary for learning data science. Consequently, learners will go through all statistical models needed in the data science domain. Further data science applications in the healthcare field will be explored in depth. Practical hands-on will enhance skills of the learners in these domains. Text, web and social media analytics are introduced to cover all aspects of data analytics.

Key features of our autonomous syllabus include:

1. Interdisciplinary Learning: Highlights an interdisciplinary approach by integrating mathematical and statistical concepts in the courses.
2. Practical Expertise: Provides extensive hands-on laboratory experiments to bridge the gap between theoretical knowledge and real-world applications.
3. Innovation and Analytics: Encourages innovative thinking and analytical skills through project-based learning and exposure to latest data science technologies.
4. Ethical Values: Inculcate a basic understanding of the societal and privacy implications of data science applications.

Learners of the Data Science Honours Program will be well-prepared for careers in the Data Science and Machine Learning domain. Learners will get an edge over the other graduates to get an entry in the world of data science professionals like Data Scientists, Data Engineers, Data Analysts.

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

Program Structure for Honours Degree in Data Science
(With Effect from 2024-2025)

			Scheme of Instruction			Scheme of Examination					
			Hours per Week		Total Credits	Duration in Hours	Maximum Marks				Total Marks
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM V	HNDSCR0501	**Mathematics for Data Science**	4	-	4	3	20	20	40	60	100
TOTAL			4	-	4	3	20	20	40	60	100
SEM VI	HNDSCR0601	**Statistical Learning for Data Science**	4	-	4	3	20	20	40	60	100
TOTAL			4	-	4	3	20	20	40	60	100
SEM VII	HNDSCR0701	**Healthcare Data Analytics**	4	-	4	3	20	20	40	60	100
PRACTICAL							**CIAP**			**ESEP**	
SEM VII	HNDSLR0701	**Healthcare Data Analytics Lab**	-	4	2	3	40			60	100
TOTAL			4	4	6	6	80			120	200
Sem	**Course Code**	**Name of the Course**	**L**	**P**			**CIA**			**ESE**	
							MSE	**CCE**	**Total**		
SEM VIII	HNDSCR0801	**Data Analytics for Text, Web and Social Media**	4	-	4	3	20	20	40	60	100
TOTAL			4	-	4	3	20	20	40	60	100
Honours TOTAL			**16**	**04**	**18**		**200**			**300**	**500**
Total Credits for Semesters V,VI, VII & VIII = 04+04+06+04=18											

*All ESE & ESEP (Theory & Practical) will be conducted for 100 marks and converted as per appropriate Teaching and Examination scheme.

CIA = Continuous Internal Assessment ESE = End Semester Examination MSE = Mid Semester Examination
CIAP = Continuous Internal Assessment Practical ESEP = End Semester Examination Practical CCE = Continuous Comprehensive Evaluation

SEMESTER V

Program: Honours Degree in Data Science	Semester: V	L	P	C
Mathematics for Data Science	**Course Code: HNDSCR0501**	**4**	**0**	**4**

Course Objectives:	
1	To build an intuitive understanding of Mathematics and relating it to Data Analytics.
2	To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3	To focus on exploring the data with the help of graphical representation and drawing conclusions.
4	To explore optimization and dimensionality reduction techniques.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Apply linear algebra and probability distributions and sampling distributions concepts to model, solve, and analyze real-world problems.
CO 2:	Select an appropriate graph representation and Apply exploratory data analysis to some real data sets and provide interpretations via relevant visualization.
CO 3:	Analyze various optimization techniques.
CO 4:	Evaluate Dimension Reduction Algorithms.

Pre-requisite course: Engineering Mathematics

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging. 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to DayExperiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar /Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging (Lab Component) 4. End Semester Examination (Theory and Lab components)
INDIRECT
1. Course-end survey 2. Activity based survey(if any)

DETAILED SYLLABUS:

Module 1: Fundamentals of Probability and Statistics	**16 Hours**

1.1 Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces,
1.2 Eigenvalues and EigenVectors, The Singular Value Decomposition (SVD)
1.3 Random Variables and their probability Distribution,
1.4 Random Sampling, Sample Characteristics and their Distributions,
1.5 Chi-Square, t-, and F-Distributions: Exact Sampling Distributions,
1.6 Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.

Module 2: Exploratory Data Analysis	**18 Hours**

2.1 Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data,
2.2 Plotting, data using Bar graph, Pie chart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph.
2.3 Need of exploratory data analysis, cleaning and preparing data,
2.4 Feature engineering, Missing values, understanding dataset through various plots and graphs, Drawing conclusions, deciding appropriate machine learning models.

Module 3: Optimization Techniques	**10 Hours**

3.1 Types of optimization-Constrained and Unconstrained optimization,
3.2 Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's method, Steepest descent method

Module 4: Dimension Reduction Algorithms	**8 Hours**

4.1 Introduction to Dimension Reduction Algorithms,
4.2 Linear Dimensionality Reduction: Principal component analysis, Linear Discriminant Analysis (LDA).
4.3 Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial

Lecture: 4 Hrs/Week		**Total Hours: 52 Hrs**

Text Books:

1. Gilbert Strang, Linear Algebra for Everyone, Wellesley Cambridge Press.
2. Vijay Rohatgi, An Introduction to Probability and Statistics, Wiley Publication.
3. Wiley-Edwin Chong, Stainslaw Zak, An introduction to Optimization, Second Edition.
4. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press.
5. Exploratory Data Analysis, John Tukey, Princeton University and Bell Laboratories.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 7th Edition, 1993.
2. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
3. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
4. William B. Claster, Mathematics and Programming for Machine Learning with R, CRC Press, 2020.

SEMESTER VI

Program: Honours Degree in Data Science	Semester: VI	L	P	C
Statistical Learning for Data Science	Course Code: HNDSCR0601	4	0	4

Course Objectives:	
1	To understand basic statistical foundations for roles of Data Scientist.
2	To develop problem-solving skills.
3	To infer about the population parameters using sample data and perform hypothesis testing.
4	To understand the basics of Regression, Multiple Linear Regression.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Develop various visualizations of the data in hand.
CO 2:	Analyze large data sets and perform data analysis to extract meaningful insights.
CO 3:	Develop and test a hypothesis about the population parameters to draw meaningful conclusions.
CO 4:	Fit a regression model to data and use it for prediction.

Pre-requisite courses: Mathematics for Data Science**.**

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging. 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to DayExperiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar /Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging (Lab Component) 4. End Semester Examination (Theory and Lab components)
INDIRECT
1. Course-end survey 2. Activity based survey(if any)

DETAILED SYLLABUS:

Module 1: Introduction to Statistics and Probability	**16 Hours**

1.1 Data and Statistics: Elements, Variables, and Observations, Scales of Measurement, Categorical and Quantitative Data, Descriptive Statistics, Statistical Inference

1.2 Descriptive Statistics: Tabular and Graphical - Summarizing Categorical Data, Summarizing Quantitative Data, Cross Tabulations and Scatter Diagram

1.3 Descriptive Statistics: Numerical Measures - Measures of Location, Measures of Variability, Measures of Distribution Shape, Relative Location, and Detecting Outliers, Box Plot, Measures of Association Between Two Variables

1.4 Probability: Experiments, Counting Rules, and Assigning Probabilities, Events and Their Probabilities, Complement of an Event, Addition Law, Independent Events, Multiplication Law Baye's theorem

1.5 Discrete Probability Distributions: Random Variables, Discrete Probability Distributions, Expected Value and Variance, Binomial Probability Distribution, Poisson Probability Distribution

1.6 Continuous Probability Distributions: Uniform Probability Distribution, Normal Curve, Standard Normal Probability Distribution, Computing Probabilities for Any Normal Probability Distribution

Module 2: Sampling and Sampling Distribution	**9 Hours**

2.1 Sampling from a Finite Population, Sampling from an Infinite Population, Sampling Methods: Probability and Non-Probability Sampling Methods

2.2 Interval Estimation: Population Mean - Known, Population Mean - Unknown, Determining the Sample Size

Module 3: Hypothesis Tests	**11 Hours**

3.1 Developing Null and Alternative Hypotheses, Type I and Type II Errors, Population Mean: Known Population Mean: Unknown Inference About Means and Proportions with Two Populations- Inferences About Population Variances, Inferences About a Population Variance, Inferences About Two Population Variances, Analysis of variance(ANOVA) - One way, Two way

3.2 Tests of Goodness of Fit and Independence, Goodness of Fit Test: A Multinomial Population, Test of Independence

Module 4: Regression and Time Series Analysis	**16 Hours**

4.1 Simple Linear Regression: Simple Linear Regression Model, Regression Model and Regression Equation, Estimated Regression Equation, Least Squares Method, Coefficient of Determination, CorrelationCoefficient, Model Assumptions, Testing for Significance, Using the Estimated Regression Equation forEstimation and Prediction Residual Analysis: Validating Model Assumptions, Residual Analysis: Outliers andInfluential Observations

4.2 Multiple Regression: Multiple Regression Model, Least Squares Method, Multiple Coefficient of

Determination, Model Assumptions, Testing for Significance, Categorical Independent Variables, ResidualAnalysis

4.3 Logistic Regression: Logistic Response function and logit, Interpreting the coefficients and odds ratios,Linear and Logistic Regression: similarities and differences, assessing the model

4.4 Time Series Analysis and Forecasting: Time Series Patterns, Forecast Accuracy, Moving Averages and Exponential Smoothing, Trend Projection, Nonparametric Methods - Sign Test, Wilcoxon Signed-Rank Test,Mann-Whitney-Wilcoxon Test, Kruskal-Wallis Test, Rank Correlation

Lecture: 4 Hrs/Week		**Total Hours: 52 Hrs**

Text Books:

1. Anderson, Sweeney, Williams, Statistics for Business and Economics: 11 th Edition or higher edition.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning, Springer, 2017.

Reference Books:

1. Lillian Pierson, Data Science for Dummies Paperback, Wiley Publications,.
2. Peter Bruce, Andrew Bruce, Practical Statistics for Data Science, 2nd Edition, OReilly Media, second edition, 2017.

SEMESTER VII

Program: Honours Degree in Data Science	Semester: VII	L	P	C
Healthcare Data Analytics	Course Code: HNDSCR0701	4	0	4
Healthcare Data Analytics Lab	Lab Code: HNDSLR0701	0	4	2
		4	4	6

Course Objectives:	
1	To explore healthcare data analytics to improve outcomes for patient health.
2	To identify data models to analyze patient records from various sources.
3	To use data analytics to generate patient centric views and find solutions to the problems.
4	To explore significant applications and trends in healthcare data to help the overall population.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Identify sources and structure of healthcare data.
CO 2:	Apply machine learning techniques on biomedical image and clinical text for healthcare data analytics.
CO 3:	Analyze the data, create predicting models, and identify quality measures for Healthcare data.
CO 4:	Use recent emerging technologies in the healthcare data analytics process.

Pre-requisite course: Basics of Python.

Course Assessment Methods:

DIRECT

1. Continuous Internal Assessment (Theory component)
2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging.
3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to DayExperiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar /Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging (Lab Component)
4. End Semester Examination (Theory and Lab components)

INDIRECT

1. Course-end survey
2. Activity based survey(if any)

DETAILED SYLLABUS:

Module 1 : Introduction to Healthcare Data Analytics	**13 Hours**

1.1 Introduction, Healthcare Data Sources and Data Analytics for Healthcare, Applications and Practical Systems for Healthcare,

1.2 Electronic Health Records(EHR), Components of EHR, Benefits of EHR, Barriers to Adopting EHR, Challenges of using EHR data, Phenotyping Algorithms.

1.3 Healthcare Foundations: Healthcare delivery - Healthcare financing - Healthcare policy – Handling Patient data: the journey from patient to computer - Standardized clinical codesets - Breaking down healthcare analytics: population, medical task, data format, disease.

Module 2 : Biomedical Image and Clinical Text Analysis	**13 Hours**

2.1 Biomedical Image analysis: Biomedical Imaging Modalities, Object detection ,Image segmentation, Image Registration, Feature Extraction

2.2 Clinical Text analysis: NLP, Mining information from Clinical Text, Information Extraction,

2.3 Rule Based Approaches, Pattern based algorithms, Machine Learning Algorithms

2.4 Clinical Text Corpora and evaluation metrics, challenges in processing clinical reports, Clinical Applications.

Module 3 : Predictive Models and Quality Measures in Healthcare	**13 Hours**

3.1 Making Predictive Models in Healthcare : Introduction to Predictive Analytics – Obtaining and Importing Dataset – Making the Response Variable - Splitting the Data into Train and Test Sets - Preprocessing the Predictor Variables – Building the Models – Using the Models to Make Predictions Improving our Models.

3.2 Healthcare Quality Measures: Introduction to healthcare measures, Medicare value-based programs: The Hospital Value-Based Purchasing (HVBP) program, The Hospital Readmission Reduction (HRR) program, The Hospital-Acquired Conditions (HAC) program, The End-Stage Renal Disease (ESRD) quality incentive program.

3.3 The Skilled Nursing Facility Value-Based Program (SNFVBP), The Home Health Value-Based Program (HHVBP), The Merit-Based Incentive Payment System (MIPS).

Module 4 : Healthcare Applications and Emerging Technologies	**13 Hours**

4.1 Applications: Descriptive Analytics Applications, Predictive Analytics Applications, Prescriptive Analytics Application.

4.2 Healthcare Emerging Technologies : Healthcare analytics and the internet,Healthcare and the Internet of Things, Healthcare analytics and social media , Healthcare and deep learning , Obstacles, ethical issues, and limitations.

Lecture:4 Hrs/Week		**Total Hours: 52 Hrs**

A. Suggested List of Experiments (Minimum 7 Experiments)

1. Clean, Integrate and Transform Electronic Healthcare Records.
2. Apply various data analysis and visualization techniques on EHR.
3. Bio Medical Image Preprocessing
4. Bio Medical Image Analytics/Segmentation.
5. Text Analytics for Clinical Text Data.
6. Diagnose disease risk from Patient data.
7. Social Media Analytics for outbreak prediction/ Drug review analytics.
8. Visual Analytics for Healthcare Data.

One beyond curriculum experiment may be conducted(To be decided by the Subject Teacher).

B. Mini Project (Group Activity)

Practical : 4 Hrs/Week	**Total Hours: 52 Hrs**

Text Books:

1. Chandan K. Reddy and Charu C Aggarwal, Healthcare data analytics, Taylor & Francis, 2015.
2. Kumar, Vikas Vik., Healthcare Analytics Made Simple: Techniques in healthcare computing using machine learning and Python, Packt Publishing Ltd, 2018.
3. Machine Learning for Healthcare Analytics Projects By Eduonix Learning Solutions

Reference Books:

1. El Morr, Christo, and Hossam Ali-Hassan. Analytics in healthcare: a practical introduction. Springer, 2019.
2. Hui Yang and Eva K. Lee, Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.
3. Sergio Consoli Diego Reforgiato Recupero Milan Petković,Data Science for Healthcare-Methodologies and Applications, Springer.

SEMESTER VIII

Program: Honours Degree in Data Science	Semester: VIII	L	P	C
Data Analytics for Text, Web and Social Media	Course Code: HNDSCR0801	4	0	4

Course Objectives:	
1	To explore various techniques for text, web and social media analytics.
2	To understand the complexities of extracting the text from different data sources and analyzing it.
3	To solve complex real-world problems using sentiment analysis.
4	To apply recommendation systems.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Apply algorithms for extraction , clustering and classification on textual data and perform prediction.
CO 2:	Apply various techniques for web data analytics using mining , searching and spamming of web data.
CO 3:	Use machine learning techniques to perform Sentiment Analysis and behavior analysis on social media data.
CO 4:	Identify current trends and emerging technologies in the data analytics process.

Pre-requisite course: Mathematics for Data Science, Statistical Learning for Data Science.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging. 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to DayExperiments/Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar /Case studies/Design Thinking/Innovation/Creativity/Blog writing/Vlogging (Lab Component) 4. End Semester Examination (Theory and Lab components)
INDIRECT
1. Course-end survey 2. Activity based survey(if any)

DETAILED SYLLABUS:

Module 1: Text Data Mining	**15 Hours**

1.1 Introduction to Text Mining: Introduction, Algorithms for Text Mining, Information Extraction from Text: Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction

1.2 Text Representation: tokenization, stemming, stop words, NER, N-gram modeling

1.3 Text Clustering: Feature Selection and Transformation Methods, distance based Clustering Algorithms, Word and Phrase based Clustering, Probabilistic document Clustering

1.4 Text Classification: Feature Selection, Decision tree Classifiers, Rule-based Classifiers,Probabilistic based Classifiers, Proximity based Classifiers.

Module 2: Web Mining	**13 Hours**

2.1 Introduction to Web-Mining: Inverted indices and Compression, Latent Semantic Indexing, Web Search

2.2 Meta Search: Using Similarity Scores, Rank Positions

2.3 Web Spamming: Content Spamming, Link Spamming, hiding Techniques, and Combating Spam

2.4 Web Usage Mining: Data Collection and Preprocessing, Sources and types of Data, Data Modelling, Session and Visitor Analysis, Cluster Analysis and Visitor segmentation, Association and Correlation Analysis,

2.5 Analysis of Sequential and Navigational Patterns, Classification and Prediction based on Web User Transactions

Module 3: Social Media Mining and Sentiment Analysis	**15 Hours**

3.1 Social Media Mining: Introduction, Challenges, Types of social Network Graphs

3.2 Mining Social Media: Influence and Homophily, Behaviour Analytics, Recommendation in Social Media: Challenges, Classical recommendation Algorithms, Recommendation using Social Context, Evaluating recommendations.

3.3 Sentiment Analysis:Introduction to Opinion mining

3.4 Document Sentiment Classification: Supervised, Unsupervised

3.5 Opinion Lexicon Expansion: Dictionary based, Corpus based

3.6 Opinion Spam Detection: Supervised Learning, Abnormal Behaviors, Group Spam Detection.

Module 4: Current Trends and Techniques	**9 Hours**

4.1 Privacy preserving data analytics, Generative AI models for text, web and social media data analytics, data ethics

Lecture:4 Hrs/Week		**Total Hours: 52 Hrs**

Text Books:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing, 3rd edition, 2020.
2. Charu. C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer Science and Business Media, 2012.
3. BingLiu, Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data, Springer, Second Edition, 2011.
4. Reza Zafarani, Mohammad Ali Abbasiand Huan Liu, Social Media Mining- An Introduction, Cambridge University Press, 2014.

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Address
Mahavir Education Chowk,
W.T. Patil Marg, Chembur
Mumbai- 400 088

विद्याधनं सर्वधनेषु प्रधानम्॥

www.sakec.ac.in

info@sakec.ac.in

@sakectweets

www.facebook.com/shahanchor

09136400555

Mahavir Education Trust's
SHAH & ANCHOR
KUTCHHI ENGINEERING COLLEGE
An Autonomous Institute Affiliated to University of Mumbai

Syllabus of Honours
Degree Programs in Technology

(with effect from 2024-25)

Internet of Things (IoT)

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

CURRICULUM STRUCTURE UG: B.Tech.

Honours/Minors Degree Program

Internet of Things

REVISION: R0-V0-2024-25

Effective from Academic Year 2024-25 onwards

Approved by Board of Studies on 18/05/2024

Approved by Academic Council on 25/05/2024

Dr. Subha Subramanian
I/C HOD

Chairman BoS
Department of Electronics & Computer Science
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Shah & Anchor Kutchhi Engg. College
Autonomous Institute
Mumbai - 88

Dr. Bhavesh Patel
Principal

Dr. Bhavesh Patel
Chairman
Academic Council
Shah & Anchor Kutchhi Engineering College
Chembur, Mumbai - 400088

Preamble

Shah and Anchor Kutchhi Engineering College was established in 1985 for the purpose of imparting quality technical education. The college is managed by Mahavir Education Trust. The college is approved by AICTE, New Delhi and DTE, Government of Maharashtra and has been conferred autonomous status by University Grants Commission (UGC) and Universityof Mumbai for a period of 10 Years with effect from the academic year 2024-25. It also has an ISO 9001:2015 Certification. The institute offers eight undergraduate courses, three post-graduate courses and one PhD research Center in IT.

The Honours Program in Internet of Things (IoT), offered by Shah and Anchor Kutchhi Engineering College, is designed to equip students with comprehensive knowledge and practical skills in IoT technology. The program integrates rigorous coursework, hands-on laboratory experiences, and real-world applications to prepare them for successful careers in this rapidly evolving field in IoT.

Over the course of two years, students will engage in an interdisciplinary curriculum that covers exploring IoT foundational principles, the underlying embedded mechanisms, deployment of different IoT platforms and its diverse applications. By examining both theoretical frameworks and practical implementations, this program seeks to provide a comprehensive understanding of how IoT technology can enhance transparency, security, and efficiency in various sectors. This program aspires to contribute to the ongoing discourse in the field of IOT technology, underscoring its significance and potential impact on the hardware and software landscape. The Internet of Things is a key driving factor in enabling the development of Industrial automation systems. IoT coupled with computer automation helps in streamlining industrial systems and improve data automation.

In the Internet of Things curriculum, knowledge of various hardware and software domains are integrated. Journey of innovations, project based learning, exposure to industries through internships have been initiated. It will lead a path towards a bright future where technology and holistic education will serve as a catalyst for positive change. Graduates of the Internet of Things Honours Program will be well-prepared for careers in various sectors, including technology, healthcare, finance, and academia. They will possess the skills required to develop innovative hardware and software solutions, conduct advanced research, and contribute to the growing field of Embedded Technology.

Mahavir Education Trust's

Shah & Anchor Kutchhi Engineering College

An Autonomous Institute Affiliated to University of Mumbai

Program Structure for Honours Degree in Internet of Things (IoT)
(With Effect from 2024-2025)

Year Semester	Course Code	Name of the Course	Scheme of Instruction: Hours per Week L	Hours per Week P	Total Credits	Scheme of Examination: Duration in Hours	Maximum Marks: CIA MSE	CIA CCE	CIA Total	ESE	Total Marks
TE SEM V	HNITCR0501	Introduction to Internet of Things system Design	4	-	4	3	20	20	40	60	
SEMESTER V TOTAL			4	-	4	3	20	20	40	60	100
TE SEM VI	HNITCR0601	Communication Protocols and Cloud services for IoT	4	-	4	3	20	20	40	60	
SEMESTER VI TOTAL			4	-	4	3	20	20	40	60	100
BE SEM VII	HNITCR0701	Analytics for the Internet of Things (IoT)	4	-	4	3	20	20	40	60	100
PRACTICALS							**CIAP**			**ESEP**	
BE SEM VII	HNITLR0702	Analytics for the Internet of Things (IoT)- LAB	-	4	2	3	40			60	100
SEMESTER VII TOTAL			4	4	6	3	20	60	80	120	200
BE SEM VIII	HNITCR0801	Industry 4.0 And Industrial Internet Of Things	4	-	4	3	20	20	40	60	
SEMESTER VIII TOTAL			4	-	4	3	20	20	40	60	100
HONOURS TOTAL			**16**	**04**	**18**		**200**			**300**	**500**

*All ESE & ESEP (Theory & Practical) will be conducted for 100 marks and converted as per appropriate Teaching and Examination scheme

CIA=Continuous Internal Assessment MSE=Mid Semester Exam CIAP=Continuous Internal Assessment Practical

ESEP=End Semester Examination Practical CCE= Continuous Comprehensive Evaluation ESE = End Semester Examination

SEMESTER V

Program: Honours Degree in Internet of Things (IoT)	Semester: V	L	P	C
Introduction to Internet of Things System Design	Course Code: HNITCR0501	4	0	4

Course Objectives:	
1	To study fundamental concepts of IoT
2	To understand roles of sensors in IoT
3	To Learn different protocols used for IoT design
4	To be familiar with data handling and analytics tools in IoT

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand the various concepts, terminologies and architecture of IoT systems.
CO 2:	Use sensors and actuators for the design of IoT.
CO 3:	Use various techniques of data storage and analytics in IoT
CO 4:	Understand various applications of IoT

Pre-requisite courses: Basic of Electronics devices and their operations

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments / Tutorials / Power-point-presentation / Group-discussion / Quiz / seminar / Case studies / Design Thinking /Innovation / Creativity/Blog writing/Vlogging, etc. 3. Pre / Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day Experiments / Assignments / Tutorials / Power-point-presentation / Group-discussion / Quiz / seminar / Case studies / Design Thinking / Innovation / Creativity/ Blog writing/Vlogging, etc. 4. End Semester Examination (Theory components)
INDIRECT
1. Course-end survey 2. Activity Based Survey (if any)

DETAILED SYLLABUS	
Module-1: Introduction to IoT	**08 Hours**
1.1 Introduction, Definitions & Characteristics of IoT, 1.2 Physical and Logical design of IoT, 1.3 IoT enabling technologies, 1.4 IoT Issues and Challenges in IoT. 1.5 IoT and M2M.	
Module-2 : Sensors and Actuators	**14 Hours**
2.1 Sensors – Sensor Fundamental, Classifications and Properties, Optical, radiation and Displacement sensors, Presence, force, Pressure, Flow Sensors, Temperature, Humidity, Moisture Chemical and Biological Sensors 2.2 Actuators: Introduction of Pneumatic, Hydraulic and Electrical Actuators. Different electrical actuators. 2.3 Identification of sensor and actuator for real-time application.	
Module-3 : IoT hardware and Interfacing platforms	**15 Hours**
3.1 IoT hardware devices: Introduction to Arduino, Embedded programming for Arduino. Raspberry Pi, Introduction to Python programming for Raspberry Pi. Introduction to ESP 8266, Introduction to NODE MCU. Introduction to ESP32. 3.2 IoT Data Analytics: Introduction, Architecture of Data Analytics, Advantages and Dis-advantages. 3.3 IoT Platforms: Thingspeak, AWS, BLYNK.	
Module-4 : IoT Applications	**15 Hours**
4.1 Home Automation, 4.2 Smart Cities, 4.3 Agriculture, 4.4 Health and Lifestyle, 4.5 IoT in Environmental Protection, Energy, Retail Management, Logistics.	

Lecture: 4 Hrs / Week **Total Hours: 52 Hrs**

Textbooks:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”,1st Edition, VPT, 2014
2. Jacob Fraden, “HandBook of Modern Sensors: physics, Designs and Applications”, 2015, Springer, New York, 3rd edition.
3. Jon. S. Wilson, “Sensor Technology HandBook”, 2011, Elsevier, Netherland, 1st edition

Reference Books:

1. Edited by Qusay F Hasan, Atta ur rehman Khan, Sajid A Madani, “Internet of Things Challenges, Advances,and Application”, CRC Press.
2. John G Webster, Halit Eren, “Measurement, Instrumentation and sensor Handbook ", 2014, 2nd edition, CRC Press, Taylor and Fransis Group, New York.
3. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013, ISBN: 978-1-118-43062-0
4. Nathan Ida, “Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction”, Second Edition, IET Control, Robotics and Sensors Series 127, 2020.

SEMESTER VI

Program: Honours Degree in Internet of Things (IoT)	Semester: VI	L	P	C
Communication Protocol and Cloud Services for IoT	Course Code: HNITCR0601	4	0	4

Course Objectives:	
1	To explore the role of the cloud in Internet of Things deployment.
2	Understand various communication protocols of Internet of Things.
3	Understand the present scope of Internet of Things with case studies.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO1	Identify the need for the cloud in IoT deployment and describe different Cloud provider's architecture
CO2	Represent and analyze various communication models, carry out the comparative analysis in terms of specified parameters
CO3	Model Internet of Things using various protocols of standard communication layers.
CO 4	Design the optimum model of connectivity solution to various things in different application areas.

Pre-requisite courses: Introduction to Internet of Things System Design

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments / Tutorials / Power-point-presentation / Group-discussion / Quiz / seminar / Case studies / Design Thinking / Innovation / Creativity /Blog writing/Vlogging, etc.. 3. Pre / Post - Experiment Test / Viva; Experimental Write-Up for each Experiment, Day to Day Experiments / Assignments / Tutorials / Power-point-presentation / Group-discussion / Quiz / seminar / Case studies / Design Thinking / Innovation / Creativity/ Blog writing/Vlogging, etc. 4. End Semester Examination (Theory components)
INDIRECT
1. Course-end survey 2. Activity Based Survey (if any)

DETAILED SYLLABUS	
Module-1 : Wireless Sensor Network	**10 Hours**
1.1 Introduction to IOT: Enabling Technologies in IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks. 1.2 Wireless Sensor Network for IoT**:** History and Context, the node, Connecting nodes, Networking Nodes, WSN and IoT.	
Module-2 : Networking and Communication Protocol	**14 Hours**
2.1 Networking Protocol: OSI Model for the IoT/M2M System Lightweight M2M Communication Protocols, Internet based Communications, IP addressing in IoT, Network Model, TCP & UDP, Client-Server architecture. 2.2 Communication Protocol: HTTP, REST APIs, WebSocket, MQTT, COAP, RFID IoT System, Protocols. M2M Communication Protocols, Bluetooth BR/EDR and Bluetooth low energy. 2.3 RFID IoT Network Architecture, ZigBee IP/ZigBee SE2.0, Wifi(WLAN),Message Communication protocols for connected devices Data exchange formats: JSON & XML	
Module-3 : Cloud Services for IoT	**13 Hours**
3.1 NIST's SPI Architecture and Cloud Standards, The Cloud of Things--The Internet of Things and Cloud Computing. 3.2 The Cloud of Things Architecture-- Four Deployment Models, Vertical Applications, Fifteen Essential Features, Four, Technological Pillars, Three Layers of IoT Systems, Foundational, Technological Enabler 3.3 Cloud Providers and Systems -- Microsoft Azure IoT, Amazon Web Services, Google's cloud IoTs.	
Module-4 : Case Studies	**15 Hours**
4.1 Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges. 4.2 E-health: Characteristics of e-health and applications- monitoring of health parameters, smart medicine box, elderly people monitoring, challenges. 4.3 IoT Smart City: Characteristics and applications– Smart Economy, Smart Environment, Smart Living Smart Grid, Smart Home, Transport and Traffic Management, Smart Healthcare.	

Lecture: 4 Hrs / Week **Total Hours:52 Hrs**

Textbooks:

1. Honbo Zhou, The Internet of Things in the Cloud A Middleware Perspective, CRC Publication.
2. Arshdeep Bagha, Vijay Medisetti, Internet of Things- Hands on Approach, Published by Arshdeep Bagha and Vijay Medisetti,2014.
3. Jeeva Jose, “Internet of Things”, ISBN-10 : 938617359X, Khanna Book Publishing, 2018.
4. Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley and Sons Ltd, UK, 2014.
5. Milan Milenkovic, Internet of Things: Concepts and System Design, Springer International Publishing, May 2020.

Reference Books:

1. Gautam Shroff, Enterprise Cloud Computing, Cambridge,2010
2. Raj Kumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing -Foundations and Applications Programming, MK Publication, 2013.
3. Agus Kurniawan, Learning AWS IoT- Effectively Manage Connected Devices on the AWS Cloud Using Services Such as AWS Greengrass, AWS Button, Predictive Analytics and Machine Learning, Packt Publication,2018.
4. Hakima Chouchi, “The Internet of Things Connecting Objects to the Web”, ISBN 078 -1- 84821-140-7, Wiley Publications
5. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things

SEMESTER VII

Program: Honours Degree in Internet of Things (IoT)	Semester: VII	L	P	C
Analytics for the Internet of Things (IoT)	Course Code: HNITCR0701	4	0	4
Analytics for the Internet of Things (IoT)- LAB	Lab Code: HNITLR0702	0	4	2
		4	4	6

Course Objectives:	
1	To learn and understand the basics of Machine Learning and IoT
2	To get acquainted with machine learning for IOT Data Analysis.
3	To design IoT applications using ML
4	To understand the Internet of Things and its benefits for society

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Identify and understand the machine learning elements and techniques for IoT
CO 2:	Implement data preprocessing methods for IoT using python
CO 3:	Explore design issues and working principles of various security measures and various standards for secure communication in IoT.
CO 4:	Discuss the architecture, operation, and business benefits of an IoT solution.

Pre-requisite courses: Introduction to Internet of Things system Design, Communication Protocols and Cloud services for IoT.

Course Assessment Methods:

DIRECT

1. Continuous Internal Assessment (Theory component)
2. Assignments / Tutorials / Power-point-presentation / Group-discussion / Quiz / seminar / Case studies / Design Thinking / Innovation / Creativity /Blog writing/Vlogging, etc..
3. Pre / Post - Experiment Test / Viva; Experimental Write-Up for each Experiment, Day to Day Experiments / Assignments / Tutorials / Power-point-presentation / Group-discussion / Quiz / seminar / Case studies / Design Thinking / Innovation / Creativity / Blog writing/Vlogging, etc. (Lab Component)
4. End Semester Examination (Theory and Lab components)

INDIRECT

1. Course-end survey
2. Activity based survey (if any)

DETAILED SYLLABUS	
Module-1: IoT and Data Analytics	**10 Hours**
1.1 Defining IoT Analytics, IoT Analytics challenges. 1.2 The AWS virtual Private Cloud (VPC) setup walk through. 1.3 Creating a key pair for the NAT and bastion instances. 1.4 Creating S3 bucket to store data. 1.5 Creating a VPC for IoT Analytics.	
Module-2: IoT and Machine Learning	**13 Hours**
2.1 Advantages of IoT and Machine Learning Integration. 2.2 Implementation of Supervised Algorithm- Regression (Linear and Logistic), SVM for IoT-Neural Network on case study: Agriculture andIoT, Smart Home etc. 2.3 Data Preparation for Predictive Maintenance Modeling, Cleaning and Standardizing IoT Data. 2.4 Applying Advanced Data Exploration Techniques. 2.5 Feature Engineering: Exploring Feature Engineering, Applying Feature Selection Techniques, Feature set selection using ML. 2.6 Machine learning for Internet of Things data analysis.	
Module-3: IoT and it's Security	**14 Hours**
3.1 Introduction, Security Requirements , Security Requirements in IoT Architecture, Sensing Layer and IoT End-Nodes, Network Layer, Service Layer, Application Interface Layer. 3.2 Cross-Layer Threats, Threats Caused in Maintenance of IoT, Security in Enabling Technologies, Security in Identification and Tracking Technologies. 3.3 Security in Integration of WSN and RFID, Security in Communications, Security in Networks, Security in Service Management, Security Concerns in IoT Applications. 3.4 Security Concerns in SCADA Systems, Security Concerns in Enterprise Information systems, Security Concerns in Social IoT , Confidentiality and Security for IoT-Based Healthcare.	
Module-4: Applications of ML and IOT	**15 Hours**
Case Studies: 4.1 IOT for Agriculture. 4.2 Remote Patient Monitoring. 4.3 Smart City. 4.4 Smart Transportation. 4.5 IOT Security using ML.	

Lecture: 4 Hrs/Week **Total Hours : 52 Hrs**

Lab Component Contents:- Part A is compulsory. Student can choose any one of Part B and Part C.

Part A	1. Implement interfacing of DHT11 with Raspberry Pi 2. Implement interfacing of Relay with Raspberry Pi 3. Demonstrate Contiki OS for RPL (like Create 2 border router and 10 REST clients, Access border router from other network (Simulator)) 4. Demonstrate use of IoT simulators (like Beviswise) on any real time device (LED/ stepper motor)
Part B	Programming for IOT : Python Programming, Develop an Application on Arduino / Raspberry-Pi to capture the values of temperature sensor after every 15 sec of time interval, store this values in .csv format and predict the temperature at particular time t using linear regression analysis. Create the dataset of at least 50-75 instances, use any data analysis tool (WEKA/Orange)
Part C	1. Download the IoT Dataset of your choice 2. Divide the dataset into Training data and Testing data. 3. Perform the classification of the instances using any machine learning algorithm like KNN Algorithm, Naïve Bayes, Decision Tree or any. 4. Evaluate the machine learning model by considering the parameter (TPR, TNR, FPR, FNR, accuracy, precision, recall, error rate etc.) References 1. https://www.kaggle.com/datasets 2. https://archive.ics.uci.edu/ml/datasets.php

Practical: 4 Hrs / Week **Total Hours : 52 Hrs**

Textbooks:

1. Analytics for the Internet of Things (IoT), Andrew Minteer, Packt Publication 2017
2. Internet of Things- Hands on Approach, Arshdeep Bagha, Vijay Medisetti, Published by Arshdeep Bagha and Vijay Medisetti,2014.
3. Internet of things For Architects, Perry Lea Packt Publication,2018

Reference Books:

1. Neeraj Kumar, Aaisha Makkar, " MACHINE LEARNING IN COGNITIVE IOT", https://www.routledge.com/ Machine-Learning-in-Cognitive-IoT/ KumarMakkar /p/ book/ 9780367359164 ISBN 9780367359164 Published June 1, 2020 by CRCPress
2. Puneet Mathur, " IoT Machine Learning Applications in Telecom, Energy, and Agriculture, With Raspberry Pi and Arduino Using Python", ISBN 978-1-4842-5549-0
3. Nicolas Modrzyk, " Real-Time IoT Imaging with Deep Neural Networks - Using Java on the Raspberry Pi 4" , Apress Publication , Year: 2020, ISBN: 9781484257210, 978148425722

SEMESTER VIII

Program: Honours Degree in Internet of Things (IoT)	Semester: VIII	L	P	C
Industry 4.0 And Industrial Internet Of Things	Course Code: HNITCR0801	4	0	4

Course Objectives:	
1	To learn the concepts of Industry 4.0 and Industrial Internet Of Things (IIOT).
2	To learn Industrial Data Transmission and Industrial Data Acquisition.
3	To learn IIOT Block chain and Security.
4	To learn different applications and securities in IIOT.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand the concepts of Industry 4.0 and IIOT.
CO 2:	To learn reference Architecture of IIOT.
CO 3:	To learn Industrial Data Transmission and Industrial Data Acquisition.
CO 4:	To learn different applications and securities in IIOT.

Pre-requisite courses: Introduction to Internet of Things system Design, Communication Protocols and Cloud services for IoT, Analytics for the Internet of Things.

Course Assessment Methods:

DIRECT
1. Continuous Internal Assessment (Theory component) 2. Assignments/Tutorials/Power-point-presentation/Group-discussion/Quiz/seminar/Case studies/Design Thinking/Innovation/Creativity/ Blog writing/Vlogging, etc.. 3. Pre/Post - Experiment Test/Viva; Experimental Write-Up for each Experiment, Day to Day experiments/Assignments/Tutorials/Power-point-presentation/ Group-discussion/ Quiz/ seminar/ Case studies/Design Thinking/Innovation/Creativity/Blog Writing/Vlogging, etc. 4. End Semester Examination (Theory)
INDIRECT
1. Course-end survey 2. Activity based survey (if any)

DETAILED SYLLABUS	
Module-1: Introduction to Industry 4.0	**12 Hours**
1.1 Overview of Industry 4.0 and Industrial Internet of Things, Industry 4.0. 1.2 Industrial Revolution: Phases of Development, Evolution of Industry 4.0, Impact, Effects & Consequences 1.3 Industrial Internet, Basics of CPS, CPS and IIOT, Design requirements of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of Industries, Smart Business Perspective, Cyber security, Impacts of Industry 4.0, Industrial Internet of Things: Basics, IIOT and Industry 4.0, Industrial Internet Systems, Industrial Sensing, Industrial Processes, 1.4 IIOT Challenges – Identifying Things within the internet, Discovering Things and the Data they possess, Managing massive amount of data, Navigating Connectivity Outages, IIOT Edge - Leveraging the Power of Cloud Computing, Communicating with Devices on the Edge, Determining a Request/Response Model	
Module-2: Industrial Data Transmission and Industrial Data Acquisition	**14 Hours**
2.1 Introduction, Features and Components of - Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Batibus, Digital STROM, 2.2 Controller Area Network, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and LoRaWAN NB-IoT, IEEE 802.11AH,Distributed Control System, PLC, SCADA 2.3 Industrial IoT: Big Data Analytics	
Module-3: IIOT Reference Architecture	**14 Hours**
3.1 Industrial Processes, Business Models and Reference Architecture for IIoT Business Models. 3.2 Types of Business Models for IoT, Software-Defined Networking (SDN) in IIoT. 3.3 The Three-Tier Topology, Key Functional Characteristics of Connectivity. Software Architectural Style for the Industrial Internet of Things - Software Architecture Practice, Advanced Architectural Styles, Systems of Systems. 3.4 Challenges of Software Engineering in IIoT, Principles for Software Architecture design in IIoT, The Principled Decomposition, The Architectural Style	
Module-4: IIoT Applications	**12 Hours**
4.1 IIoT Applications: Factories and Assembly Line, Food Industry, Healthcare, Power Plants, Electricity Sector, Solar Energy Sector. 4.2 Supply Chain and Inventory Management, facility management. 4.3 IoT in Oil and Gas Industry	

Lecture: 4 Hrs / Week **Total Hours : 52 Hrs**

Textbooks:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
3. "Industrial Internet of Things and Communications at the Edge", by Tony Paine, CEO, Kepware Technologies
4. Research Papers

Reference Books:

1. "Practical Internet of Things Security", by Brian Russell, Drew Van Duren (Packt Publishing)
2. "Industrial Internet of Things and Communications at the Edge", by Tony Paine, CEO, Kepware Technologies
3. "Architectural Design Principles For Industrial Internet of Things", Hasan Derhamy, Luleå University of Technology, Graphic Production

Mahavir Education Trust's

SHAH & ANCHOR

KUTCHHI ENGINEERING COLLEGE

An Autonomous Institute Affiliated to University of Mumbai

Address
Mahavir Education Chowk,
W.T. Patil Marg, Chembur
Mumbai- 400 088

विद्याधनं सर्वधनेषु प्रधानम्॥

www.sakec.ac.in

info@sakec.ac.in

@sakectweets

www.facebook.com/shahanchor

09136400555