Fourth Year BE

SCHEME & SYLLABUS

Autonomous Scheme 2021-22

Artificial Intelligence & Machine Learning

ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service and Excellence

VISION

To be a global premier Institution of professional education and research

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular, for quality professional education
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies
- Attract, nurture and retain the best faculty and technical manpower
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities
- Promote all-round personality development of the students through interaction with alumni, academia and industry
- Strengthen the Educational Social Responsibilities (ESR) of the Institution

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution
Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E.(CSE, ECE, EEE, ME and CIV) & PG (MBA and MCA)
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2021-22)

Artificial Intelligence and Machine Learning

FOURTH YEAR

(VII and VIII Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and two of the PG programs, namely, MBA and MCA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

CONTENTS

ABOUT THE DEPARTMENT

Artificial Intelligence (AI) and Machine Learning (ML) are being looked as the drivers for the next industrial revolution happening in the world today. Artificial Intelligence has been utilized in various fields like Medicine, Language processing, Finance, Education, Transportation, Business, Law and more.

Artificial Intelligence is the branch of Computer Science that emphasizes the development of intelligent machines which think and work like humans. With the advancement in technology, we are already connected to AI in one way or the other – whether it is Siri, Watson or Alexa. More and more companies are investing resources in Machine Learning (ML), indicating a robust growth in AI products and apps in the near future.

AI and ML are integral parts of data science, where techniques from both such as regression, predictive analytics and more are applied for insight generation. Job Opportunities for AI & ML engineers such as - Business Intelligence Developer, Research Scientist, Full stack developer, Software architect, Data analyst, Data warehouse engineer and Product manager are highly demanding. Demand for AI and ML engineers is projected to be 1,25,00 in the next five years.

The four-year engineering course in AI and ML at SJEC offers subjects like Introduction to Sensors, ML with Python, Big Data Analytics, Natural Language Processing (NLP), Applied Statistics, Expert System, Fuzzy Logic, Virtual Reality, Robotics Process Automation (RPA), Internet of Things (IoT), Speech Processing, Computation Intelligence, Pervasive Computing, Knowledge and Data Engineering, ML and AI for Healthcare & Agriculture, Deep Learning, Game Theory, etc.

DEPARTMENT VISION

To impart value-based quality education with the motive of transforming mankind with excellence and competing areas of engineering, technology and management.

DEPARTMENT MISSION

1. Focus on the practical aspects of the curriculum to make learning a meaningful and interesting experience.
2. Encourage active collaboration with industries, communities, and fellow institutions within the country and abroad.
3. Infuse strong moral and ethical principles in students in order to make them conscientious citizens and excellent human beings.
4. Cultivate the competitive spirit required for success.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide students with a solid foundation and the ability to use engineering concepts, mathematics, physics, and humanities required to develop, analyse, design, and implement solutions to the problems in intelligent computing and business systems.
2. To develop in students, the knowledge of computer science and engineering to work in domains such as artificial intelligence, machine learning and data science.
3. To foster in students, the capacity of teamwork through efficient communication in multidisciplinary projects.
4. To prepare students for building successful careers in artificial intelligence, data science and business systems to meet the needs of society while incorporating professional ethics.
5. To inspire learners to pursue higher education in their desired fields and engage in research.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations on complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and the synthesis of information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. **Entrepreneurship and Freelancing**: Recognize the tenets of entrepreneurship, freelancing and the prerequisites for starting a business in the IT or related fields.

2. **Competitive Exams**: Participate skillfully in competitive examinations for certification, professional advancement, and admission to higher studies.

VII Semester (B.E. – Artificial Intelligence and Machine Learning)													
Sl. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
						L	**T**	**P**					
1	PCC	21AIM701	Advanced AI and ML	AIML	AIML	2	2	-	03	50	50	100	3
2	PCC	21AIM702	Deep Learning and Neural Networks	AIML	AIML	2	2	-	03	50	50	100	3
3	PEC	21AIM703X	Professional Elective - 2	AIML	AIML	3	-	-	03	50	50	100	3
4	PEC	21AIM704X	Professional Elective - 3	AIML	AIML	3	-	-	03	50	50	100	3
5	OEC	21AIM705X	Open Elective - 2	AIML	AIML	3	-	-	03	50	50	100	3
6	SDC	21AIS706	Technical Seminar	AIML	AIML	-	-	2	-	100	-	100	1
7	SDC	21AIP707	Major Project Work (Phase I & II)	AIML	AIML	-	-	6	03	50	50	100	5
					Total	**13**	**04**	**08**	**18**	**400**	**300**	**700**	**21**

21AIM703X : Professional Elective II					
21AIM7031	Computer Vision	21AIM7033	Business Intelligence	21AIM7035	Soft and Evolutionary Computing
21AIM7032	Robotic Process Automation	21AIM7034	Blockchain Technology		
21AIM704X : Professional Elective III					
21AIM7041	Augmented and Virtual Reality	21AIM7043	Predictive Analytics	21AIM7045	Cryptography and Cyber Security
21AIM7042	NoSQL Database	21AIM7044	High Performance Computing		

21AIM705X : Open Elective II					
21AIM7051	Deep Learning	21AIM7053	Soft Computing	21AIM7055	Internet of Things
21AIM7052	Robotic Process Automation	21AIM7054	Natural Language Processing		

VIII Semester (B.E. – Artificial Intelligence & Machine Learning)													
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
						L	**T**	**P**					
1	SDC	21AEC801	Massive Open Online Course **(**MOOC)	Any MOOC topic (Choices are given by respective Department) with minimum 8 weeks to be completed between III Sem to VIII Sem								100	2
2	SDC	21AIP802	Major Project Work (Final Presentation and Report Submission)	AIML		-	-	-	03	50	50	100	5
3	INT	21INT803	Research / Industry Internship			-	-	-	03	50	50	100	10
					Total	-	-	-	**06**	**100**	**100**	**300**	**17**

Note: Research Internship / Industry Internship is to be carried out during the 8th semester for 15 weeks.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B. Plan day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

VII Semester

Advanced AI and ML			
Course Code	**21AIM701**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Articulate fundamentals of Intelligent Agents.
- Demonstrate the reasoning on Uncertain Knowledge.
- Examine explanation-based learning in solving AI problems.
- Illustrate the use of KNN.
- Explore the Text feature Engineering concepts with Applications.

Module-1 Uncertain knowledge and Reasoning (8 hours)

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use The Wumpus World Revisited
TB1: Ch 13

Module-2 Probabilistic Reasoning (8 hours)

Representing Knowledge in an Uncertain Domain: The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks. **TB1: Ch 14**

Module-3 Neural Network and Genetic Algorithms (8 hours)

Neural networks Representation: Brief history and Evolution of Neural network, Biological neuron, Basics of ANN, Activation function, MP model.
Neural Network and genetic algorithms: Problems – Perceptrons– Multilayer Networks and Back Propagation Algorithms – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.
TB3: Ch 6 TB2: Ch 4.3 to 4.6, Ch 9.2, 9.4, 9.5

Module-4 Recommendation and Text Analytics (8 hours)

Recommender System: Datasets, Association rules, Collaborative filtering, User-based similarity, item-based similarity, using surprise library, Matrix factorization
Text Analytics: Overview, Sentiment Practical Applications, Naïve Bayes model for sentiment classification, using TF-IDF vectorizer, Challenges of text analytics
TB4: Ch 9, Ch 10

Module-5 Natural Language Processing (8 hours)

Language Models, Information Retrieval: IR scoring functions, IR system evaluation, IR refinements, The PageRank algorithm, The HITS algorithm, Question answering
Information Extraction: Probabilistic models for information extraction, Conditional random fields for information extraction
TB1: Ch 22.1, 22.3, 22.4

Course Outcomes: At the end of the course the student will be able to:	
21AIM701.1	Explain the reasoning on Uncertain Knowledge.
21AIM701.2	Discuss the representation of Conditional Distributions.
21AIM701.3	Design explanation-based learning to solve AI problems
21AIM701.4	Investigate ML algorithms effectively to solve real world problems
21AIM701.5	Examine Instant based techniques and derive effectively learning rules to real world problems.
21AIM701.6	Analyze AI and ML techniques in a range of real-world applications

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence,A Modern Approach	Stuart J. Russell,Peter Norvig	Pearson	3rd Edition, 2015
2	Machine Learning	Tom M. Mitchell	McGraw-Hill Education	1st Edition, 2017
3	Machine Learning	Anuradha Srinivasaraghavan, VincyJoeph	Wiley	1st Edition, 2019
4	Machine Learning using Python	Manaranjan Pradhan, U Dinesh Kumar	Wiley	1st Edition, 2019
Reference Books				
1	An Introduction to Multi Agent Systems	Michael Wooldridge	John Wiley & Sons Inc	2nd Edition, 2009

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106/102/106102220/
- https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
- https://nptel.ac.in/courses/106/106/106106139/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM701.1	2								2	2			1	
21AIM701.2		2			2				2				2	
21AIM701.3	3								2	2				
21AIM701.4		2	2		2				1				2	
21AIM701.5			2			2				2			2	2
21AIM701.6						3						3	2	1

1: Low 2: Medium 3: High

Deep Learning and Neural Networks			
Course Code	**21AIM702**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand major deep neural network frameworks and issues in basic neural networks.
- Solve real-world applications using Deep learning.
- Identify suitable deep learning approaches for given applications.
- Demonstrate the working of TensorFlow.
- Know the significance of Autoencoders.

Module-1 Introduction to Neural Networks and Deep Neural Networks (8 hours)

Introduction: The Neuron, Expressing Linear Perceptron as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU Neurons, SoftMax Output Layer, Deep Neural Networks – Forward and Back Propagation – Parameters – Hyperparameters.

TB1: Ch 1

Module-2 Training Feed-forward Neural Network (8 hours)

Gradient Descent, Gradient Descent with Sigmoidal Neurons, Stochastic and Minibatch Gradient Descent, Test Sets, Validation Sets and Overfitting, Preventing Overfitting in Deep Neural Networks, RMSProp and Adam Optimization, Implementation of neural network using TensorFlow, Exercise: Boston Housing Price Prediction with Feed Forward Neural Networks.

TB1: Ch 2

Module-3 Convolutional Neural Network (8 hours)

Foundations of Convolutional Neural Networks – CNN operations – Architecture – Simple Convolution Network – Deep Convolutional Models – ResNet, AlexNet, Inception Net and others. Exercise: Handwritten digit recognition using CNN.

TB1: Ch 5 TB2: Ch 8

Module-4 Models for Sequence Analysis (8 hours)

Recurrent Neural Networks, The Challenges with Vanishing Gradients, Long Short-Term Memory (LSTM) Units, TensorFlow Primitives for RNN Models, Implementing a Sentiment Analysis Model, Solving seq2seq Tasks with Recurrent Neural Networks. Exercise: Sentiment Analysis for Movie Reviews using RNN.

TB1: Ch 7

Module-5 Introduction to Auto Encoders and GAN (8 hours)

Autoencoders: Efficient data representation, Performing PCA, Stacked, Autoencoders, Denoising, Sparse autoencoders, variational and other autoencoders. Generative Adversarial Networks. Exercise: Image generation using GAN.

TB1: Ch 6 TB2: Ch 10.

Course Outcomes: At the end of the course the student will be able to:	
21AIM702.1	Describe the basic concepts of Neural Networks and Deep Learning.
21AIM702.2	Make use of Tensor Flow to build model.
21AIM702.3	Identify Convolutional Neural Network for a given scenario
21AIM702.4	Select Deep Learning models for sequence analysis.
21AIM702.5	Apply the concept of Autoencoders and GAN.
21AIM702.6	Build Deep learning models for Real-world applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Deep Learning A Practitioner's Approach	Josh Patterson and Adam Gibson	O'Reilly	1rst Edition, 2017
2	Neural Networks and Deep Learning	Charu C Aggarwal	Springer	2nd Edition, 2023
Reference Books				
1	Hands on Machine Learning with Scikit-Learn &TensorFlow	AurelienGeron	O'Reilly	2nd Edition, 2019
2	Deep Learning	Lan Good fellow and Yoshua Bengio	MIT Press	2nd Edition, 2016

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=dPWYUELwIdM
- https://www.youtube.com/watch?v=ILsA4nyG7I0
- https://www.youtube.com/watch?v=TtyoFTyJuEY
- https://www.youtube.com/watch?v=tIExopLw29U&list=PLv8Cp2NvcY8AbK0RNZGeQFEPESqCzHQvj

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM702.1	2				2				2					
21AIM702.2			1						2				1	
21AIM702.3			2		2								1	
21AIM702.4			2										1	
21AIM702.5			2						2					
21AIM702.6		2			2				2				1	

1: Low 2: Medium 3: High

Computer Vision			
Course Code	**21AIM7031**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn basic principles of image formation, image processing algorithms.
- Understand different algorithms for recognition from single or multiple images/videos.
- Understand the core vision tasks of scene understanding and recognition.
- Choose the appropriate segmentation and clustering techniques for vision modeling.
- Apply different vision levels for image/video analysis, object recognition in building a computer vision model.

Module-1 Introduction and Image Formation (8 hours)

Introduction and Image Formation: What is computer vision? A brief history, Geometric primitives and transformations, Photometric image formation, The digital camera. Pinhole Perspective, Weak Perspective, Cameras with Lenses, The Human Eye, Intrinsic Parameters and Extrinsic Parameters, Geometric Camera Calibration.
TB1: Ch-1.1 to 1.3

Module-2 Early Vision – One Image (8 hours)

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates.
Local Image Features: Computing the Image Gradient, Representing the Image Gradient, Finding Corners and Building Neighborhoods, Describing Neighborhoods with SIFT and HOG Features.
TB1: Ch -4.1 to 4.5, Ch -5.1 to 5.4, Ch -6

Module-3 Early Vision – Multiple Images (8 hours)

Stereopsis: Binocular Camera Geometry and the Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Application - Robot Navigation.
Structure from Motion: Internally Calibrated Perspective, Uncalibrated Weak-Perspective and Uncalibrated Perspective Cameras.
TB1: Ch -7.1, 7.2, 7.4, 7.7, Ch 8

Module-4 Mid-level Vision (8 hours)

Segmentation by Clustering: Important Applications, Image Segmentation by Clustering Pixels Image Segmentation in Practice.
Grouping and Model fitting: The Hough Transform, Fitting Lines and Planes, Fitting Curve Structures, Fitting Using Probabilistic Models, Model Selection: Which Model Is the Best Fit?
TB1: Ch -9.2, 9.4, 9.5 Ch 10-10.1 to 10.3, 10.5, 10.7, Ch 11-11.1 to 11.4

Module-5 High-level Vision (8 hours)

Registration: Registering Rigid Objects, with Projection, Registering Deformable Objects.
Smooth Surface and their Outlines: Elements of Differential Geometry, Contour Geometry.
Range Data Detecting Objects in Images: Active Range Sensors, Range Data Segmentation, Range Image Registration and Model Acquisition, Object Recognition, Detecting Objects in Images
TB1: Ch 12.1 to 12.3, Ch 14

Course Outcomes: At the end of the course the student will be able to:	
21AIM7031.1	Describe the fundamental image processing techniques required for computer vision.
21AIM7031.2	Explain Image formation process.
21AIM7031.3	Analyze appropriate shape analysis techniques.

21AIM7031.4	Make use of clustering for segmentation and analyse Hough Transform.
21AIM7031.5	Analyze mid-level and high-level vision techniques.
21AIM7031.6	Design applications using computer vision techniques.

Sl. No.	Title of the Book	Name ofthe Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Computer Vision – A modern approach	D. Forsyth and J. Ponce	Prentice Hall	2nd Edition, 2012
Reference Books				
1	Building Computer Vision Applications Using Artificial Neural Networks - With Step-by-step Examples in Opencv and Tensorflow with Python	Shamshad Ansari	Apress	1st Edition, 2020
2	Digital Image Processing	Rafael C. Gonzalez and Richard E.Woods	Prentice Hall	4th Edition 2018

Web links and Video Lectures (e-Resources):

- https://youtu.be/V_xro1bcAuA?si=otfZ_1VYInB6tz1W
- https://www.udacity.com/course/introduction-to-computer-vision--ud810
- https://www.mygreatlearning.com/academy/learn-for-free/courses/computer-vision-essentials
- https://www.mltut.com/best-free-computer-vision-courses/
- https://www.youtube.com/watch?v=D5hmApvpLH4
- https://www.youtube.com/watch?v=01sAkU_NvOY

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7031.1	2											2		2
21AIM7031.2		2	2										2	
21AIM7031.3						2			2	1		2		
21AIM7031.4		2	2	2	2	1	2	1						
21AIM7031.5				1	2	1			1	2	2			
21AIM7031.6			1		1				2	2	2			2

1: Low 2: Medium 3: High

Robotic Process Automation			
Course Code	**21AIM7032**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the basic concepts of RPA.
- Know where RPA can be applied and how it is implemented.
- Learn the different types of variables, Control Flow and data manipulation techniques.
- Understand Image, Text and Data Tables Automation
- Know various types of Exceptions and strategies to handle

Module-1 RPA Foundations and Skills (8 hours)

IRPA Foundations: What is RPA?, Flavors of RPA, History of RPA, The Benefits of RPA, The downsides of RPA, RPA Compared to BPO, BPM and BPA, Consumer Willingness for Automation, The Workforce of the Future. **RPA Skills:** On-Premise Vs. the Cloud, Web Technology, Programming Languages and Low Code, OCR, Databases, APIs, AI, Cognitive Automation, Agile, Scrum, Kanban and Waterfall, DevOps, Flowcharts.

TB1: Ch 1, Ch 2

Module-2 Robotic process automation, Record and Play (8 hours)

Process Methodologies: Lean Six Sigma, How to Implement Six Sigma, Six Sigma Roles and Levels, Lean Six Sigma, Finding the Right Balance, Applying Lean and Six Sigma to RPA Conclusion. **Robotic process automation:** Components of RPA, RPA Platforms, About UiPath, The future of automation. **Record and Play:** Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder - Step-by-step examples using the recorder.

TB1: Ch 3, TB2: Ch 1, Ch 2

Module-3 Sequence, Flowchart, and Control Flow and Data Manipulation (8 hours)

Sequence, Flowchart, and Control Flow: Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow. **Data Manipulation:** Variables and Scope, Collections, Arguments - Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with example).

TB2: Ch 3, Ch 4

Module-4 Taking Control of the Controls (8 hours)

Taking Control of the Controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls - mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points.

TB2: Ch 5

Module-5 Exception Handling, Debugging, and Logging, Future of RPA (8 hours)

Exception Handling, Debugging, and Logging: Exception handling, Common exceptions, ways to handle, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting. **Future of RPA:** Consolidation and IPOs, Microsoft, Attended Automation, Vertical-Specific Companies, Hype Factor, SaaS, Chatbots, AI, Privacy and Ethics,

TB2: Ch 8, Ch 10

Course Outcomes: At the end of the course the student will be able to:	
21AIM7032.1	Describe the basic concepts and challenges of Robotic Process Automation

21AIM7032.2	Apply UiPath Studio to automate processes using Lean Six Sigma and Task Recorder.
21AIM7032.3	Demonstrate the ability to create workflows and perform data manipulation using UiPath.
21AIM7032.4	Analyze and implement various techniques for interacting with user interface controls using UiPath.
21AIM7032.5	Evaluate and apply methods for exception handling, debugging, and logging within RPA projects.
21AIM7032.6	Design and develop a comprehensive RPA project that integrates the foundational concepts, workflow design and error management skills.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems	Tom Taulli	Apress	1st Edition February 2020
2	Learning Robotic Process Automation	Alok Mani Tripathi	Packt Publishing	1st Edition, March 2018
Reference Books				
1	Introduction to Robotic Process Automation :A Primer	Frank Casale , Rebecca Dilla, Heidi Jaynes, Lauren Livingston	The Institute for Robotic Process Automation (IRPA)	2018
2	Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks& Become An RPA Consultant	Richard Murdoch	Richard Murdoch &RPA Ultra	2020
3	Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation	Srikanth Merianda	Consulting Opportunity Holdings Llc	1st Edition, 2018

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=tMo3wXKbxuw
- https://www.youtube.com/watch?v=007xRS2_JnI
- https://www.youtube.com/watch?v=NzamfhBthao
- https://www.youtube.com/watch?v=m7r2TRT2ESc
- https://www.youtube.com/watch?v=QaPTqO_ypGE

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7032.1	3	2						1					3	
21AIM7032.2		3	2		2									
21AIM7032.3	3		3				1							
21AIM7032.4			2	3					1					2
21AIM7032.5			2		3	1								
21AIM7032.6	2		3						3	2			3	3

1: Low 2: Medium 3: High

Business Intelligence			
Course Code	**21AIM7033**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the Business Intelligence, Analytics and Decision Support system.
- Understand the decision-making process and identify the technologies for decision supportsystems
- Understand data warehousing, business reporting, visual analytics and business performance management operations.
- Understand the models used for the decision-making process.
- Understand the importance of automated decision systems in various applications

Module-1 Introduction to Business Intelligence, Analytics and Decision Support (8 hours)

Overview of Business Intelligence, Analytics and Decision Support: Changing Business Environments and Computerized Decision Support, Managerial decision making, Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems(DSS), A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics.
Case Study: Business Intelligence, Business Analytics and Big Data. **TB1**

Module-2 Decision Making and Decision Support Systems (8 hours)

Foundations and Technologies for Decision Making: Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.
Case Study: Decision making and Decision Support components. **TB1**

Module-3 Descriptive Analytics: Data warehousing and Business Reporting (8 hours)

Data warehousing: Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, Data Warehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes. Data warehouse Development, Data Warehousing Implementation Issues.
Business Reporting, Visual Analytics, Business Performance Management: Business Reporting Definitions and Concepts, Data and Information Visualization, Different Types of Charts and Graphs, The Emergence of Data Visualization and Visual Analytics, Performance Dashboards, Business Performance Management, Performance Measurement, Balanced Scorecards, Six Sigma as a Performance Measurement System
Case Study: Data Warehousing, ETL, Business Reporting **TB1**

Module-4 Prescriptive Analytics: Model Based Decision Making (8 hours)

Optimization and Multi-Criteria Systems: Decision Support Systems Modeling, Structure off Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking. Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making with Pairwise Comparisons.
Case Study: Decision modelling using spreadsheets **TB1**

Module-5 Prescriptive Analytics: Expert Systems (8 hours)

Automated Decision Systems, The Artificial Intelligence Field, **Expert Systems:** Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems, Benefits, Limitations, and Critical Success Factors of Expert Systems.
Case Study: Application of expert systems. **TB1**

Course Outcomes: At the end of the course the student will be able to:	
21AIM7033.1	Apply the types of data to the Decision Support systems and Business Intelligence framework.
21AIM7033.2	Apply the decision making process and DSS concepts in the business applications supporting problem resolution..
21AIM7033.3	Analyze the importance of data warehousing and business reporting tools to perform descriptive analytics for business issues in the organizations.
21AIM7033.4	Analyze the relevance of model based decision making to perform prescriptive analytics for business decisions in the organizations.
21AIM7033.5	Analyze the value of expert systems in the decision making process and also discuss areas suitable for application of expert system.
21AIM7033.6	Analyze the influence of technologies & business intelligence in overcoming the issues in various business application cases.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Business Intelligence and Analytics:Systems for decision support	Ramesh Sharda, Dursun Delden, Efraim Turban	Pearson Publishers	10th Edition, 2015
Reference Books				
1	Business IntelligenceThe Savvy Manager's Guide	David Loshin	Elsevier Publishers	2nd Edition, 2013
2	Fundamentals of Business Analytics	R N Prasad, Seema Acharya	Wiley Publishers	2nd Edition, 2016
3	Data MiningTechniques. ForMarketing, Sales and Customer Relationship Management	Berry M. &Linoff G	Wiley PublishingInc	2nd Edition, 2004
4	Data Science for Business	Foster Provost and Tom Fawcett	O'Reilly Media,Inc	1st Edition, 2013

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=dn97ux9exbY
- https://www.youtube.com/watch?v=N8F7eOqgH8Q
- https://www.youtube.com/watch?v=zbcCdoHeS4w
- https://www.youtube.com/watch?v=KSJqdMqLQA4
- https://www.youtube.com/watch?v=jkCCnwvO_fg
- https://www.youtube.com/watch?v=Yb2KF-sAJh4
- https://www.netsuite.com/portal/resource/articles/business-strategy/business-intelligence- examples.shtml

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7033.1	1								1	2			1	
21AIM7033.2	2								1	2			2	
21AIM7033.3	2		2		2				1	2			2	
21AIM7033.4	2		2						1	2			2	
21AIM7033.5	2		2						1	2			2	1
21AIM7033.6	2				2				1	2			2	1

1: Low 2: Medium 3: High

Blockchain Technology			
Course Code	**21AIM7034**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand basic of Blockchain Technology
- Explain Bitcoins and Alternative coins used in Blockchain
- Describe the idea of Ethereum Blockchain and Smart Contract
- Explore Solidity Programming language and Remix IDE to develop smart contract.
- Understand Hyperledger fabric and its framework

Module-1 Introduction (8 hours)

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.
Decentralization: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations**.**
TB1: Ch 1, 2

Module-2 Bitcoin (8 hours)

Bitcoin: Introduction to Bitcoin, Digital keys and Addresses, Transactions, Blockchain, Mining
Alternative Coins: Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash
TB1: Ch 5, 8

Module-3 Ethereum 101 (8 hours)

Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts.
Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain Precompiled contracts. **TB1: Ch 9, 10**

Module-4 Development Tools and Frameworks (8 hours)

Development Tools and Frameworks: Languages, Compilers, Solidity compiler (solc) Installation on Linux, Installation on macOS, Integrated Development Environments (IDEs), Tools and libraries, Ganache MetaMask, Truffle Installation, Contract development and deployment.
Introducing solidity: Types, Value types,Literals, Enums, Function types, Reference types, Global variables, Control structures, Layout of a solidity source code file.
TB1: Ch 13

Module-5 Hyperledger Fabric (8 hours)

Hyperledger Fabric: Building on the foundations of open computing, Fundamentals of the Hyperledger project, The Linux Foundation, Hyperledger, Open source and open standards, Hyperledger frameworks, tools, and building blocks, Hyperledger Fabric component design, Principles of Hyperledger design, Hyperledger Fabric reference architecture, Hyperledger Fabric runtime architecture, Strengths and advantages of componentized design
Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media Exploring. **TB1: Ch 17 TB2: Ch 2**

Course Outcomes: At the end of the course the student will be able to:	
21AIM7034.1	Explain the fundamental building blocks of Blockchain technology.
21AIM7034.2	Discuss the concepts of Bitcoin and their usage in various blockchain applications.
21AIM7034.3	Use the concept of smart contracts and Ethereum and their application in various applications.

21AIM7034.4	Execute smart contract using Solidity, Remix IDE and Ethereum frameworks.
21AIM7034.5	Analyze Hyperledger fabric including its framework, design principles and architecture
21AIM7034.6	Develop block chain-based solutions by using the concepts learnt to solve real world problems.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Mastering blockchain - Distributed ledgers, decentralization andsmart contracts explained	Imran Bashir	Packt PublishingLtd	2nd Edition, 2017
2	Hands-On Block Chain with Hyperledger: BuildingDecentralized Applications with Hyperledger Fabricand Composer	Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna	Packt PublishingLtd	1st Edition, 2018
Reference Books				
1	Blockchain Technology (Concepts and applications),	Kumar saurabh, Ashutosh saxena,	Wiley, 2020	11th Edition 2010
2	Bitcoin Cryptocurrency and Technologies	Arvind Narayanan Joseph Edward Bonneau ,	Princeton University Press	2016
3	Blockchain Basics: ANon-Technical Introduction in 25 Steps	Daniel Drescher,	Apress	1st Edition, 2017
4	Mastering Bitcoin: Unlocking Digital Cryptocurrencies	Andreas M. Antonopoulos,	O'Reilly Media	1st Edition, 2014

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105184/
- blockgeeks.comguide/what-is-block-chain-technology https://nptel.ac.in/courses/106105184/
- https://www.coursera.org/specializations/blockchain
- https://www.geeksforgeeks.org/blockchain/
- https://www.tutorialspoint.com/blockchain/index.htm
- https://www.youtube.com/watch?v=AWPisuBx1Zo
- https://www.youtube.com/watch?v=SyVMma1IkXM

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7034.1	2	1				1							1	
21AIM7034.2	1	2	1		1			1						
21AIM7034.3	1			2									2	
21AIM7034.4		1	2	1	2			1						
21AIM7034.5	2	1		1	2	1							2	
21AIM7034.6			**1**	1	2			2					1	

1: Low 2: Medium 3: High

Soft and Evolutionary Computing			
Course Code	**21AIM7035**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn the basic concepts of Soft Computing
- Become familiar with neural networks.
- Know the significance of genetic algorithms.
- Understand the need for fuzzy systems.
- Illustrate soft computing techniques to solve problems.

Module-1 Soft Computing (8 hours)

Introduction to soft computing: ANN, FS, GA, SI, ES, Comparing among intelligent systems **ANN:** introduction, biological inspiration, BNN&ANN, classification, first Generation NN, perceptron, illustrative problems
TB1: Ch 1, Ch2

Module-2 Adaline, Madeline, ANN (8 hours)

Adaline, Medaline, ANN: (2^{nd} generation), introduction, BPN, KNN, HNN, BAM, RBF, SVM, Spike Neural Models and illustrative problems
TB1: Ch 3

Module-3 Fuzzy Wuzzy (8 hours)

Fuzzy Logic: introduction, human learning ability, undecidability, probability theory, classical set and fuzzy set, fuzzy set operations, fuzzy relations, natural language and fuzzy interpretations, structure of fuzzy inference system, Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making, illustrative problems.
TB1: Ch 5

Module-4 Introduction to Genetic Algorithm (8 hours)

Genetic Algorithm: Introduction to GA, GA, procedures, working of GA, GA applications, applicability, evolutionary programming, working of EP, GA based Machine learning classifier system, illustrative problems.
TB1: Ch 7

Module-5 Swarm Intelligent System (8 hours)

Swarm Intelligent system: Introduction, Background of SI, Ant colony system Working of ACO, Particle swarm Intelligence (PSO).
TB1: Ch 8

Course Outcomes: At the end of the course the student will be able to:	
21AIM7035.1	Describe suitable soft computing techniques for various applications.
21AIM7035.2	Demonstrate various soft computing techniques for complex problems.
21AIM7035.3	Implement fuzzy techniques to solve realistic problems.
21AIM7035.4	Apply Genetic Algorithms through practical experimentation.
21AIM7035.5	Evaluate Swarm Intelligence techniques.
21AIM7035.6	Analyze Neuro-fuzzy hybrid systems and their applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
	Textbooks			
1	Principles of Soft Computing	Shivanandam, Deepa S. N	Wiley India Pvt. Ltd	3rd Edition, 2018
Reference Books				
1	Soft computing	N. P Padhy and S P Simon	Oxford University Press	1st Edition, 2015
2	Neuro-Fuzzy and Soft Computing	Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani	Pearson	2002
3	Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications	S. Rajasekaran, G.A. Vijayalakshmi Pai	PHI Learning Pvt.Ltd	2017
4	Neural Networks Algorithms, Applications, and Programming Techniques	James A. Freeman and David M. Skapura	Pearson	1st Edition, 2002

Web links and Video Lectures (e-Resources):

- https://youtu.be/8LdZMqcFEHs?si=-5-ECYHvU61Wajkv
- https://youtu.be/K9gjuXjJeEM?si=oWs8Qw2szvwxgtJk
- https://youtu.be/Nn5YbbcuXdY?si=0rJjVXgBuPOJEmXq
- https://youtu.be/h4zkfgLKxPM?si=Q2q2oTcJZLPFofzn
- https://youtu.be/3XqeCYnaSqc?si=G6WAkGZZy0JXJPcD
- https://www.vssut.ac.in/lecture_notes/lecture1423723637.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1423722821.pdf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7035.1	2													
21AIM7035.2	2	2												
21AIM7035.3	1	2										2		
21AIM7035.4			2											2
21AIM7035.5					2									2
21AIM7035.6												2		2

1: Low 2: Medium 3: High

Augmented and Virtual Reality			
Course Code	**21AIM7041**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the fundamental concepts and principles of Augmented Reality (AR) and Virtual Reality (VR).
- Explore the historical development and evolution of AR and VR technologies.
- Know the hardware components of AR and VR systems and their roles in immersive experiences.
- Gain insights into software development principles for AR and VR applications.
- Learn advanced topics in AR and VR, including multi-sensory experiences and ethical considerations.

Module-1 Introduction to Augmented Reality Virtual Reality (8 hours)

Introduction: What is VR/AR About? What is VR? What is AR? The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology, VR Becomes an Industry, The Five Classic Components of a VR System.
TB1: Ch 1.1 to 1.3. TB2: Ch: 1.1 to 1.5

Module-2 Input and Output Devices (8 hours)

Input and Output devices: Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces, Graphics Displays, Sound Displays, Haptic Feedback.
TB2: Ch 2.1 to 2.3, Ch 3.1 to 3.3

Module-3 Computing Architectures for VR and Modeling (8 hours)

The Rendering Pipeline, PC Graphics Architecture, Workstation-Based Architectures, Distributed VR Architectures, Geometric Modeling, Kinematics Modeling, Physical Modeling, Behavior Modeling.
TB2: Ch 4.1 to 4.4, Ch 5.1 to 5.4

Module-4 VR Programming and Human Factors in VR (8 hours)

Toolkits and Scene Graphs, World ToolKit, Java 3D, Methodology and Terminology, User Performance Studies, VR Health and Safety Issues, VR and Society.
TB2: Ch 6.1 to 6.3, Ch 7.1 to 7.4

Module-5 Traditional and Emerging Applications of VR (8 hours)

Medical Applications of VR, Education, Arts and Entertainment, Military VR Applications, VR Applications in Manufacturing, Applications of VR in Robotics, Information Visualization.
TB2: Ch 8.1 to 8.3, Ch 9.1 to 9.3

Course Outcomes: At the end of the course the student will be able to:	
21AIM7041.1	Describe the fundamental principles and concepts of Augmented Reality (AR) and Virtual Reality (VR).
21AIM7041.2	Identify the input and output devices of AR VR systems.
21AIM7041.3	Compare various computing architectures for VR and Modeling
21AIM7041.4	Utilize relevant tools towards development of AR and VR applications.
21AIM7041.5	Analyze advanced applications of AR and VR technology.
21AIM7041.6	Analyze ethical considerations to AR/VR design, development, and implementation, addressing societal and privacy issues.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Virtual and Augmented Reality (VR/AR)	Bernhard Jung,Paul Grimm, RalfDoerner, Wolfgang Broll	Springer International Publishing	1st Edition 2022
2	Virtual Reality technology	Grigore C. Burdea Philippe Coiffet	Wiley	2nd Edition 2010
Reference Books				
1	Understanding Virtual Reality	William R.Sherman and Alan B. Craig	Morgan Kaufmann	1st Edition 2002
2	Developing Virtual Reality Application	William R.Sherman, Alan B. Craig and Jeffrey D. Will	Morgan Kaufmann	3rd Edition, 2005
3	Spatial Augmented Reality: Merging Real and Virtual Worlds	Oliver Bimber and Ramesh Raskar	A K Peters/CRC Press	1st Edition, 2005
4	Virtual Reality Technology	Burdea, Grigore C and Philippe Coiffet	McGraw Hill Book Co., New York	6th Edition, 2017

Web links and Video Lectures (e-Resources):

- https://youtu.be/WzfDo2Wpxks?feature=shared
- https://youtu.be/FJAO6jDYljs?feature=shared
- https://youtu.be/04AMaTsXFJU?feature=shared
- https://youtu.be/vz0UUVDt2ps?feature=shared
- https://youtu.be/XLP4YTpUpBI?feature=shared
- https://sopa.tulane.edu/blog/whats-difference-between-ar-and-vr
- https://timesofindia.indiatimes.com/readersblog/reflective-ruminations/ar-and-vr-technology-transforming-our-lives-through-immersive-experiences-52485/
- https://www.forbes.com/sites/ariannajohnson/2023/06/02/augmented-reality-ar-vs-virtual- reality-vr-whats-the-difference-and-how-do-they-work/
- https://edu.gcfglobal.org/en/thenow/understanding-virtual-reality-and-augmented-reality/1/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7041.1	2													
21AIM7041.2		2												
21AIM7041.3				2										
21AIM7041.4		2											1	
21AIM7041.5			2											
21AIM7041.6			2								2			2

1: Low 2: Medium 3: High

NoSQL Database			
Course Code	**21AIM7042**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the distinctions between NoSQL and relational databases.
- Learn the principles of schema-less data modeling.
- Know the strategies for handling large datasets.
- Understand the interaction with NoSQL using common languages.
- Become familiar with the fundamentals of database security and data integrity.

Module-1 NoSQL Database Architecture and Data Models (8 hours)

Why NoSQL: The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL
Aggregate Data Models: Aggregates, Key-Value Document Data Models, Column-Family Stores, Summarizing Aggregate Oriented Databases
More Details on Data Models: Relationships, Graph Databases, Schema less Databases, Materialized Views, Modeling for Data Access
TB: Ch 1, 2, 3

Module-2 Advanced Topics in NoSQL Database Systems (8 hours)

Distribution Models: Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication
Consistency: Update Consistency, Read Consistency, Relaxing Consistency, Relaxing Durability.
Version Stamps: Business and System Transactions, Version Stamps on Multiple Nodes
Map-Reduce: Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations
TB: Ch 4, 5, 6, 7

Module-3 Fundamentals of Key-Value and Document Databases (8 hours)

Key-Value Databases: What Is a Key-Value Store, Key-Value Store Features, Suitable Use Cases, When Not to Use
Document Databases: What Is a Document Database, Features, Suitable Use Cases, When Not to Use
TB: Ch 8, 9

Module-4 Exploring Column-Family Stores and Graph Databases (8 hours)

Column-Family Stores: What Is a Column-Family Data Store, Features, Suitable Use Cases, When Not to Use
Graph Databases: What Is a Graph Database, Features, Suitable Use Cases, When Not to Use
TB: Ch 10, 11

Module-5 Diverse Database Paradigms and Decision Criteria (8 hours)

Beyond NoSQL: File Systems, Memory Image, XML databases, Object Databases
Choosing your Database: Programmer Productivity, Data Access Performance, Sticking with the Default. **TB: Ch 14, 15**

Course Outcomes: At the end of the course the student will be able to:	
21AIM7042.1	Explain the value and challenges of NoSQL databases.
21AIM7042.2	Apply Aggregate Data Models and relationships to model data access effectively.
21AIM7042.3	Investigate advanced NoSQL topics, including distribution models and consistency.

21AIM7042.4	Utilize Key-Value and Document Databases while considering ethical implications.
21AIM7042.5	Analyze Column-Family Stores and Graph Databases, considering societal impacts.
21AIM7042.6	Evaluate diverse database paradigms and make informed decisions based on productivity and performance considerations.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence	Sadalage, P. & Fowler	Wiley Publications	1st Edition, 2019
Reference Books				
1	MongoDB: The Definitive Guide	Kristina Chodorow and Michael Dirolf	O'Reilly Media	2nd Edition, 2013
2	Cassandra: The Definitive Guide	Jeff Carpenter and Eben Hewitt	O'Reilly Media	2nd Edition, 2016
3	Redis in Action	Josiah L. Carlson	Manning Publications	1st Edition, 2013
4	Riak Handbook	Mathias Meyer	O'Reilly Media	1st Edition, 2012

Web links and Video Lectures (e-Resources):

- https://youtu.be/qEhNHOEa5sE?si=GRTwUJTavyX3fkZs
- https://youtu.be/ilI-inAjdf8?si=RdOesC5Tb8_OXZ6j
- https://youtu.be/ExcRbA7fy_A?si=IWOFq0TmkMxse_ql
- https://www.khoury.northeastern.edu/home/kathleen/classes/cs3200/20-NoSQLMongoDB.pdf
- http://pages.di.unipi.it/turini/Basi%20di%20Dati/Slides/11.NoSQL-slides.pdf
- https://youtu.be/ns9Erq0ua1A?si=txb34qqsuOWmczc1

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7042.1	2													
21AIM7042.2	2	2												
21AIM7042.3			2											2
21AIM7042.4			2			2								
21AIM7042.5						2								2
21AIM7042.6		2												2

1: Low 2: Medium 3: High

Predictive Analytics			
Course Code	**21AIM7043**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn the fundamental principles of analytics for business and learn how to Visualize and explore data to better understand relationships among variables.
- Understand the techniques of modeling and examine how predictive analytics can be used in decision making.
- Apply predictive models to generate predictions for new data.
- Develop the knowledge of Linear Algebra to solve the system of equations.

Module-1 Introduction to Analytics (8 hours)

Introduction: Prediction Versus Interpretation, Key Ingredients of Predictive Models, Terminology Example Data Sets and Typical Data Scenarios, A Short Tour of the Predictive Modeling Process, **Case Study**: Predicting Fuel Economy
TB1: Ch 1, 2

Module-2 Data Pre-processing and Model Tuning (8 hours)

Data Transformations for Individual Predictors, Data Transformations for Multiple Predictors, Dealing with Missing Values, Model Tuning, Data Splitting, Resampling Techniques. Choosing Final Tuning Parameters, Data Splitting Recommendations, Choosing Between Models.
Case Study: Credit Scoring
TB1: Ch 3, 4

Module-3 Regression Models (8 hours)

Measuring Performance in Regression Models: Quantitative Measures of Performance, Linear Regression, Partial Least Squares, Penalized Models. **Nonlinear Regression Models:** Neural Networks, Multivariate Adaptive Regression Splines, Support Vector Machines, K-Nearest Neighbors. **Regression Trees and Rule-Based Models:** Basic Regression Trees, Regression Model Trees, Rule-Based Models, Random Forests, Boosting.
Case Study: Quantitative Structure-Activity Relationship Modeling
TB1: Ch 5, 6, 7, 8

Module-4 Classification Models (8 hours)

Measuring Performance in Classification Models: Class Predictions, Evaluating Predicted Classes, Evaluating Class Probabilities, **Discriminant Analysis and Other Linear Classification Models**: Logistic Regression, Linear Discriminant Analysis, Penalized Models, **Nonlinear Classification Models:** Neural Networks, Flexible Discriminant Analysis, Na¨ıve Bayes, Basic Classification Trees, Rule-Based Models.
Case Study: Job Scheduling
TB1: Ch 11, 12, 13, 14, 17

Module-5 An Introduction to Feature Selection (8 hours)

Consequences of Using Non-informative Predictors, Approaches for Reducing the Number of Predictors, Wrapper Methods, Filter Methods, Selection Bias. **Factors That Can Affect Model Performance:** Type III Errors, Measurement Error in the Outcome, Measurement Error in the Predictors, Discretizing Continuous Outcomes, When Should You Trust Your Model's Prediction?
Case Study: Predicting Cognitive Impairment.
TB1: Ch 19, 20

Course Outcomes: At the end of the course the student will be able to:	
21AIM7043.1	Describe the importance of predictive analytics and processing of data for Analytics.

21AIM7043.2	Identify different types of predictive models, pre-processing and model tuning.
21AIM7043.3	Apply regression and classification model on applications for decision making and evaluate the performance.
21AIM7043.4	Identify the impact of class imbalance on performance measure for model predictions and models that can mitigate the issue during training.
21AIM7043.5	Analyze time series forecasting models in a variety of business contexts.
21AIM7043.6	Build analytics solutions for real-world business scenarios.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Applied Predictive Modeling,	Kuhn, Max, and Kjell Johnson	Springer,	3rd Edition, 2019
2	Predictive analytics using R, Simulation educators	Jeffrey Strickland	Colorado	1st Edition Springs,2015
Reference Books				
1	Predictive Analytics for dummies	Anasse Bari, Mohamed Chaouchi,Tommy Jung	Wiley	2nd Edition, 2016
2	Data Mining and Predictive Analytics	Daniel T.Larose and Chantal D.Larose	Wiley	2nd Edition, 2015

Web links and Video Lectures (e-Resources):

- https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics
- https://www.youtube.com/watch?v=Kd0C-8q0HkI
- https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data-into-future-insights.html
- https://www.conestogac.on.ca/fulltime/predictive-analytics
- https://www.youtube.com/watch?v=Cx8Xie5042M
- https://www.youtube.com/watch?v=1xw915rbyG4

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7043.1	1												1	
21AIM7043.2	2	1		1										
21AIM7043.3	1	2		1									2	1
21AIM7043.4													2	1
21AIM7043.5	1	3			2								1	2
21AIM7043.6		1	1											1

1: Low 2: Medium 3: High

High Performance Computing			
Course Code	**21AIM7044**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the scope and challenges of parallel computing in modern computing environments.
- Learn the principles of parallel algorithm design to decompose tasks and manage interactions in parallel systems.
- Understand the concept of groups and communicators in message passing paradigms.
- Know thread basics and synchronization primitives in shared address space platforms.
- Understand the concepts of GPU and CUDA

Module-1 Introduction and Parallel Programming Platforms (8 hours)

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing.
Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.
TB1: Ch 1.1, 1.2, Ch 2.1 – 2.7

Module-2 Principles of Parallel Algorithm Design and Communication Operations (8 hours)

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads.
Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations
TB1: Ch 3, Ch 4

Module-3 Analytical Modeling and Message-Passing Paradigm (8 hours)

Analytical Modeling of Parallel Systems: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems. Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs.
Programming using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.
TB1: Ch 5, Ch 7

Module-4 Shared Address Space Platforms (8 hours)

Programming Shared Address Space Platforms: Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, 08 Composite Synchronization Constructs, Tips for Designing Asynchronous Programs.
Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication.
Solving a System of Linear Equations Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bucket and Sample Sort.
TB1: Ch 6, Ch 8, Ch 9

Module-5 GPU and CUDA(8 hours)
GPU and CUDA: GPUs as Parallel Computers, Architecture of a Modern GPU, Evolution of Graphics Pipelines, GPU Computing, CUDA Program Structure, Device Memories and Data Transfer, Kernel Functions and Threading, CUDA Thread Organization, Using blockIdx and threadIdx , Synchronization and Transparent Scalability. **TB2: Ch 1.1,1.2, Ch 2, Ch 3, Ch 4.1-4.3**

Course Outcomes: At the end of the course the student will be able to:	
21AIM7044.1	Describe the principles of parallel computing.
21AIM7044.2	Illustrate various parallel programming models and their implementation.
21AIM7044.3	Identify the need for performance optimization for parallel applications.
21AIM7044.4	Apply programming shared memory platforms, including thread basics, synchronization primitives, and dense matrix algorithms.
21AIM7044.5	Analyze the CUDA programming for high-performance parallel computing, enabling scalable and optimized solutions for complex computational tasks.
21AIM7044.6	Analyze the graph algorithms for solving discrete optimization problems.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Introduction to Parallel Computing	AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar	Addison-Welsey	2nd Edition, 2013
2	Programming Massively Parallel Processors: AHands-On Approach	David B. Kirk and Wen-mei W. Hwu.	Elsevier India Pvt. Ltd.	1st Edition, 2010
Reference Books				
1	Parallel Programming: Techniques and Applications Using Networked Workstationsand Parallel Computers	Wilkinson and M. Allen,	Prentice Hall	2nd Edition, 2006
2	Parallel Programming inC with MPI and OpenMP	M.J. Quinn	McGraw-Hill	1st Edition, 2017

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106108055
- https://www.cs.purdue.edu/homes/ayg/book/Slides/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7044.1	1	2	1										1	
21AIM7044.2		2	1										1	2
21AIM7044.3	1	2	2										1	
21AIM7044.4		2	2										1	2
21AIM7044.5		2	2										1	
21AIM7044.6			2										2	

1: Low 2: Medium 3: High

Cryptography and Cyber Security			
Course Code	**21AIM7045**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn classical encryption techniques for practical application.
- Understand the principles and workings of block ciphers along with their practical applications.
- Acquire knowledge of public-key cryptography, and other public-key cryptosystems.
- Explore various aspects of cybercrime, including its definition, origins, classifications, legal perspectives, and preventive measures.

Module-1 Classical Encryption Techniques (8 hours)

Information and Network Security Concepts: Cybersecurity, Information Security and Network Security, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Cryptography, Network Security, Trust and Trustworthiness, Standards.
Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Technique.
Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles
TB1: Ch 1, 3, 4

Module-2 Block Cipher Operation (8 hours)

Block Cipher Operation: Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES Mode for Block-Oriented Storage Devices, Format-Preserving Encryption.
Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm.
TB1: Ch 7, 9

Module-3 Introduction to Cybersecurity (8 hours)

Introduction: Why Cybersecurity? Information Security and Cybersecurity, How Do Computers Work Together?, Cyberattacks Today, Security Targets, **Technique and Human Beings:** Psychological Attacks, Phishing, Humans vs. Machines, Can Psychological Attacks Be Prevented?. **Risk :** What Is Risk?, Threats in IT Systems, Countermeasures, Risk Management, Systematic Security Analysis, Risk Management as a PDCA Process.
TB2: Ch 1, 2, 3

Module-4 Cybercrime (8 hours)

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Classifications of Cybercrimes, Cybercrime: The Legal Perspective, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era.
Cyber offences: How criminals plan them: Introduction, how criminals plan the attacks, Social Engineering, Cyberstalking, Cybercafé and Cybercrimes, Botnets, Attack Vector, Cloud Computing
TB3: Ch 1, 2

Module-5 Tools used in Cyber Crime and Forensics (8 hours)

Tools and Methods used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.
Understanding Computer Forensics: Introduction, Historical Background, Digital Forensics Science, The need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis

of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensic Lab, Computer Forensic and Steganography, Relevance of OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics auditing, Antiforensics. **TB3: Ch 4, 7**

Course Outcomes: At the end of the course the student will be able to:	
21AIM7045.1	Identify the vulnerabilities in any computing system and explain the basics of cryptography techniques for enhancing the security
21AIM7045.2	Describe different cryptographic algorithms and their applications in network security
21AIM7045.3	Discuss fundamental cybersecurity concepts used to assess and manage risks in IT systems.
21AIM7045.4	Analyze the proliferation of mobile and wireless devices and emerging trends in mobility and their implications for cybersecurity.
21AIM7045.5	Analyze the importance of legal aspects of cybercrime, need for cyber law and computer forensics.
21AIM7045.6	Develop the attribute of self-learning, skill of oral and written communication and ability to work in teams to solve real world cybercrime scenarios.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Cryptography and Network Security - Principles and Practice	Dr.William Stallings	Pearson Education	8th Edition, 2023
2	Introduction to Cybersecurity	Robin Sharp	Springer	1st Edition, 2023
3	Cyber Security	Nina Godbole , Sunit Belapure	Wiley	2nd Edition, 2017
Reference Books				
1	Introduction to Cryptography with Coding Theory	Wade Trappe and Lawrence C. Washington	Pearson	2nd Edition, 2005
2	Cybersecurity: A Practical Guide to the Law of Cyber Risk	Jeffrey R. Kosseff	Wiley	1st Edition, 2020
3	Network Security Essentials: Applications and Standards	William Stallings	Pearson	7th Edition, 2017
4	Cryptography Engineering: Design Principles and Practical Applications	Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno	Wiley	1st Edition, 2010

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/classical-cryptosystems
- https://toc.seas.harvard.edu/links/cs-127-cryptography
- https://pll.harvard.edu/subject/cybersecurity
- https://www.coursera.org/learn/cybercrime
- https://learning.edx.org/course/course-v1:RITx+CYBER502x+2T2017/home

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7045.1	2	2						1	1	1	1			
21AIM7045.2	2	2						1	1	1	1			
21AIM7045.3	3	3												
21AIM7045.4	3	3												
21AIM7045.5					2	2								
21AIM7045.6					1	1		1		1			1	

1: Low 2: Medium 3: High

Deep Learning			
Course Code	**21AIM7051**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand major deep neural network frameworks and issues in basic neural networks.
- Solve real-world applications using Deep learning.
- Select suitable deep learning approaches for given application.
- Know the significance of autoencoders.
- Demonstrate the working of Tensor Flow for Deep Neural Networks.

Module-1 Introduction to Neural Networks and Deep Neural Networks (8 hours)

What is Deep Learning, Math behind Deep Learning- linear algebra and statistics, Vector Data. Time Series Data. Image Data. Video Data. How does machine learning work, Evaluating the Machine Learning models. Neural Networks, The Biological Neuron, The Perceptron, Multilayer Feed-Forward Networks.

TB1: Ch 1

Module-2 Training feed-forward Neural Network (8 hours)

Training Neural Networks-Backpropagation Learning, Activation Functions- Linear, Sigmoid, Tanh, Softmax, Rectified Linear. Loss Functions-Loss Functions for Regression, Loss Functions for Classification, Hyperparameters- Learning Rate, Regularization, Momentum, Sparsity, Implementation of neural network using TensorFlow.

TB1: Ch 2

Module-3 Convolutional Neural Network (8 hours)

Foundations of Convolutional Neural Networks – CNN operations – Architecture – Simple Convolution Network – Deep Convolutional Models – ResNet, AlexNet, Inception Net and others.

TB1: Ch 7 TB2: Ch 8

Module-4 Models for Sequence analysis (8 hours)

Recurrent Neural Networks, The Challenges with Vanishing Gradients, Long Short-Term Memory (LSTM) Units, TensorFlow Primitives for RNN Models, Implementing a Sentiment Analysis Model, Solving seq2seq Tasks with Recurrent Neural Networks.

TB2: Ch 7

Module-5 Introduction to Auto Encoders and GAN (8 hours)

Autoencoders: Efficient data representation, Performing PCA, Stacked, Autoencoders, Denoising, Sparse autoencoders, variational and other autoencoders. Generative Adversarial Networks.

TB1: Ch 4, 5 TB2: Ch 10

Course Outcomes: At the end of the course the student will be able to:	
21AIM7051.1	Describe the basic concepts of Neural Networks and Deep Learning.
21AIM7051.2	Make use of Tensor Flow to build neural network model.
21AIM7051.3	Identify Convolutional Neural Network for a given scenario
21AIM7051.4	Select Deep Learning models for sequence analysis.
21AIM7051.5	Apply the concept of Autoencoders and GAN.
21AIM7051.6	Build Deep learning models for Real-world applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Deep Learning A Practitioner's Approach	Josh Patterson and Adam Gibson	O'Reilly	1st Edition, 2017
2	Neural Networks and Deep Learning	Charu C Aggarwal	Springer	2nd Edition, 2018
Reference Books				
1	Hands on Machine Learning with Scikit-Learn &TensorFlow	AurelienGeron	O'Reilly	2019
2	Deep Learning	Lan Good fellow and Yoshua Bengio	MIT Press	2nd Edition, 2016

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=dPWYUELwIdM
- https://www.youtube.com/watch?v=ILsA4nyG7I0
- https://www.youtube.com/watch?v=TtyoFTyJuEY
- https://www.youtube.com/watch?v=tIExopLw29U&list=PLv8Cp2NvcY8AbK0RNZGeQFEPESqCzHQvj

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7051.1	2				2									
21AIM7051.2			1										1	
21AIM7051.3			2		2								1	
21AIM7051.4			2										1	
21AIM7051.5			2											
21AIM7051.6		2			2								1	

1: Low 2: Medium 3: High

Robotic Process Automation			
Course Code	**21AIM7052**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the basic concepts of RPA.
- Know where RPA can be applied and how it is implemented.
- Learn the different types of variables, Control Flow and data manipulation techniques.
- Understand Image, Text and Data Tables Automation
- Know various types of Exceptions and strategies to handle

Module-1 RPA Foundations and Skills (8 hours)

IRPA Foundations: What is RPA?, Flavors of RPA, History of RPA, The Benefits of RPA, The downsides of RPA, RPA Compared to BPO, BPM and BPA, Consumer Willingness for Automation, The Workforce of the Future. **RPA Skills:** On-Premise Vs. the Cloud, Web Technology, Programming Languages and Low Code, OCR, Databases, APIs, AI, Cognitive Automation, Agile, Scrum, Kanban and Waterfall, DevOps, Flowcharts.

TB1: Ch 1, Ch 2

Module-2 Robotic process automation, Record and Play (8 hours)

Robotic process automation: Components of RPA, RPA Platforms, About UiPath, The future of automation. **Record and Play:** Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder - Step-by-step examples using the recorder.

TB2: Ch 1, Ch 2

Module-3 Sequence, Flowchart, and Control Flow and Data Manipulation (8 hours)

Sequence, Flowchart, and Control Flow: Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow. **Data Manipulation:** Variables and Scope, Collections, Arguments - Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with example).

TB2: Ch 3, Ch 4

Module-4 Taking Control of the Controls (8 hours)

Taking Control of the Controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls - mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points.

TB2: Ch 5

Module-5 Exception Handling, Debugging, and Logging, Future of RPA (8 hours)

Exception Handling, Debugging, and Logging: Exception handling, Common exceptions, ways to handle, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting. **Future of RPA:** Consolidation and IPOs, Microsoft, Attended Automation, Vertical-Specific Companies, Hype Factor, SaaS, Chatbots, AI, Privacy and Ethics,

TB2: Ch 8, Ch 10

Course Outcomes: At the end of the course the student will be able to:	
21AIM7052.1	Describe the basic concepts and challenges of Robotic Process Automation
21AIM7052.2	Explain the components of RPA and the basic functionalities of UiPath Studio.
21AIM7052.3	Demonstrate the ability to create workflows and perform data manipulation using UiPath.

21AIM7052.4	Analyze and implement various techniques for interacting with user interface controls using UiPath.
21AIM7052.5	Evaluate and apply methods for exception handling, debugging, and logging within RPA projects.
21AIM7052.6	Design and develop a comprehensive RPA project that integrates the foundational concepts, workflow design and error management skills.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems	Tom Taulli	Apress	1st Edition (February 2020)
2	Learning Robotic Process Automation	Alok Mani Tripathi	Packt Publishing	1st Edition, March 2018
Reference Books				
1	Introduction to Robotic Process Automation: APrimer	Frank Casale , Rebecca Dilla, Heid Jaynes, Lauren Livingston	The Institute for Robotic Process Automation (IRPA)	2018
2	Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant	Richard Murdoch	Richard Murdoch & RPA Ultra	2020
3	Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation	Srikanth Merianda	Consulting Opportunity Holdings Llc	1st Edition, 2018

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=tMo3wXKbxuw
- https://www.youtube.com/watch?v=007xRS2_JnI
- https://www.youtube.com/watch?v=NzamfhBthao
- https://www.youtube.com/watch?v=m7r2TRT2ESc
- https://www.youtube.com/watch?v=QaPTqO_ypGE

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7052.1	3	2						1					3	
21AIM7052.2		3	2											
21AIM7052.3	3		3				1							
21AIM7052.4			2	3					1					2
21AIM7052.5			2		3	1								
21AIM7052.6	2		3										3	3

1: Low 2: Medium 3: High

Soft Computing			
Course Code	**21AIM7053**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the principles and characteristics of Soft Computing.
- Analyze Soft Computing principles, encompassing Genetic Algorithms, Fuzzy Systems, and Neural Networks, for advanced problem-solving techniques.
- Apply in-depth understanding of Genetic Algorithms, including working cycles, parameter optimization, and specialized variants.
- Develop knowledge in Fuzzy Systems, exploring Sets, reasoning methods, and clustering techniques to address uncertainty effectively.

Module-1 Introduction to Soft Computing (8 hours)

Overview of Soft Computing: Soft Computing, Features of Soft Computing, Hard Computing, Features of Hard Computing, Hybrid Computing. **Optimization and Some Traditional Methods:** Introduction to Optimization, Traditional Methods of Optimization.
TB1: Ch 1.1 to 1.3, Ch 2.1, 2.2

Module-2 Genetic Algorithms (8 hours)

Working Cycle of a Genetic Algorithm. Binary-Coded GA: Crossover or Mutation, A Hand Calculation, Fundamental Theorem of GA/Schema Theorem, Limitations of a Binary-Coded GA. **GA-parameters Setting**. Advantages and Disadvantages of Genetic Algorithms. **Some Specialized Genetic Algorithms:** Real-Coded GA, Micro-GA, Visualized Interactive GA, Scheduling GA
TB1: Ch 3.1 to 3.3, 3.5, Ch 4.1 to 4.4

Module-3 Fundamentals of Fuzzy Systems: Sets and Reasoning (8 hours)

Introduction to Fuzzy Sets: Crisp Sets, Fuzzy Sets, Measures of Fuzziness and Inaccuracy of Fuzzy Sets, **Fuzzy Reasoning and Clustering:** Fuzzy Logic Controller, Fuzzy Clustering.
TB1: Ch 7.1 to 7.3, Ch 8.1 to 8.3

Module-4 Neural Networks Essentials (8 hours)

Fundamentals of Neural Networks: Introduction, Static vs. Dynamic Neural Networks, Training o Neural Networks. **Some Examples of Neural Networks:** Multi-Layer Feed-Forward Neural Networ (MLFFNN), Radial Basis Function Network (RBFN), Self-Organizing Map
TB1: Ch 9.1 to 9.3, Ch 10.1 to 10.4

Module-5 Hybrid Soft Computing: Genetic-Fuzzy-Neural Integration (8 hours)

Fuzzy Control Systems, Examples of Fuzzy Control System Design, Combined Genetic Algorithms: Fuzzy Logic, Combined Genetic Algorithms: Neural Networks, Combined Neural Networks: Fuzzy Logic**.**
TB2: Ch 13 , TB1: Ch 11.1,11.2, Ch 12.1, 12.2, Ch 13.1,13.2

Course Outcomes: At the end of the course the student will be able to:	
21AIM7053.1	Understand the fundamental concepts and features of soft computing, hard computing, and hybrid computing, as well as traditional optimization methods.
21AIM7053.2	Apply genetic algorithms, including binary-coded GA, crossover, mutation, and parameter setting, to solve optimization problems.
21AIM7053.3	Make Use of fuzzy systems, including fuzzy sets, measures of fuzziness and inaccuracy, and fuzzy reasoning and clustering techniques.
21AIM7053.4	Evaluate different neural network architectures such as MLFFNN, RBFN, and self-organizing maps for various applications.

21AIM7053.5	Examine hybrid Soft Computing systems by combining Genetic Algorithms, Fuzzy Logic, and Neural Networks for improved problem-solving efficiency.
21AIM7053.6	Create comprehensive solutions for complex problems by combining soft computing, genetic algorithms, fuzzy systems, and neural networks.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Soft Computing: Fundamentals andApplications	D. K. Pratihar	Narosa	2nd Edition, 2013
2	Fuzzy Logic with Engineering Applications	Timothy J. Ross	John Wiley &Sons, Ltd	3rd Edition, 2010
Reference Books				
1	Neural networks, fuzzy systems and evolutionary algorithms	S. Rajasekaran and Dr G. A. Vijayalakshmi Pai	PHI Learning	2nd Edition, 2003
2	Genetic Algorithms:Search and Optimization	David Edward Goldberg	Addison-Wesley	13th Edition, 1989

Web links and Video Lectures (e-Resources):

- https://youtu.be/K9gjuXjJeEM?feature=shared
- https://youtu.be/quCEmM2JBbk?feature=shared
- https://youtu.be/0xXMTIyVauk?feature=shared
- https://youtu.be/3XqeCYnaSqc?feature=shared
- https://youtu.be/ 0nZuG4sTw?feature=shared
- https://youtu.be/CBTEVFphv-E?feature=shared
- https://cse.iitkgp.ac.in/~dsamanta/courses/sca/resources/slides/01%20Intro.pdf
- https://cse.iitkgp.ac.in/~dsamanta/courses/sca/resources/slides/08%20ANN%20Training.pdf

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIM7053.1	2	2												
21AIM7053.2			2											
21AIM7053.3			2											
21AIM7053.4				2										
21AIM7053.5														2
21AIM7053.6						2								2

1: Low 2: Medium 3: High

Natural Language Processing			
Course Code	**21AIM7054**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Introduce the fundamental concepts and techniques of natural language processing.
- Gain an in-depth understanding of the computational properties of natural languages
- Understand the commonly used algorithms for processing linguistic information.
- Examine NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Explore the applications of NLP and challenges in processing natural language texts.

Module-1 Introduction and Language Modelling (8 hours)

Introduction: What is NLP, Origins of NLP, Language and Knowledge, Challenges, Different levels of Language Analysis, Language and grammar, NLP applications.
Language Modeling: Introduction, Grammar based Language Models-Generative Grammars, Statistical Language Model- N-gram models. **TB1: Ch 1 TB2: Ch 1, 2**

Module-2 Word Level Analysis (8 hours)

Word Level Analysis: Introduction, Regular Expressions, Finite State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part of-Speech Tagging. **TB2: Ch 3**

Module-3 Syntactic Analysis (8 hours)

Syntactic Analysis: Context-Free Grammar, Constituency-Phrase level, Sentence level, Parsing Top-down Parsing, Bottom-up Parsing, A Basic Top-Down Parser, Ambiguity in Parsing, The CYK Parser, Probabilistic Parsing, Indian Languages. **TB2: Ch 4**

Module-4 Semantics Analysis and Discourse (8 hours)

Semantics Analysis: The representation of meaning, Syntax driven semantic analysis, Word Senses Relations between senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation
Computational Discourse: Discourse segmentation, Text Coherence Relations, Reference Resolution, Anaphora resolution.
TB1: Ch 19, 20.1, 21 TB2: Ch 5

Module-5 Applications (8 hours)

Applications: Machine Translation – Direct and Rule based MT, Information Retrieval-Design Features of IR systems, Classical IR models**,** Information Extraction, Automatic Text Summarization, Question Answering System.
TB2: Ch 8, 9, 11

Course Outcomes: At the end of the course the student will be able to:	
21AIM7054.1	Discuss importance of NLP and the techniques used for language modeling in NLP
21AIM7054.2	Discover the tools and techniques for Processing natural language texts at word and sentence level.
21AIM7054.3	Analyze natural language texts for syntax.
21AIM7054.4	Analyze natural language texts for semantics and pragmatics.
21AIM7054.5	Examine real world applications involving natural language processing techniques.
21AIM7054.6	Create applications to carry out natural language processing.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Speech and Language processing: Introduction to Natural Language Processing, Computational Linguisticsand Speech Recognition.	Daniel Jurafsky, James H Martin	Pearson Publications	3rd Edition, 2023
2	Natural LanguageProcessing and Information Retrieval	U.S. Tiwary, Tanveer Siddiqui	Oxford University Press	1st Edition 2008
Reference Books				
1	Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana	O'Reilly Media, Inc.	1st Edition, 2020
2	Information Storage and Retrieval systems – Theory and Implementation	Gerald J. Kowalski and Mark. T. Maybury	Kluwer academic Publishers	2nd Edition, 2006

Web links and Video Lectures (e-Resources):

- https://scikitlearn.org/stable/tutorial/text_analytics/working_with_text_data.html
- https://nptel.ac.in/courses/106101007
- https://onlinecourses.nptel.ac.in/noc19_cs56/preview
- https://www.youtube.com/watch?v=zlUpTlaxAKI&list=PLKnIA16_RmvZo7fp5kkIth6nRTeQQsjfX
- https://www.youtube.com/watch?v=808M7q8QX0E&list=PLaZQkZp6WhWyvdiP49

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7054.1			2											
21AIM7054.2				2	2									
21AIM7054.3		2	2											
21AIM7054.4		2	2											
21AIM7054.5		2	2											
21AIM7054.6					2								1	

1: Low 2: Medium 3: High

Internet of Things			
Course Code	**21AIM7055**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the definition and significance of the Internet of Things.
- Learn the architecture, operation, and business benefits of an IoT solution.
- Examine the potential Security issues in IoT and explore the relationship between IoT, cloud computing, and big data.
- Design and program IoT devices, use real IoT protocols for communication, Secure the elements of an IoT device.

Module-1 Introduction to The Internet of Things (8 hours)

IoT Definition, what is the Internet of Things? IoT-enabled Applications, Envisioning the Internet of Things Era, The Popular M2M Applications, The Emergence of the IoT Platform as a Service (PaaS) **Realization of IoT Ecosystem Using Wireless Technologies:** Architecture for IoT Using Mobile Devices, Mobile Technologies for Supporting IoT Ecosystem, Mobile Use Cases for IoT **TB1: Ch1, Ch2**

Module-2 Architecture and Communication Protocol (8 hours)

Low Power Wide Area Networking Technologies, **Standards**: Physical/Link Layer, IEEE 802.3 (Ethernet, IEEE 802.11, Network Layer, IPv6 and IPv4, Transport Layer, TCP and UDP, Application Layer. Layered Architecture for IoT, Protocol Architecture of IoT, Infrastructure Protocols, IPv6 over Low-Power Wireless Personal Area Networks, Z-Wave, ZigBee, Protocols for IoT Service Discovery. **TB1: Ch2, Ch3**

Module-3 Networking Protocol (8 hours)

Network Layer, The 6LoWPAN Adaptation Layer, CoAP, CoSIP Protocol Specification, A Protocol for Constrained Session Initiation, The DNMP Protocol, Implementation with IEEE 802.15.4 and IEEE 802.11s, IoT Gateway, A P2P-based Large-scale Service Discovery Architecture, Sensor and Actuator Networks, Message Queue Telemetry Transport, Extensible Messaging and Presence Protocol, Advanced Message Queuing Protocol, Constrained Application Protocol, Security Issues in the IoT, Authorization Mechanisms for Secure IoT Services.**TB1: Ch 4**

Module-4 Platforms for IOT Applications and Analytics (8 hours)

The IoT Building Blocks, Azure IoT Hub, The IoT Data Analytics Platforms, The IoT Data Virtualization Platforms, IoT Data Visualization Platform, The IoT Edge Data Analytics, Hardware for the IoT, Classes of Constrained Devices, Hardware Platforms, Raspberry Pi, Arduino, IoT and Cloud-Inspired Smarter Environments, The Architectural Components of the Smarter Traffic System, Big Data Analytics: The Prominent Use Cases. **TB1: Ch 5, 6, 7**

Module-5 Edge/Fog Computing Paradigm and Security of IOT (8 hours)

Introduction of Fog/Edge Computing, Mobile Edge Computing (MEC), Mobile Cloud Computing (MCC), IoT Data Security, Introducing Integrated Fog Computing Platforms, Wearable Technology, Future Trends for IoT in Health Care, Security Requirements of an IoT Infrastructure, Security Threats in Different Use Cases of IoT. **TB1: Ch 8, 9, 10**

Course Outcomes: At the end of the course the student will be able to:	
21AIM7055.1	Illustrate the smart objects and the technologies to connect them to network
21AIM7055.2	Identify the impact and challenges posed by IoT networks leading to new architectural models.
21AIM7055.3	Apply the basics of IoT network models, protocols of all layers with the constrained network.

21AIM7055.4	Compare different Application protocols for IoT and Infer the role of Data Analytics and Security in IoT.
21AIM7055.5	Discover sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry and security issues.
21AIM7055.6	Build applications using basic technologies of IOT.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	Pethuru Raj and Anupama C. Raman	CRC Press,	1st Edition, 2017
Reference Books				
1	Security and Privacy in Internet of Things (IoTs):Models, Algorithms, and Implementations	Fei Hu	CRC	1st Edition, 2016
2	Internet of Things: Principles and Paradigms	R. Buyya and A.K. Dastjerdi (eds.),	Cambridge, MA, USA: Morgan Kaufmann (Elsevier)	1st Edition, 2016
3	Internet of Things: Architectures, Protocols and Standards	Simone Cirani, Gianluigi Ferrari, Marco Picone, LucaVeltri	Wiley	1st Edition, 2018

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=LlhmzVL5bm8
- https://www.youtube.com/watch?v=h0gWfVCSGQQ
- https://www.youtube.com/watch?v=UrwbeOIlc68
- https://www.youtube.com/watch?v=Gah1B7GyFZE
- http://digimat.in/nptel/courses/video/106105166/L02.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIM7055.1	2												1	
21AIM7055.2		2	3	2									1	
21AIM7055.3		2	2										1	
21AIM7055.4	1	2	3										1	
21AIM7055.5			3										1	
21AIM7055.6													1	

1: Low 2: Medium 3: High

Technical Seminar			
Course Code	**21AIS706**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE	-
Total Hours	20 hours	Credits	01

Course Learning Objectives:

1. To equip students with the ability to conduct in-depth research, analyze technical literature, and explore contemporary advancements in their field of study.
2. To effectively organize, design, and deliver technical presentations that convey complex information clearly to a diverse audience.
3. To encourage students to critically analyse and evaluate emerging trends, technologies, or methodologies relevant to their chosen seminar topic.
4. To enable students to improve their written and oral communication by preparing well-structured seminar reports and articulating ideas confidently during presentations.
5. To stimulate independent learning and problem-solving abilities by allowing students to explore specific topics of interest, enhancing self-directed research and learning.
6. To prepare students to effectively discuss and defend their technical knowledge in a professional setting, such as viva-voce, aligning with future industry or academic pursuits.

1. Selection of Technical Seminar Topic

- Students should select a technical topic related to their field of study, preferably focusing on recent advancements or emerging technologies. Inter-disciplinary/Multi-disciplinary topics are appreciated.
- Topics must be approved by the seminar coordinator within the first few weeks of the semester.

2 Research and Preparation

- Extensive research should be carried out using credible sources such as research papers, technical journals, books, and online databases.
- A minimum of 10-20 references is recommended, ensuring a mix of primary and secondary sources.

3. Seminar Report

- A detailed report (approximately 20-30 pages) must be prepared, summarizing the research findings and organized in a structured manner.
- The report should include sections like introduction, literature review, methodology, results, discussion, conclusion, and references.
- The report should follow a standard format as prescribed by the Department (font, spacing, citation style, etc.).

4. Oral Presentation

- Students must deliver an oral presentation lasting 15-20 minutes, followed by a question-and-answer session.
- Presentations should be well-structured, with appropriate use of visuals (slides, graphs, diagrams) to clearly convey technical content.
- All presentations must be conducted on scheduled dates, and attendance is mandatory for both presenters and all other students.

5. Question and Answer Session

- After the presentation, students will face a viva-voce where they are required to answer questions posed by the Departmental Seminar Evaluation Committee regarding their seminar topic.
- The viva will test the student's depth of understanding, research analysis, and ability to think critically about the subject matter.

6. Evaluation Criteria
• **Seminar Report**: Clarity, technical depth, comprehensiveness, quality of research, organization, and adherence to format (50 marks). • **Oral Presentation**: Communication skills, visual aids, clarity of content, timing, etc. (25 marks). • **Viva-Voce**: Ability to answer questions effectively, depth of understanding, and analytical skills (25 marks).
7. Submission Deadlines
• The report should be submitted at least one week prior to the scheduled presentation date. • Late submissions will be penalized as per department rules.
8. Plagiarism Check
• All seminar reports must be subjected to plagiarism checking, and the similarity index should be within acceptable limits specified by the Department. • Instances of plagiarism will result in penalties, which could include rejection of the report or a reduction in marks.
9. Mentorship and Feedback
• Students are required to consult with their faculty mentors regularly throughout the preparation phase to seek guidance and feedback. • At least three mentorship meetings should be recorded before the final presentation.
10. Attendance
• Students must attend all seminar sessions conducted by their peers, as it promotes collaborative learning and constructive feedback. • Attendance could be considered for internal evaluation.

Course Outcomes: At the end of the course the student will be able to :	
21AIS706.1	Demonstrate a thorough understanding of a specialized topic by conducting extensive research and presenting technical content effectively.
21AIS706.2	Exhibit proficiency in delivering well-organized and visually supported oral presentations, clearly articulating complex technical ideas to an audience.
21AIS706.3	Apply critical thinking and research methodologies to explore, analyze, and synthesize information from various sources, leading to sound conclusions.
21AIS706.4	Prepare a detailed and well-structured seminar report that adheres to technical writing standards, showcasing the ability to document research findings comprehensively.
21AIS706.5	Respond confidently and competently to questions during the viva-voce, defending the technical work and demonstrating an in-depth understanding of the topic.
21AIS706.6	Engage actively in peer seminars, providing constructive feedback, and reflecting on insights gained from discussions with fellow students and faculty.

Useful Links:
• https://homes.cs.washington.edu/~mernst/advice/giving-talk.html (How to give a technical presentation) • https://learnerbits.com/essential-tips-for-engineering-presentations • https://onlinecourses.nptel.ac.in/noc24_hs175/preview (Technical English for Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIS706.1	-	1	-	3	-	-	-	-	-	2	-	-	-	-
21AIS706.2	-	-	-	-	2	-	-	-	-	3	-	1	-	-
21AIS706.3	-	2	-	3	-	-	-	-	-	-	-	-	-	-
21AIS706.4	-	-	-	-	-	1	-	2	-	3	-	-	-	-
21AIS706.5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
21AIS706.6	-	-	-	-	-	1	-	-	-	3	-	2	-	-

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21AIP707**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:6)	SEE	3 Hrs
Total Hours	60 hours	Credits	05

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- **Feasibility**: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

5. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.
- **Demonstration**: If possible, include a live demonstration of the project or show relevant

simulations and results.

- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the final report, presentation, and the ability to answer questions.

8. Plagiarism Check

- **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources.
- **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).

9. Mentorship and Feedback

- **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.
- **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.

10. Post Submission

- **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field.
- **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Project Synopsis Evaluation (Phase I)	Beginning of the 7th Semester	10 marks
2. Project Progress Evaluation	Middle of the 7th Semester	20 marks
3. Project Report Evaluation (Phase II)	End of the 7th Semester	20 marks
Semester End Examinations (SEE)		
4. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		
• When all the Project Objectives are met and the Project Work is successfully completed and final Project Report is submitted as reported by the Department Project Evaluation Committee (DPEC), the CIE and SEE performance of the 7th semester will be carried forward to the 8th semester. There will not be any separate CIE and SEE for such project batches in the 8th semester.		

- In case of any Project Objectives not met, Project Work not completed or final Project Report not submitted, as reported by the DPEC, the CIE and SEE will be conducted in the 7th semester for the completed portion of the Project Work. In such cases, the submission of the Draft Copy of the Project Report is mandatory for evaluation. The remaining part of the project shall be completed during the 8th semester and there will be a CIE and SEE for the Project Work in the 8th semester.

Students are advised to complete the Project Work during the 7th semester and devote the 8th semester for Industry Internship/Research Internship.

Course Outcomes: At the end of the course the student will be able to :	
21AIP707.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21AIP707.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21AIP707.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21AIP707.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21AIP707.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21AIP707.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AIP707.1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21AIP707.2	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21AIP707.3	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21AIP707.4	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**
21AIP707.5	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
21AIP707.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**

1: Low 2: Medium 3: High

VIII Semester

Massive Open Online Course (MOOC)			
Course Code	**21AEC801**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE	3 Hrs
Total Hours	20 hours	Credits	02

Course Learning Objectives:

1. Enable students to acquire a strong foundation in core engineering subjects through high-quality, accessible online resources.
2. Facilitate skill development in specific engineering domains using practical exercises, simulations, and projects offered through the MOOC platform.
3. Encourage students to develop autonomy in learning by navigating and managing their course content, assignments, and assessments independently.
4. Expose students to interdisciplinary concepts and applications, fostering an understanding of how engineering principles integrate with other fields.
5. Provide exposure to global best practices and trends in engineering, allowing students to learn from international faculty and peer collaboration.
6. Develop essential soft skills by participating in discussion forums, group projects, and peer assessments, enhancing communication and teamwork skills.

1. Selection of MOOCs

1.1 Accredited Platforms: Students shall select MOOCs from accredited platforms such as Coursera, edX, SWAYAM/NPTEL, Udacity, or any online learning platform recognized by the respective Engineering Department / Board of Studies (BoS). Engineering Departments with the approval of BoS shall publish a list of MOOCs courses in the beginning of every semester.

1.2 Prerequisites: Students shall ensure that he/she has completed any foundational courses or prerequisites required for the chosen MOOCs.

1.3 Relevant Courses: Students shall choose courses that are relevant to the Student's Engineering discipline and career goals. Students shall NOT opt for the course which is part of their curriculum (I to VIII semester B.E program) and Honors Degree/Minor Degree courses. In case of any overlapping in the contents of the MOOC Course with that in the curriculum or other courses, the maximum permitted overlapping in the course contents (syllabus) is 20-25%.

1.4 Credit Value: Students shall ensure that the selected MOOCs collectively account for 2 credits. Typically, a 2-credit MOOC will require around 20-25 hours of study and a 1-credit MOOC will require 10-12 hours of study.

1.5 Duration of Course: A 4-weeks MOOCs is eligible for 1-credit. Students are advised to enrol for one 8-weeks MOOCs course to earn 2 credits. However, Students can also take two 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied.

2. Approval Process

2.1 Pre-Approval: Students must seek pre-approval from the Department MOOCs Coordinator before enrolling in MOOCs.

2.2 Submission of Proposal: Students can submit a detailed proposal to Department MOOCs Coordinator including the name of the MOOCs, the platforms, course duration, credit value, and relevance to their field of study.

If a Student has already completed any MOOCs course/s from the beginning of the III semester B.E, that satisfies the criteria mentioned in the clause 1. Selection of MOOCs, such course/s can be considered by the Department for credit transfer, provided the student has NOT already claimed the benefit of completing the MOOCs under any assessment in any of the subject.

2.3 Evaluation: The Department will evaluate the proposal for relevance, academic rigor, and credit equivalence and will communicate the decision to the Students.

3. Registration and Enrollment
3.1 Official Enrollment: Students shall register for the approved MOOCs on the respective platforms. **3.2 Documentation:** Students shall keep documentation of registration and course details for future reference and provide the same when asked by the Department.
4. Course Completion
4.1 Active Participation: Students shall engage actively in all course activities including lectures, assignments, quizzes, and discussion forums. **4.2 Completion Certificate:** Students shall obtain a verified certificate of completion for MOOC Course. Free versions without certificates are NOT eligible for credit.
5. Assessment and Evaluation
5.1 Performance Tracking: Students shall maintain records of performance in all assessments throughout the course. **5.2 Final Assessment:** The Department may conduct a final assessment (proctored exam) to ensure that the knowledge gained aligns with the academic standards. This summative assessment (proctored exam) by the Engineering Department is mandatory in the absence of such assessment in the MOOC course/s by the online platform.
6. Credit Transfer
6.1 Submission of Certificates: Students shall submit the completion certificate/s and performance records to the Department MOOCs Coordinator. **6.2 Credit Evaluation:** The Department will evaluate the certificates and performance records to approve the credit transfer. **6.3 Grade Conversion:** College will take care to convert the grades from the MOOCs into the grading system as per established Academic Rules and Regulations.
7. Integration into Academic Record
7.1 Transcript Update: Upon approval, the credits and grades will be integrated into the student's academic transcript. **7.2 Grade Point Average (GPA) Calculation:** The MOOC grades are included in the calculation of the student's GPA.
8. Support and Resources
8.1 Academic Advising: The Department MOOCs Coordinator shall provide guidance and support to the students throughout the process. **8. 2 Technical Support:** The Department MOOCs Coordinator shall ensure that students have access to the necessary technical resources to complete MOOCs courses.
9. Feedback and Improvement
9.1 Student Feedback: Department MOOCs Coordinator shall collect feedback from students on their MOOC experiences to improve future implementations. **9.2 Continuous Improvement:** MOOCs guidelines and processes will be updated based on student feedback, Department feedback and evolving educational standards.

Course Outcomes: At the end of the course the student will be able to :	
21AEC801.1	Students will demonstrate a strong grasp of essential engineering concepts and methodologies relevant to their chosen field.
21AEC801.2	Students will apply engineering knowledge to solve real-world problems through projects and case studies presented in the course.
21AEC801.3	Students will proficiently use online tools and resources, including simulations, interactive modules, and digital libraries, to enhance their learning experience.
21AEC801.4	Students will gain insights into new technologies and innovations within engineering, preparing them to adapt to technological advancements.

21AEC801.5	Students will exhibit improved teamwork and communication skills by engaging in online discussions, group projects, and peer assessments.
21AEC801.6	Students will develop a broader understanding of how engineering intersects with other disciplines and cultural contexts, informed by national/global perspectives gained through the MOOC.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AEC801.1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21AEC801.2	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
21AEC801.3	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
21AEC801.4	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21AEC801.5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**1**	**-**	**-**
21AEC801.6	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21AIP802**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE	3 Hrs
Total Hours	20 hours	Credits	05

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

2. Progress Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

3. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

4. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.
- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

5. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the final report, presentation, and the ability to answer questions.

6. Plagiarism Check
• **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources. • **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).
7. **Mentorship and Feedback**
• **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback. • **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.
8. Post Submission
• **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field. • **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Progress Review	During the 8th semester	25 marks
2. Project Report Evaluation	End of the 8th Semester	25 marks
Semester End Examinations (SEE)		
3. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		

Course Outcomes: At the end of the course the student will be able to :	
21AIP802.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21AIP802.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21AIP802.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21AIP802.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21AIP802.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21AIP802.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AIP802.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
21AIP802.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
21AIP802.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
21AIP802.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
21AIP802.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
21AIP802.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Research Internship

Course Learning Objectives:

1. To equip students with the knowledge of fundamental research principles, methodologies, and techniques applicable to their engineering discipline.
2. To enable students to formulate research questions, design experiments or studies, and use appropriate data collection and analysis tools.
3. To foster the ability to think critically and innovatively while solving complex engineering problems during the research process.
4. To guide students in developing the skills necessary for writing clear and well-structured research reports, papers, and presentations.
5. To instill an understanding of ethical practices in research, including integrity, responsible data handling, and respect for intellectual property.
6. To prepare students to work effectively in research teams, communicate their ideas clearly, and present their findings to both technical and non-technical audiences.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) and the Research Supervisor to understand the research goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, research agreements and confidentiality agreements, if applicable.
3. **Research Proposal:** Develop a research proposal in consultation with the Research Supervisor and academic mentor outlining the objectives, methodology, and expected outcomes.

During the Internship

1. **Work Plan:** Follow a structured research plan provided by the supervising researcher or mentor.
2. **Literature Review:** Conduct a comprehensive literature review to understand the current state of research in the chosen area.
3. **Regular Meetings:** Participate in regular meetings with academic and research mentors to discuss progress, challenges, and next steps.
4. **Lab Work/Field Work:** Engage in experimental work, simulations, or field studies as required by the research project.
5. **Data Collection and Analysis:** Collect, analyze, and interpret data using appropriate tools and techniques.
6. **Documentation:** Maintain detailed records of research activities, experiments, and findings.

Deliverables

1. **Weekly Reports:** Submit weekly progress reports to academic and research mentors.
2. **Monthly Reports:** Submit monthly progress reports to academic and research mentors.
3. **Mid-Term Review:** Participate in a mid-term review meeting to assess progress and realign research goals if necessary.
4. **Report and Research Paper:** Prepare a draft report and a research paper detailing the research problem, methodology, results and discussions, and conclusions.
5. **Presentation:** Deliver a presentation summarizing the research work to faculty, peers, and other stakeholders upon completion of the internship.

Assessment Criteria
1. **Research Quality:** Evaluate the quality and rigor of the research conducted. 2. **Report Quality:** Assess the clarity, organization, and thoroughness of the report and the research paper. 3. **Presentation:** Evaluate the effectiveness and clarity of the final presentation. 4. **Innovation and Creativity:** Consider the originality and innovative aspects of the research. 5. **Self-Reflection:** Review the student's ability to critically reflect on their research experience and identify areas for future growth.
Post-Internship
1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the research experience and areas of improvement. 2. **Publication:** Explore opportunities to publish the research findings in academic journals or conferences. 3. **Networking:** Maintain professional relationships established during the internship for future research collaborations.
Additional Tips
• **Curiosity:** Cultivate a curious mindset and a willingness to explore new ideas. • **Collaboration:** Work collaboratively with other researchers and team members. • **Adaptability:** Be open to modifying research approaches based on findings and feedback. • **Communication:** Develop strong written and oral communication skills to effectively present research findings. • **Time Management:** Prioritize tasks and manage time efficiently to meet research deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (Only OFFLINE)	Will be conducted during the 7th semester BE. Students shall submit the Research Internship Proposal and make a presentation and answer questions raised by the Departmental Internship Evaluation Committee (DIEC). Marks split-up: Research Internship Proposal – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): II (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on progress done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): III (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final internship report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
CIE Marks (Max 100)	Average of the CIE:I , CIE-II and CIE:III marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply appropriate research methodologies and tools to design and conduct experiments, analyze data, and draw conclusions.
21INT803.2	Demonstrate the ability to identify and solve complex engineering problems through innovative and systematic research approaches.
21INT803.3	Acquire proficiency in using advanced technologies, tools, and techniques relevant to their field of research.
21INT803.4	Develop skills in writing comprehensive research reports, documentation, and effectively presenting research findings.
21INT803.5	Understand and apply ethical standards in research, including plagiarism avoidance, proper citations, and data integrity.
21INT803.6	Gain experience in working collaboratively within a research team and contributing effectively to the shared goals of the project.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

3. VTU Mandatory Internship Guidelines 2021.
Available at https://vtu.ac.in/pdf/regulations2021/anex4.pdf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21INT803.1	**1**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.3	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**
21INT803.5	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**	**-**

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Industry Internship

Course Learning Objectives:

1. To develop practical engineering skills through hands-on experience in a real-world industrial environment.
2. To enhance the ability to identify, analyze, and solve complex engineering problems encountered during the internship.
3. To gain an understanding of the functioning of the industry, including exposure to its standards, practices, and emerging technologies.
4. To improve communication, collaboration, and teamwork skills by working with professionals in a multidisciplinary team setting.
5. To foster adaptability by learning to work in dynamic and fast-paced industrial environments while embracing lifelong learning.
6. To instill a sense of professional ethics, responsibility, and accountability in engineering practice by adhering to industry-specific codes of conduct.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) to understand the internship goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, internship agreements if applicable etc.
3. **Goal Setting:** Define specific, measurable, achievable, relevant, and time-bound (SMART) goals in consultation with academic and industry mentors.

During the Internship

1. **Work Plan:** Follow a structured work plan provided by the host organization.
2. **Mentorship:** Regularly meet with assigned industry and academic mentors to review progress and seek guidance.
3. **Work Diary/Daily Report/Learning Diary:** Maintain a diary/logbook documenting daily activities, learnings, challenges, and reflections.
4. **Professional Conduct:** Adhere to the professional and ethical standards of the host organization, including dress code, punctuality, and communication protocols.
5. **Skill Application:** Actively participate in projects and tasks assigned, applying theoretical knowledge to practical situations.

Deliverables

1. **Weekly Reports:** Submit the weekly progress reports to academic and industry mentors.
2. **Monthly Reports:** Submit the monthly progress reports to academic and industry mentors.
3. **Mid-Term Review/Evaluation:** Participate in a mid-term review meeting/evaluation to assess progress and realign goals if necessary.
4. **Final Report:** Prepare a comprehensive final report in the specified format detailing the projects undertaken, skills acquired, challenges faced, and overall learning experience.
5. **Presentation:** Deliver a presentation summarizing the internship experience to faculty evaluators and peers upon completion of the internship.

Assessment Criteria

1. **Performance Evaluation:** Receive feedback from the industry mentor based on work performance, technical skills, and professional behaviour.

2. **Report Quality:** Evaluate the quality, clarity, and comprehensiveness of the final report. 3. **Presentation:** Assess the effectiveness and clarity of the final presentation. 4. **Self-Reflection:** Review the student's ability to critically reflect on their learning experience and identify areas for future growth.
Post-Internship
1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the internship experience and areas of improvement. 2. **Certification:** Obtain an internship completion certificate from the host organization. 3. **Networking:** Maintain professional relationships established during the internship for future opportunities.
Additional Tips
• **Professionalism:** Demonstrate a professional attitude and work ethic at all times. • **Adaptability:** Be open to learning and adapting to new environments and technologies. • **Communication:** Develop strong communication skills to effectively collaborate with colleagues and mentors. • **Time Management:** Prioritize tasks and manage time efficiently to meet deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on work done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
Continuous Internal Evaluation (CIE): II (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
CIE Marks (Max 100)	Average of the CIE:I and CIE:II marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply engineering concepts and theoretical knowledge to solve real-world industry problems.
21INT803.2	Enhance their problem-solving abilities by identifying, analyzing, and providing innovative solutions to engineering challenges in the industry.
21INT803.3	Develop key professional skills such as teamwork, communication, and time management in a corporate or industrial environment.
21INT803.4	Gain exposure to industry-standard tools, technologies, methodologies, and regulatory standards relevant to their field of study.
21INT803.5	Demonstrate understanding and adherence to professional ethics, safety regulations, and responsibilities in an industrial setting.
21INT803.6	Build a network of industry professionals and gain insights into career opportunities, preparing them for future employment in the engineering sector.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

3. VTU Mandatory Internship Guidelines 2021.
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Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21INT803.1	3	2	-	-	-	1	-	-	-	-	1	-	-	-
21INT803.2	-	3	2	1	-	-	-	-	-	-	1	-	-	-
21INT803.3	-	-	-	-	-	-	-	-	3	2	-	-	-	-
21INT803.4	-	-	-	-	3	2	-	-	-	-	-	1	-	-
21INT803.5	-	-	-	-	-	2	-	3	-	-	-	-	-	-
21INT803.6	-	-	-	-	-	-	-	-	2	3	-	1	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi
Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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