AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 7 UG Programmes

Savitribai Phule Pune University

All India Shri Shivaji Memorial Society's

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Faculty of Science and Technology

Curriculum Structure and Syllabus

M. Tech. Computer Engineering

(Artificial Intelligence and Data Science) (2025 Pattern)

(With effect from Academic Year 2025-26)

www.aissmscoe.com

M. Tech. Computer Engineering (Artificial Intelligence and Data Science Engineering)

(2025 Pattern)

ABBRAVIATIONS

Abbreviation	Title	Abbreviation	Title
PSM	Program Specific Mathematics Course	OE	Open Elective
PSB	Program Specific Bridge Course	SLC	Self-Learning Course
PCC	Program Core Course	AEC	Ability Enhancement Course
PEC	Program Specific Elective Course	MLC	Mandatory Learning Course
LC	Laboratory Course	CCE	Co-curricular & Extracurricular Activities
VSE	Vocational and Skill Enhancement Course		

M. Tech. Computer Engineering (Artificial Intelligence and Data Science)

(2025 Pattern)

Distribution of Credits

S.N.	Course Type	Course Title	No. of Credits (Semester wise)				Credits	
			I	II	III	IV	Total	%
1	PSM	Program Specific Mathematics Course	04	--	--	--	04	4.54
2	PSB	Program Specific Bridge Course	04	--	--	--	04	4.54
3	PCC	Program Core Course	12	08	--	--	20	22.72
4	LC	Laboratory Course	02	02	--	--	04	4.54
5	MLC	Mandatory Learning Course	--	--	02		02	2.72
6	PEC	Program Specific Elective Course	--	04	--	--	04	4.54
7	AEC	Ability Enhancement Course	--	04	--	--	04	4.54
8	OE	Open Elective	--	04	--	--	04	4.54
9	VSE	Vocational and Skill Enhancement Course	--	--	16	16	32	36.36
10	SLC	Self-Learning Course	--		04	04	08	9.09
11	CCE	Co-curricular & Extracurricular Activities	--	--	--	02	02	2.72
			22	**22**	**22**	**22**	**88**	**100**

M. Tech. Computer Engineering (Artificial Intelligence and Data Science)

Curriculum Structure: Semester I

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme		Examination Scheme						Credits
				L	P	CCA		ESE	TW	OR	Total	
						Activities	MSE					
1.	PSM	PSM501AID	Mathematical Foundations For Data Science	4	--	20	30	50	--	--	100	4
2.	PSBC	PSB511AID	Scalable System for Data Science	4		20	30	50			100	
3.	PCC	PCC521AID	Foundation of Neural Network	4	--	20	30	50	--	--	100	4
4.	PCC	PCC522AID	Next Generation Artificial Intelligence	4	--	20	30	50	--	--	100	4
5.	PCC	PCC523AID	Machine Learning Algorithm	4	--	20	30	50	--	--	100	2
6.	LC	LC531AID	AI & DS Lab	--	4	--	--	--	25	25	50	2
7.	MLC* *(Non-credit)*	MLC541AID	Communication Skill and Personality Development	2	--	20	30	--	--	--	50	--
			Total	**22**	**4**	**120**	**180**	**250**	**25**	**25**	**600**	**22**

L: Lecture**, P:** Practical**, CCA:** Continuous Comprehensive Assessment**; MSE:** Mid Semester Examination; **ESE:** End Semester Examination**; TW:** Term Work**, OR:** Oral Examination; * Common to all programs

M. Tech. Computer Engineering (Artificial Intelligence and Data Science)

Curriculum Structure: Semester II

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme		Examination Scheme					Credits
				L	P	CCA		ESE	TW	OR	Total	
						Activities	MSE					
1.	PCC	PCC-524-AID	Advance Deep Learning	4	--	20	30	50	--	--	100	4
2.	PCC	PCC-525-AID	Advance Natural Language Processing	4	--	20	30	50	--	--	100	4
3.	PEC	PEC551DES	Program Specific Elective	4	--	20	30	50	--	--	100	4
4.	LC	LC532DES	Advance AID Lab	--	4	--	--	--	25	25	50	2
5.	AEC*	AEC-561-AID	Research Methodology and IPR	4	--	20	30	50	--	--	100	4
6.	OE *	Open Elective	Open Elective	4	--	20	30	50	--	--	100	4
7.	MLC * *(Non-credit)*	MLC542DES	Sustainable Engineering and Circular Economy	2	--	20	30	--	--	--	50	--
			Total	**22**	**6**	**120**	**180**	**250**	**25**	**25**	**600**	**22**

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Program Specific Elective Course (Select any ONE)			
Course Code	**Title**	**Course Code**	**Title**
PEC-551A-AID	Fuzzy Logic and Fuzzy Set	PEC-551C- AID	Artificial Intelligence in Cyber Security
PEC-551B- AID	Advance Data Mining	**PEC-551D- AID**	Cloud Data Management

Open Elective Course (Select any ONE)			
Course Code	**Title**	**Course Code**	**Title**
OE-573- CON	Organizational Ethics and Human Resource Management	OE-573-STR	Artificial Intelligence in cyber security
OE-571-CEE	Economics of innovation	OE-571-PED	Entrepreneur Development

M. Tech. Computer Engineering (Artificial Intelligence and Data Science)

Curriculum Structure: Semester III

Sr. No.	Course Code	Course Code	Course Name	Teaching Scheme		Examination Scheme						Credits
				L	P	CCA Activities	MSE	ESE	TW	OR	Total	
1.	VSE	VSE611-AID	Dissertation Phase – I	--	12	--	--	--	100	50	150	6
2.	SLC	SLC62-AID	Massive Open Online Course –I	4	--	--	--		100	--	100	4
3.	VSE	VSE612-AID	Internship/ On Job Training /	--	16	--	--	--	100	100	200	8
4.	MLC*	MLC643AID	Human Rights	2		20	30	--	--	--	50	2
5.	MLC*	MLC602DES	Introduction to Constitution	2	--	20	30	--	--	--	50	2
			Total	**8**	**28**	**40**	**60**		**300**	**150**	**550**	**22**

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M. Tech. Computer Engineering (Artificial Intelligence and Data Science)

Curriculum Structure: Semester IV

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme		Examination Scheme						Credits
				L	P	CCA		ESE	TW	OR	Total	
						Activities	MSE					
1.	VSE	SE612AID	issertation Phase – II	--	24	--	--	--	200	100	300	12
2.	SLC	LC621AID	assive Open Online Course –II ight Weeks Duration)	4	--	--	--	--	100	--	100	4
3.	CCE	CE631AID	eminar / Paper presentation in Conference/Patent Filing/Copyright	--	4	--	--	--	25	25	50	2
4.	MLC*	MLC641AID	Introduction to Cyber Security	4		20	30	50			100	4
			Total	**4**	**36**	**20**	**30**	**50**	**325**	**125**	**550**	**22**

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***CONTINUOUS COMPREHENSIVE ASSESSMENT (CCA)**

(A) Activities: 20 Marks (Any TWO)

(i) Field Visit	(iii) Case Study	(v)Technical report on advance topic
(ii) Research Note	(iv) Simulation	

Guidelines:

SN	Activity	Requirements	Evaluation Criteria (Marks out of 10)
1	**Field Visit**	• Participate in at least one relevant industrial/field visit. • Submit a report with objectives, observations, process details, and analysis linking theory to practice. • The report should include relevant photographs, sketches, or process flow diagrams.	• Report content quality and technical depth– 4 • Depth of analysis & observations – 4 • Presentation and formatting– 2
2	**Research Note**	• Select a current research problem in Mechanical Design Engineering. • Prepare a research note with background, literature review (min. 10 references), and research idea, methodology outline, or design approach • Follow IEEE/ASME citation style.	• Literature review quality – 4 • Originality & relevance – 4 • Academic writing & formatting – 2
3	**Case Study**	• Select a case involving design failure, optimization, sustainability or innovation. • Submit a report with problem statement, technical analysis (calculations/simulations), and recommendations/conclusions.	• Problem clarity & technical accuracy – 3 • Analytical depth & methodology – 5 • Presentation & structure – 2
4	**Simulation**	• Use software (ANSYS, SolidWorks, MATLAB, ABAQUS, etc.). • Report must include problem definition, modeling approach, assumptions, results, and interpretation. • Submit simulation files for evaluation.	• Accuracy of model setup – 4 • Quality of results & interpretation – 4 • Report clarity – 2
5	**Technical Report on Advanced Topic**	• Select an advanced/emerging topic • Prepare a word report with technical details, applications, challenges, and future scope. • Include at least 10-15 recent references from peer reviewed journals (past 5 years).	• Technical depth & coverage – 4 • Critical analysis & insight – 4 • Presentation & formatting – 2

(B) Mid Semester Evaluation (MSE)

(i)	Class Test – I	Unit I	15 Marks
(ii)	Class Test – II	Unit II	15 Marks

END Semester Examination (ESE)

Examination will be carried out on unit 3,4 and 5 carrying following marks weightage:

Unit No.	Marks Weightage
Unit III	16
Unit IV	17
Unit V	17

DISSERTATION WORK:

The dissertation work shall be based on the knowledge acquired by the student during the coursework and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Dissertation Phase – I

Dissertation Phase – I is the integral part of the project Work. In this, the student shall complete the partial work of the Project that will consist of problem statement, literature review, project overview, scheme of implementation (UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. The candidate shall deliver a presentation as a part of the progress report of Project work Stage-I, on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the progress report of Project Work Stage-I in standard format duly certified for satisfactory completion of the work by the concerned guide. The report must undergo plagiarism screening using anti-plagiarism software, and the similarity index shall not exceed 25%.

Dissertation Phase – II

In Dissertation Phase – II, the student shall complete the balance part of the Project that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis & validation of results and conclusions.

The student shall prepare the final report of Project work in standard format duly certified for satisfactory completion of the work by the concerned guide. The dissertation must undergo plagiarism screening using anti-plagiarism software, and the similarity index shall not exceed 25%. It is mandatory to publish **one paper in conference** and **one paper in peer reviewed journal** before submission of the dissertation.

MOOC COURSE SELECTION AND EVALUATION GUIDELINES:

Students shall select a MOOC course related to current trends in their respective engineering discipline, preferably aligned with their area of specialization. The course must be at the postgraduate level and should be selected in consultation with the assigned guide and approved by the designated authority. It may be taken from recognized MOOC platform such as NPTEL. Students are required to submit hard copies of all course assignments. The student is expected to register for the examination and obtain the certificate from competent authority.

Evaluation Guidelines: Students will be evaluated progressively for a total 100 Marks.

Sr. No.	**Parameter**	**Marks**
1	Presentation of the Selected topic	20
2	Assignment Scores	50 (The total marks obtained in the assignments shall be proportionally converted to an equivalent score out of 50.)
3	Certification Granted Based on the MOOC Provider's Examination	30
Total Marks		**100**

INTERNSHIP/ ON JOB TRAINING:

Each student shall undertake an internship/ On job training of **8–10 weeks** in an industry, research institute, or consultancy firm under the guidance of an allocated faculty supervisor. The faculty guide shall be responsible for monitoring and evaluating the student's progress, in coordination with the industry/research supervisor.

Students must maintain a detailed project diary recording tasks performed, data collected, observations made, and challenges encountered. Progress shall be demonstrated through regular reporting, presentations, and proper documentation. The student is required to meet with the institute supervisor fortnightly to discuss and record progress.

Three progress reviews will be conducted during the internship:

Review–I: Understanding of the organization, assigned tasks, and work plan. (20 Marks)

Review–II: Mid-term progress, skill application, and problem-solving approach. (20 Marks)

Review–III: Completion status, demonstration of outcomes, and final feedback. (20 Marks)

The documentation comprising training report, project diary will carry 40 Marks.

Upon completion, the student shall submit a comprehensive internship report summarizing skills acquired, activities undertaken, challenges faced, and results achieved. A completion certificate from the host organization is mandatory. The final evaluation will be based on the internship report, feedback from the industry/research guide, and an oral examination.

Exit option to qualify for PG Diploma in Artificial Intelligence and Data Science: 12-14 Weeks domain specific industrial internship after successfully completion of first year of the program.

SEMESTER I

Semester I

PSM501AID: Mathematical Foundations for Data Science

Program:	M.Tech. Artificial Intelligence and Data Science					**Semester:**	I
Course:	Mathematical Foundations for Data Science					**Code:**	MAS1402
Credits	**Teaching Scheme (Hrs./Week)**			**Evaluation Scheme and Marks**			
	Lecture	**Practical**	**Tutorial**	**FA**		**SA**	**Total**
				FA1	**FA2**		
04	04	-	-	20	30	50	100

Prior knowledge of: 1. Probability theory 2. Statistics **is essential**

Course Objectives: This course aims at enabling students

- Understand the foundational concepts of data collection, descriptive statistics, and data simulation techniques.
- Explore and apply probability distributions and hypothesis testing for statistical inference.
- Learn techniques for linear regression, multivariate analysis, and dimensionality reduction.
- Apply statistical classification and decision-making methods including Bayesian and non-metric techniques.
- Use supervised learning algorithms and advanced tools such as decision trees and support vector machines for data-driven modeling.

Course Outcomes:

- After learning the course, the students will be able to:
- Analyze and summarize data using appropriate descriptive statistical techniques.
- Perform hypothesis testing and fit various probability distributions to real-world data.
- Apply linear regression and multivariate techniques for predictive modeling.
- Implement dimensionality reduction and classification techniques for complex datasets.
- Evaluate and apply decision-making algorithms including non-parametric and machine learning methods like CART and SVM.

Detailed Syllabus:

Unit No.	**Description**
1	**Introduction and Motivation**: Data and Statistics, Data collection/generation and descriptive statistics Data collection, types of data, Sampling methods – data generation methods, Importing Data- Bootstrap sampling, Jackknife sampling- bias and variance, simulation, confidence levels, sample size determination, descriptive statistics. **(10 Hours)**
2	**Statistics Concepts**: Random Variables and Probability Distributions, Probability Distributions, Fitting of data and Inferential statistics Hypothesis testing, Fitting of distribution to data, Binomial, Poisson uniform exponential Normal distributions one, way, two-way analysis of variance **(10 Hours)**
3	**Linear Regression:** Linear Regression by Least Squares, Dimensionality Reduction Methods and supervised learning methods Multivariate statistics, multivariate normal distribution, multivariate regression analysis– Principal component analysis, Two-

	Way Analysis of Variance–Linear discriminant analysis, Fisher's discriminant analysis, Statistical decision making, Bayesian classification. **(10 Hours)**	
4	**Nonmetric decision making:** Histograms, kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries. regression and classification Trees-decision trees, CART methods, Support Vector Machines. **(11 Hours)**	
5	**Statistical Tests**: Specific tests for different scenarios. T-tests: For comparing means of two groups. Chi-square tests: For analyzing categorical data and feature selection. ANOVA: For comparing means of three or more groups. **Statistical Software & Tools:** Gain proficiency in using relevant tools like Python (Pandas, NumPy), R, and Tableau for data analysis and modeling. **(11 Hours)**	
	Total	52

Text Books:

1. Richard M. Heiberger, "Statistical Analysis and Data Display An Intermediate Course with Examples in R", Second Edition, Springer Texts in Statistics, More information about this series at http://www.springer.com/series/417.
2. John A. Rice , "Mathematical Statistics and Data Analysis", University of California, Berkeley, Edition III, MathematicalStatisticsandDataAnalysis3ed.pdf.
3. Introduction to statics and data Analysis with exercises, solutions and applications", textbook 2022. Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R | SpringerLink

Reference Books:

1. *Krishna Kumar Mohbey, Arvind Pandey, Dharmendra Singh Rajput*, "Predictive Analytics Using Statistics and Big Data: Concepts and Modeling", ISBN: 978-981-14-9051-4 (Print), ISBN: 978-981-14-9049-1 (Online),Year of Publication: 2020, DOI:10.2174/9789811490491120010l, Predictive Analytics Using Statistics and Big Data: Concepts and Modeling
2. Introduction to Data Analysis Handbook", Migrant & Seasonal Head Start Technical Assistance Center Academy for Educational Development, AED/TAC-12 Spring 2006. ED536788.pdf
3. "Probability" all-of-statistics.pdf"
4. "Practical Statics for Data Scientists", by peter Bruce , Andrew Bruce, 2nd Edition O'relly publication, Practical Statistics for Data Scientists [Book]
5. Statistics and Data Analysis for Social Science, **Edition:** Second Edition, B**y:**Eric J. Krieg **Publisher:** SAGE Publications, Inc. **Publication year:** 2020 **Online pub date:** January 19, : https://doi.org/10.4135/9781071909546
6. Learning Statistics with jamovi, ATutorial for Beginners in Statistical Analysis Danielle J. Navarro and David R. Foxcroft. Danielle J. Navarro and David R. Foxcroft, Learning Statistics with jamovi: A Tutorial for Beginners in Statistical Analysis. Cambridge, UK: Open Book Publishers, 2025, https: //doi.org/10.11647/OBP.0333

PSB511AID: Scalable Systems for Data Science

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Paper		TW	Oral/ Presentation	Total	
	Lect./Week	CCA	ESE				
PSB511AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• To introduce systems and approaches for large scale data science problems. • To understand handling large data sets. • To learn how large-scale machine learning and distributed machine learning approaches work • Developing Data Science algorithms and analytics using Big Data platforms
Course Outcome:	• Understand handling large data sets Learn approaches for solving large scale data science problems link analysis and finding similar items • Understand real-world problems which need scalable systems for large scale data science such as web advertising and recommendation systems • Learn the basic principles of large-scale machine learning and distributed machine learning • Scaling data Science algorithms and analytics using Big Data platforms. • Implement models using programming languages to solve large scale data science projects.
Course Contents:	**UNIT I Big Data** Big Data & Platform Design Goals, Big Data & other computing platforms. Programming for Large Datasets:. Distributed systems, scalability and metrics, Degrees of Parallelism, MapReduce- Uses, Model working, simple and advanced applications programming. Runtime Systems: Hadoop- Open cloud server, Class cluster, Hadoop distributed file system. Hadoop YARN, Hadoop Mapreduce, Fault Tolerance. **(10 Hours)**
	UNIT II Prediction Prediction over graphs – Scalable learning and inference over graphs, Semi supervised learning (SSL)- self training and co training, Graph Based SSL. Streaming Naive Bayes – Introduction to Naïve Bayes, Complexity of Naïve Bayes, Implementation of Naïve Bayes Classifier, Large vocabulary counting, Sorting – Merge sort, Unix sort, Large vocabulary Naïve Bayes, Distributed Counting, optimizations. **(10 Hours)**
	UNIT III Learning Scalable Logistic Regression and SGD. Learning as optimization, Stochastic gradient descent, SGD versus streaming, Logistic regression versus Rocchio and Naïve Bayes, Efficient Logistic Regression with Stochastic Gradient Descent, Regularized logistic regression, Sparse updates for Regularized logistic regression, Bounded memory logistic regression, SGD implementation. **(10 Hours)**

	UNIT IV Matrix Factorization Large-scale Matrix Factorization (MF) - Recovering Latent factor in a matrix, Matrix factorization for collaborative filtering, MF for image and text modeling, Large scale MF for distributed SGD, Distributed SGD for Mapreduce.MR Advanced Topics: Inverted Index, PageRank, Distributed graph procesing: Apache Giraph, GoFFish **(11 Hours)**
	UNIT V Distributed stream processing Distributed and fault-tolerant real-time computation, Distributed Stream Processing systems- Apache Storm. Parameter Server- Architecture, Key- value vectors, Range Push and Pull, User defined functions on the server, Asynchronous tasks and dependency, Flexible consistency, user defined filters, messages, consistent hashing, server management, worker management. Evaluation of parameter server – Sparse Logistic Regression and Latent Dirichlet Allocation. **(11 Hours)**
Textbook & Reference Books:	• Select chapters from Mining of Massive Datasets, JureLeskovec, AnandRajaraman and Jeff Ullman, 2nd Edition (v2.1), 2014. • Select chapters from Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer, 1st Edition, Morgan & Claypool Publishers, 2010 • Research papers and articles - [MR for ML on Multicore, NIPS 06], [Hogwild!], [Bottou, 2010], [Gemulla et al., KDD 2011] • Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services, 2015. • Scala for Data Science Paperback – Import, by Pascal Bugnion

Semester I
PCC521AID Foundation of Neural Network

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
PCC521AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	This course aims at enabling students • to learn basic of human Neural network. • to learn artificial neural network. • to develop learning algorithm f neural network. • to apply artificial Neural Networks in real life.
Course Outcomes:	After learning the course, the students will be able to: • to understand the Building Blocks of Neural network. • to learn Backpropagation algorithm. • to explore Network Architectures • to develop Intuition for Predictions. • to apply Neural Networks in real life.
Course Contents:	**UNIT-I** Regression, Linear regression, logistic regression, classification, binary classification and multiclass classification, Inferential statistics, population, sample, parameter, statistic, random sample, sampling, cross validation. Concept of frequency distribution, measures of central tendency, moment techniques. Summarizing and Exploring Data. Sampling distributions, basic concepts of inference (estimation & hypothesis testing), point estimation & interval estimation. **(10 Hours)**
	UNIT II: Architecture of human brain neuron, Concepts of human brain training, perceptron, Artificial neurons vs Biological neurons, Key Components of an ANN, Working of Artificial Neural Networks, Estimation, Single Layer Perceptron., backpropagation learning algorithm, types of activation function etc **(10 Hours)**
	UNIT III Multilayer perceptron, Types of Artificial Neural networks, Feedforward Multi-Layer Feed Forward Networks. **(10 Hours)**
	UNIT IV Neural Network (FNN), Convolutional Neural Network (CNN), Radial Basis Function Network (RBFN), Recurrent Neural Network (RNN). BPTT algorithm. **(11 Hours)**

	UNIT V **(11 Hours)** Deep Neural net with forward and back propagation Optimization Algorithms in ANN Training, Gradient AIDcent, Adam (Adaptive Moment Estimation, RMSProp: Stochastic Gradient AIDcent (SGD). Applications of Artificial Neural Networks, Challenges in Artificial Neural Networks.
Textbook & Reference Books:	• Fundamentals of Neural Networks: Architectures, Algorithms And Applications: United States Edition Paperback – 9 December 1993 by Laurene V. Fausett (Author) • Neural Networks and Learning Machines Third Edition Simon Haykin McMaster University Hamilton, Ontario, Canada • Laurene fausett, Fundamentals of Neural Network Architecture, algorithms and applications – pearsons education.

Semester I
PCC522AID: Next Generation Artificial Intelligence

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
PCC522AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• To understand the theoretical foundations and recent advances in generative AI, • To equip students with practical skills to design, build, and deploy next-generation AI systems. • To analyze ethical, privacy, fairness, and governance issues associated with modern AI systems. • To enable students to critically evaluate and compare emerging AI architectures and paradigms. • To prepare students for research and innovation in next-generation AI: identifying key challenges, exploring recent literature, and proposing novel solutions
Course Outcomes:	• **Explain** the architecture and working principles of state-of-the-art generative models, multimodal AI systems, and foundation models. • **Design and implement** AI systems using modern tools with considerations for computational constraints. • **Evaluate** AI models for interpretability, fairness, transparency, robustness, and other ethical metrics. • **Compare and contrast** various deployment paradigms and make design decisions based on application scenario. • **Identify research gaps** in next-generation AI and propose directions for future work.
Course Contents:	**UNIT I Foundations of Next Generation AI** Evolution of Artificial Intelligence: From Symbolic AI to Deep Learning to Generative AI, Limitations of Traditional AI and Motivation for Next Generation AI, Overview of Generative AI, Multimodal AI, and Foundation , Models Key Differences: Conventional AI vs. Next Gen AI, Applications and Industry Use Cases (Healthcare, Finance, Education, Robotics) **(10 Hours)**

	UNIT II Generative AI and Large Language Models (10 Hours) Principles of Generative AI: Diffusion Models, GANs, and Transformers, Large Language Models (LLMs): Architecture, Training, and Fine-tuning, Prompt Engineering Learning, generative AI Applications: Text, Code, Music, and Image Generation, Case Studies: GPT, BERT, Gemini

	UNIT III Emerging AI Paradigms (10 Hours) Explainable AI (XAI): Transparency, Interpretability, and Trust in AI, Edge AI & Federated Learning: On-device intelligence and privacy-preserving AI, Multimodal AI: Fusion of Text, Vision, Speech, and Sensor Data, Hands-on Case: Multimodal Models (e.g., CLIP, GPT-4V, Gemini)
	UNIT IV Next Gen AI in Real-World Systems (11 Hours) AI for Robotics, Autonomous Vehicles, and Smart Mobility,AI in Healthcare: Drug Discovery, Medical Imaging, Personalized Treatment, AI in Education: Adaptive Learning Platforms and Intelligent Tutoring, AI for Sustainable Development and Smart Cities
	UNIT V Future Directions, Ethics, and Policies (11 Hours) **Ethical Dimensions of AI:** Issues of bias, fairness, transparency, accountability, and data privacy, **Responsible and Trustworthy AI:** Principles, governance models, and global frameworks for ethical deployment, **Security Challenges:** Adversarial machine learning, robustness, and detection of synthetic media (deepfakes)., **AI and the Future of Work:** Human–AI collaboration, evolving job roles, and essential skills for the AI-driven economy
Textbook & Reference Book:	1. Russell, S. & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th Edition). Pearson. 2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press. 3. Foster, D. (2023). *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play* (2nd Edition). O'Reilly. 4. Shetty, D.S., & Manohar, S.R. (2021). ***Artificial Intelligence and Machine Learning***. Cengage India**.** 5. Bahree, A. (2024). *Generative AI in Action*. Manning. 6. O'Reilly Media (2022). *Explainable AI for Practitioners*. 7. Christian, B. (2020). *The Alignment Problem: Machine Learning and Human Values*. W. W. Norton & Company. 8. Balas, V.E., et al. (2023). *Explainable Edge AI: A Futuristic Computing Perspective*. Springer.

Semester I
PCC523AID: Machine Learning Algorithm

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	End semester Assessment				
PCC-523-AIDS	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• To study the basic concepts of machine learning algorithms and regression techniques. • Acquire knowledge on data pre-processing techniques. • To acquaint with the concepts of dimensionality reduction. • To learn and apply supervised learning techniques. • To learn and apply clustering techniques
Course Outcome:	• Apply data pre-processing techniques to prepare training data set for machine learning. • Analyse the data and apply regression techniques. • Demonstrate the dimensionality reduction techniques. • Implement supervised machine learning algorithms. • Implement clustering algorithms.
Course Contents:	**UNIT I** Basics of Machine Learning - Types of Machine Learning Algorithms - Data Preprocessing - Introduction of Regression Algorithms – Linear Regression – Multivariate Linear Regression – Logistic Regression. **(10 Hours)**
	UNIT II Introduction– Subset Selection - Principal Component Analysis (PCA) – Factor analysis – Multidimensional Scaling - Linear Discriminant Analysis (LDA) Case Study **(10 Hours)**

	UNIT III Classification Algorithms – Decision Tree Representation, Alternative measures for selecting attributes, Decision tree representation – ID3 – CART , Naive Bayes – classifying with conditional probabilities – K-Nearest Neighbor **(10 Hours)**
	UNIT IV Clustering algorithms -Introduction, Distance based clustering- K-means algorithm, choosing number of clusters, Clustering around medoids – silhouettes, Hierarchical clustering **(11 Hours)**
	UNIT V Introduction – Bagging: Random Forest – Boosting: Adaboost and XGBoost Algorithms Light GBM – Stacking. **(11 Hours)**
Textbook & Reference Books:	• Tom M. Mitchell, "Machine Learning", McGraw-Hill Science, 1997. • Timothy Howard Jackson "AI and Machine Learning for Coders: A Programmer's Guide to Artificial Intelligence", 2022. • Peter Harrington, "Machine Learning in action", Manning Publication, 2012. • Henrik Brink, Joseph W. Richards, and Mark Fetherolf, "Real-World Machine Learning", Manning Publications, 2017.

Semester I

LC531AID : Artificial Intelligence and Data Science Lab Laboratory

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
LC531AID	--	--	--	50	50	100	2

Course Objectives:	• Familiarize with search and game playing strategies. • Introduce logic programming concepts through Prolog • Learn probabilistic reasoning on uncertain data. • Learn knowledge representation and inference • Learn building AI Systems
Course Outcome:	• Solve AI problems through Python Programming • Demonstrate an intelligent agent • Evaluate Search algorithms • Build knowledge representation system and infer knowledge from it • Apply probabilistic reasoning on data.
Course Content	Lab practice shall consist of following assignments/experiments: 1. Implementation of uninformed search techniques. 2. Implementation of informed search techniques. 3. Implementation of game search. 4. Implementation of a program to represent knowledge 5. Implementation of a program to construct a Bayesian network from given data. 6. Implementation of a program to infer from the Bayesian network. 7. Installation of Prolog and demonstration of basic operations. 8. Mini Project work
Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective. It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher.	

Semester I

MLC541AID: Communication Skill and Personality Development

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
MLC541 AID	**2**	**50**	**50**	**--**	**--**	**100**	**-**

Course Objectives:	• To be understood, to be accepted, to get something done, and to understand others • To enhancing self-awareness. • To improving interpersonal relationships. • To build confidence. • To foster adaptability, and promoting effective communication
Course Outcomes:	• To facilitate more effective communication • To increased self-confidence. • To improve relationships, better problem-solving abilities. • To enhance leadership skills, and greater career success. • To be a more positive and confident personality
Course Contents:	**UNIT I Communication: An Introduction:** Definition, Nature and Scope of Communication, Importance and Purpose of Communication, Process of Communication, Types of Communication, Non-Verbal Communication, Personal Appearance, Gestures, Postures, Facial Expression, Eye Contacts, Body Language(Kinesics), Time language, Silence, Tips for Improving Non-Verbal Communication **(10 Hours)**
	UNIT II Verbal Communication (ORAL-AURAL): Purpose of Listening, Listening to Conversation (Formal and Informal), Active Listening- an Effective Listening Skill, Benefits of Effective Listening, Barriers to Listening, Academic Listening (Listening to Lectures), Listening to Talks and Presentations, Note Taking Tips **(10 Hours)**
	UNIT III Oral Communication Skills: Importance of Spoken English, Status of Spoken English in India, International Phonetic Alphabet(IPA) Symbols, Spelling and Pronunciation, Asking for and giving information, Offering and responding to offers, Requesting and responding to requests, Congratulating people on their success, Expressing condolences, Asking questions and responding politely, Apologizing and forgiving, Giving instructions, Seeking and giving permission Expressing opinions(likes and dislikes), Agreeing and disagreeing, Demanding explanations, Asking for and giving advice and suggestions, Expressing sympathy **(10 Hours)**

	UNIT IV Reading Skills: Purpose, Process, Methodologies, Skimming and Scanning, Levels of Reading, Reading Comprehension, Academic Reading Tips. **(10 Hours)**
	UNIT V Verbal Communication (Written): Effective Writing Skills, , Elements of Effective Writing (What is Writing?), The Sentence, Phrases and Clauses, Types of Sentences, Main Forms of Written Communication, Paragraph Writing (Linkage and Cohesion), Letter Writing(formal and informal), Essay writing, Notices, Summarizing, Précis Writing, Note-making, Report writing, paper writing. **(10 Hours)**
Textbook & Reference Books:	• How to Win Friends & Influence People" by Dale Carnegie and "The 7 Habits of Highly Effective People" by Stephen Covey. • Communication Skill and Personality development, by Abhinav Kumar (Author). • The Essential Communication Skills Toolbox, Kindle Edition, by Ziv Soferman (Author) Format: Kindle Edition • Personality Development and Soft Skills by Barun K. Mitra • Develop Self-Confidence, Improve Public Speaking by Dale Carnegie

SEMESTER II

Semester II
PCC524AID: Advance Deep Learning

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
PCC524AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• Introduce the concepts, architecture and limitations of neural networks • Provide foundational concepts of deep learning • Understand the concepts convolution neural networks • Familiarize with architectures of recurrent neural networks • Impart the knowledge of advanced applications of deep neural networks.
Course Outcome :	• Introduction of Perceptron, Fully Connected Layer, Neural Network, Optimization, Activation functions, AIDign of Output Layer, Error Calculation, Mean Square Error Function, Cross-Entropy Error Function, Convolutional • Neural Network, Recurrent Neural Network, Attention Mechanism Network, Graph Convolutional Neural Network • Backward Propagation Algorithm: Derivatives and Gradients, Common Properties of Derivatives, Derivative • of Activation Functions, Gradient of Loss Function, Gradient of Fully Connected Layer, Chain Rule, Back Propagation Algorithm.
Course Contents:	**UNIT I** Introduction of Perceptron, Fully Connected Layer, Neural Network, Optimization, Activation functions, AIDign of Output Layer, Error Calculation, Mean Square Error Function, Cross-Entropy Error Function, Convolutional Neural Network, Recurrent Neural Network, Attention Mechanism Network, Graph Convolutional Neural Network, Backward Propagation Algorithm: Derivatives and Gradients, Common Properties of Derivatives, Derivative of Activation Functions, Gradient of Loss Function, Gradient of Fully Connected Layer, Chain Rule, BackPropagation Algorithm. **(10 Hours)**
	UNIT II Model Capacity, Overfitting and Under fitting, Validation Set and Hyper parameters, Early Stopping, Model AIDign Regularization, Dropout, Data Augmentation, Convolutional Neural Networks: Problems with Fully Connected N, Local Correlation, Weight Sharing, Convolution Operation, Single-Channel Input and Single Convolution Kernel, Multi-channel Input and Single Convolution Kernel, Multi-channel Input and Multi-convolution Kernel, Stride Size, Padding, LeNet-5.

	(10 Hours)
	UNIT III Representation Learning, Gradient Propagation, Pooling Layer, Batch Norm Layer, Forward Propagation, Backward Propagation, AlexNet, VGG Series, GoogLeNet, Convolutional Layer Variants: Dilated/Atrous Convolution, Transposed Convolution, Separate Convolution, Deep Residual Network, DenseNet. **(10 Hours)**
	UNIT IV Recurrent Neural Network: Sequence Representation Method, Embedding Layer, Pre-trained Word Vectors, Recurrent Neural Network, Is a Fully Connected Layer Feasible?, Shared Weight, Global Semantics, Gradient Propagation, How to Use RNN Layers Simple RNN Cell, RNN Sentiment Classification, Gradient Vanishing and Gradient Exploding, Gradient Clipping, RNN Short-Term Memory, LSTM Principle, Forget Gate, Input Gate, Update Memory, Output Gate, GRU Introduction, Reset Door, Pre-trained Word Vectors, fundamentals of Sentiment Analysis. **(11 Hours)**
	UNIT V Autoencoder: Principle of Autoencoder, Encoder, Decoder, Autoencoder, Image Reconstruction, Autoencoder Variants Dropout Autoencoder, Adversarial Autoencoder, Variational Autoencoder, Principle of VAE, Reparameterization Trick, Generative Adversarial Networks: GAN Principle, Network Structure, Network Training, Unified Objective Function, Generator, GAN Variants, DCGAN, InfoGAN, CycleGAN, WGAN, Self- Attention GAN, BigGAN, Nash Equilibrium, Discriminator State, Generator State, GAN Training Difficulty: Hyperparameter Sensitivity, Model Collapse, WGAN Principle, Reinforcement Analysis **(101Hours)**
Textbook & Reference Books:	• Liangqu Long Xiangming Zeng, "Beginning Deep Learning with TensorFlow, First edition, Appress, 2022 • 2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning, Release 0.16.6, 2018.

Semester II

PCC525AID: Advance Natural Language Processing

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
PCC525AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• Develop competency to use the Python programming language. • Develop an appreciation for structures in natural language which computers are confronted with when processing natural language. • Learn various techniques under Natural Language Processing (NLP) to solve language processing problems. • Introduce frontier areas in NLP research.
Course Outcomes:	• Understand the basics of NLP • Apply the basic ML and DL techniques for NLP • Understand and realize the advanced NLP Techniques. • Understand the concept of NLU, NLG and apply the concept of Information Retrieval • Apply ethics to be followed while building NLP Applications and how to use NLP Libraries
Course Contents:	**Unit – I** Phases of NLP, Text Preprocessing: Tokenization, Stemming and Lemmatization, Pos Tagging, Named Entity Recognition. NLP Feature Engineering, Word Count Vector, Word Sense Disambiguation **(10 Hours)**
	Unit – II N -gram Models, Hidden Markov Models, Maximum Likelihood Estimation. Supervised, Unsupervised and Semi Supervised Learning. Text Classification and Sentiment Analysis, Topic Modelling and Clustering, Word Embeddings, RNN & LSTMs for NLP, CNN for NLP. **(10 Hours)**
	Unit – III Sequence- to -Sequence Models, Attention Mechanisms, Transformer Architecture: BERT, GPT **(10 Hours)**
	UNIT IV : Text Generation, Question Answering, Dialogue Systems and Chatbots. Machine Translation, Cross Lingual Transfer Learning. Text Indexing and Search, Text Summarization. **(11 Hours)**
	UNIT V Bias and Fairness in NLP, Privacy Concerns in NLP Applications. NP libraries: NLTK, Spacy, Tensor Flow, Pytorch. NLP Applications: Sentiment Analysis, Named Entity Recognition in Real World Data Sets, Text Classification for Various Domains. **(11 Hours)**
Textbook & Reference Books:	• Vijay Madisetti and Arshdeep Bahga, "Internet of Things: A Hands-on Approach", VPT, 1st edition, 2014.

	• James Allen, "Natural Language Understanding", 2nd Edition, Pearson Education, 2003. • Jurafsky, Dan and Martin, James, "Speech and Language Processing", 2nd Edition, Prentice Hall, 2008. • Matt Richardson & Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), Third Edition, 2016

Semester II

PEC551AID: PROGRAM SPECIFIC ELECTIVE COURSE (PEC-MDE)

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
PEC551AAID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

(Select any ONE)	
COURSE CODE	**TITLE**
PEC551AAID	Fuzzy Logic and Fuzzy Set
PEC551BAID	Artificial Intelligence in cyber security
PEC551CAID	Advance Data Mining
PEC551DAID	Cloud Data Management

PEC551AAID: Fuzzy Logic and Fuzzy Set	
Course Objectives:	• To understand fuzzy logic basics and operations. • To understand fuzzy arithmetic and representations and classical logic.
Course Outcomes:	• Understand automated methods for fuzzy systems. • Apply fuzzy logic for engineering problems.
Course Contents:	**UNIT I** Fuzzy Set: Introduction, uncertainty, Newtonian mechanics, Probability Theory, organized simplicity, disorganized complexity, trans computational problems. **(10 Hours)**
	UNIT II Crisp Sets: An overview, fuzzy sets: Basic types, basic concepts. Fuzzy sets versus crisp sets, additional properties of alpha-cuts, representations of fuzzy sets. **(10 Hours)**

	UNIT III Operations on Fuzzy sets: Types of operations, fuzzy complements, Fuzzy instructions: t-Norms. Fuzzy Unicons: t-co norms, combination of operations, aggregation operations. **(10 Hours)**
	UNIT IV Fuzzy Logic: Classical logic, logic, reasoning, propositional logic, logic operation's logic formulas, tautology, inference rules, Boolean algebra, properties of Boolean algebra, quantification, predicate logic, multi-valued logic, fuzzy propositions, fuzzy quantifiers, linguistic hedges. **(11 Hours)**
	UNIT V Inference from conditional Fuzzy propositions, Inference from conditional and quantified propositions. Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Model, Input space partitioning, Fuzzy modelling. **(11 Hours)**
Text Book Reference Books:	• Li Min Fu," Neural Networks in Computer Intelligence", 1st Edition, McGraw-Hill, Inc,1994. • George J Klir/Bo Yuan, "Fuzzy sets & Fuzzy Logic, Theory & Applications", 1st Edition, PHI, 2015. • S.R. Jang, C.T. Sun, E. Mizutani. "Neuro Fuzzy & Soft Computing: A Computational approach to learning & Machine Intelligence" J Pearson Education, 1996.

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCE	ESE				
PEC551BAID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

PEC551BAID :Artificial Intelligence in cyber security	
Course Objectives:	• To equip students realise the scope of artificial intelligence in preventing security threats. • To automate the process of detection using artificial intelligence tools • To give an overview to the intrusion techniques
Course Outcomes:	• Deploy artificial intelligence based solutions for preventing cyber attacks • Understand the basic underlying architecture used for intrusion detection • Understand the heuristic methods used for cyber security
Course Contents:	**UNIT I** Time series analysis, Stochastic time series model, ANN time series model, Support Vector time series models, Time series decomposition, Time series analysis in cybersecurity. Time series trends and seasonal spikes, Predicting DDoS attacks - ARMA, ARIMA, ARFIMA. Voting ensemble. **(10 Hours)**

	UNIT II Using data science to catch email fraud and spam, Anomaly detection using K-means, Using windows logs and active directory data. Decision tree and Context-based malicious event detection. Statistical and machine learning approaches to detection of attacks on computers - Techniques for studying the Internet and estimating the number and severity of attacks, network based attacks, host based attacks. Statistical pattern recognition for detection and classification of attacks, and techniques for visualizing network data, etc. **(10 Hours)**
	UNIT III Using heuristics to detect malicious pages, Using machine learning, logistic regression, and SVM to detect malicious URLs. Multiclass classification to detect malicious URLs. Levenshtein distance to differentiate malicious URLs from others. Using TensorFlow for intrusion detection. Machine learning to detect financial fraud - imbalanced data and credit card frauds, managing under- sampled data for logistic regression. Adam gradient optimiser for deep learning. Feature extraction and cosine similarity to quantify bad passwords. **(10 Hours)**
	UNIT IV Overview of intrusions, system intrusion process, dangers of system intrusions, history and state of the art of intrusion detection systems (IDSs): anomaly detection, misuse detection, types of IDS: Network- Based IDS. Host-Based IDS, Hybrid IDS. **(11 Hours)**
	UNIT V Intrusion Prevention Systems (IPS): Network-Based IPS, Host-Based IPS, Intrusion Detection Tools, the limitations and open problems of intrusion detection systems, advanced persistent threats, case studies of intrusion detection systems against real-world threats and malware. **(11 Hours)**
Text Book & Reference Books:	• Soma Halder, Sinan Ozdemir, "Hands-on Machine Learning for Cybersecurity", Packt Publishing. • Roberto Di Pietro, Luigi V. Mancini, Intrusion Detection System, Springer ,2008 • Anderson, Ross (2001). Security Engineering: A Guide to Building Dependable Distributed Systems. New York: John Wiley & Sons. pp. 387–388. ISBN 978-0-471-38922-4.

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCE	ESE				
PEC551CAID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

PEC551CAID:Advance Data Mining	
Course Objectives:	• 1 Deal with data issues that will be need for successful application of data mining • Select a suitable model for a given statistical problem and dataset • Understand statistical logic of data mining algorithms • Use advanced statistical and data mining computer software to analyse large data volumes • Implement models suitable for data analysis in some computer language
Course Outcomes:	• Understand the fundamentals in data mining. • Explore various classification techniques. • Implement clustering techniques and to apply it on various datasets. • Investigate several web and text mining techniques. • AIDcribe temporal and spatial data mining process.

Course Contents:	**UNIT I** Data mining Overview and Advanced Pattern Mining Data mining tasks – mining frequent patterns, associations and correlations, classification and regression for predictive analysis, cluster analysis , outlier analysis; advanced pattern mining in multilevel, multidimensional space – mining multilevel associations, mining multidimensional associations, mining quantitative association rules, mining rare patterns and negative patterns. **(10 Hours)**
	UNIT II Classification by back propagation, support vector machines, classification using frequent patterns, other classification methods – genetic algorithms, roughest approach, fuzzy set approach **(10 Hours)**
	UNIT III Advance Clustering: A: Density - based methods: DBSCAN, OPTICS, DENCLUE B: Grid-Based methods: STING, CLIQUE; Exception – maximization algorithm; clustering High- Dimensional Data; Clustering Graph and Network Data. **(10 Hours)**
	UNIT IV Introduction, web mining, web content mining, web structure mining, we usage mining, Text mining – unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering. **(11 Hours)**
	UNIT V Introduction; Temporal Data Mining – Temporal Association Rules, Sequence Mining, GSP algorithm, SPADE, SPIRIT Episode Discovery, Time Series Analysis, Spatial Mining – Spatial Mining Tasks, Spatial Clustering. Data Mining Applications. **(11 Hours)**
Text Books Reference Books:	• Jiawei Hang Micheline Kamber, Jian pei, Morgan Kaufmannn, "Data Mining Concepts and Techniques. • Arun K Pujari, "Data Mining Techniques", Universities Press. 35. • Advanced Data Mining & Applications, Jie Tang, Irwin King, Ling Chen, Jianyong Wang, Springer. • Advanced Data Mining Techniques, David L. Olson, Dursun Delen, Springer.

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCE	ESE				
PEC551DAID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

PEC551DAID:Cloud Data Management	
Course Objectives:	• Use Cloud-Based software services by comprehending the cloud Computing Architecture. • Configure Virtual Machines using Virtualization techniques. • Implement Virtualized storage system in Cloud. • Use Machine Learning algorithms in Cloud Environment. • Deploy Machine Learning Models on Cloud.
Course Outcome :	• Demonstrate the concepts and technologies of Cloud Computing • Understand the security aspects associated with Cloud Computing • Manage cloud infrastructure in terms of organisation, scale, and security. • Demonstrate the virtual server component of Cloud Computing • Understand Cloud storage and usage monitoring along with security mechanism
Course Contents:	**UNIT I** Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and AIDign, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures. Scalability and Cloud Services- Large Scale Data Processing- Databases and Data Stores- Data Archival. **(10 Hours)**
	UNIT II Data Security - Storage strategy and governance; security and regulations. AIDigning secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments. Monitoring and management; security auditing and SIEM. **(10 Hours)**
	UNIT III Data Location and Control - Architecture of storage, analysis and planning. Storage network AIDign considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), AIDign for storage virtualization in cloud computing, host system AIDign considerations. **(10 Hours)**

	UNIT IV Global storage management locations, scalability, operational efficiency. Global storage distribution; terabytes to petabytes and greater. Policy based information management; metadata attituAID; file systems or object storage. **(11 Hours)**
	UNIT V Securing data for transport, AIDigning backup/recovery solutions to guarantee data availability in a virtualized environment. AIDign a replication solution, local remote and advanced. Investigate Replication in NAS and SAN environments. Data archiving solutions; analyzing compliance and archiving AIDign considerations. **(11 Hours)**
Text Book & Reference Books:	• Cloud data management, Liang Zhao, Sherif Sakr Anna Liu, Athman Bouguettaya, Springer • Cloud data development and Management, Lee Chao, CRC Press. • Data management in the Cloud: Challenged and Opportunities, Divyakanth Agarwal, Sudipto Das, Amr El Abbadi, Morgan & Claypool Publishers. • Data Management in the Cloud, George Bowlin, Create Space Independent Publisher.

Semester II

LC532AID: Advanced Artificial Intelligence & Data Science Laboratory

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
LC532AID	--	--	--	50	50	100	2

Course Objectives:	• To AIDign and implement search strategies • To implement game-playing techniques • To implement CSP techniques • To develop systems with logical reasoning • To develop systems with probabilistic reasoning
Course Objective	• Classify given problem and identify the need of intelligent agent. • Apply appropriate search-based method for a given problem. • Make suitable modifications to programs as per user requirements for solving real world problems • Analyze various AI approaches to knowledge– intensive problem solving, reasoning and planning. • AIDign an expert system for a given AI problem
Course Contents:	Solve any 5 1. Implement basic search strategies – 8-Puzzle, 8 – Queens problem, Crypt arithmetic. 2. Implement A* and memory-bounded A* algorithms. 3. Implement Minimax algorithm for game playing (Alpha-Beta pruning). 4. Solve constraint satisfaction problems. 5. Implement propositional model-checking algorithms. 6. Implement forward chaining, backward chaining, and resolution strategies. 7. Build naïve Bayes models. 8. Implement Bayesian networks and perform inferences. 9. Mini-Project.

Semester II

AEC561AID: Research Methodology and IPR

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
AEC561AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• Understand the fundamentals of research methodology, formulation of research problems, and AIDign of experiments. • Develop the ability to conduct literature reviews, use research tools, and interpret data. • Understand ethical issues in research, technical writing, and publishing. • Familiarize students with Intellectual Property Rights and patent laws. • Understand the process of patenting, IP commercialization, and protection of innovations.
Course Outcomes:	• Understand research fundamentals, problem formulation, and research process • AIDign research studies and apply appropriate data collection and analysis methods
Course Contents:	**UNIT I Introduction to Research Methodology** Meaning and objectives of research, Types of research: basic, applied, qualitative, quantitative, empirical, exploratory, Research process and flowchart, Research problem formulation and hypothesis development, Characteristics of good research Defining research objectives and scope **(10 Hours)**
	UNIT II Research AIDign and Data Collection Types of research AIDign: experimental, AIDcriptive, exploratory, Sampling techniques and sample size determination, Methods of data collection: primary and secondary data, surveys, interviews, case studies, Measurement scales, validity, and reliability, Overview of statistical tools (mean, SD, correlation, regression) **(10 Hours)**
	UNIT III Technical Writing and Research Ethics Structure and components of research reports, thesis, and papers, Writing style: clarity, precision, citations, referencing (APA/IEEE), Plagiarism, paraphrasing, and tools for plagiarism detection, Ethical issues in research: data fabrication, falsification, conflict of interest, Peer review process and publication ethics **(10 Hours)**

	UNIT IV Introduction to IPR and Patent System Introduction to Intellectual Property Rights (IPR): types and importance, Patents, copyrights, trademarks, industrial AIDigns, trade secrets, Indian and global patent systems: WIPO, TRIPS, WTO, Patentability criteria: novelty, inventive step, industrial application, Non-patentable inventions in India **(11 Hours)**
	UNIT V Patent Filing and IPR Management Patent search and drafting basics (claims, specifications), Patent filing procedure (India and PCT routes), Infringement and litigation, Technology transfer, licensing, and commercialization, Role of IPR in academia and industry, Case studies on patents and technology innovation **(11 Hours)**
Text Book & Reference Books:	• C.R. Kothari, Research Methodology: Methods and Techniques, New Age International, 2004 • Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*, Sage Publications, 4th Edition • Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, Sage Publications, 4th Edition • Wayne Goddard & Stuart Melville, *Research Methodology: An Introduction* • Yogesh Kumar Singh, *Fundamental of Research Methodology and Statistics*, New Age • Prabuddha Ganguli, *Intellectual Property Rights: Unleashing the Knowledge Economy*, Tata McGraw Hill

Semester II
OE: OPEN ELECTIVE

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
OE571AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

(Select any ONE)	
COURSE CODE	**TITLE**
OE573CON	Organizational Ethics and Human Resource Management
OE571CEE	Economics of Innovation
OE573STR	Financial Management
OE571PED	Entrepreneurship Development

OE573CON: ORGANIZATIONAL ETHICS AND HUMAN RESOURCE MANAGEMENT	
Course Objectives:	1. To introduce fundamental concepts of Human Resource Management. 2. To introduce the processes pertaining to different functions of HRM. 3. To introduce the recent trends with respect to global HRM.
Course Contents:	**UNIT I ORGANIZATIONAL ETHICS (10 Hrs)** • Introduction to Organizational Ethics: Definition, scope, and significance in engineering and technology-driven organizations; distinction between legal compliance and ethical responsibility. • Ethical Theories and Frameworks: Overview of utilitarianism, deontology, virtue ethics; application of ethical principles to engineering decision-making and dilemmas. • Ethical Leadership: Role of leadership in shaping ethical behavior; ethical decision-making by managers; ethical influence and personal integrity in leadership.

	UNIT II Governance, Culture, and Stakeholder Ethics (10 Hrs) • Corporate Governance: Principles of transparency, accountability, and ethical oversight; governance structures in engineering organizations. • Ethical Culture and Infrastructure: Organizational culture, coAID of conduct, ethics committees, whistleblowing mechanisms, and compliance frameworks. • Stakeholder Ethics and CSR: Stakeholder theory; corporate social responsibility (CSR); ethical challenges in supply chains, sustainability, and technological innovation.
	UNIT III Introduction to Human Resource Management (10 Hrs) Introduction, Development of HRM, Concept of Human Resource Development (HRD)& HRM, Importance of Human Resource Management., Functions of Human Resource Management., Role of HR Manager, Structure of HRM Department, Duties and Responsibilities of HR-Manager.
	UNIT IV Manpower Planning And Recruitment And Selection (11 Hrs) Definition and objectives, Need, Importance of Human Resource Planning: Short term and Long term, Process of Human Resource Planning, Concept of Recruitment, Importance of Recruitment, Sources of Recruitment, Concept of Selection, Importance of selection, Selection Tests and Types of Interviews, Facing Interviews, Basis of Selection, Induction
	UNIT V Training And Development And Performance Appraisal (11 Hrs) Definition of Training and Development, Methods & Types of Training, Objectives and Importance of Training, Training Methods, Evaluation of Training Programme, Models of Evaluation, Cross-Cultural Training, Concept of Management Development, Concept of Performance Appraisal, Importance of Performance Appraisal, Methods of Performance Appraisal, Errors of Appraisal. Merit Rating: Need, and Methods, Job Evaluation, Job AIDcription, Movement of human resources within organization (Promotion, Transfer, Job Enlargement, Job Enrichment, Job rotation, Job Sharing.)

Reference Books:	• Mike W. Martin & Roland Schinzinger, *Ethics in Engineering*, McGraw-Hill Education • Charles D. Fleddermann, *Engineering Ethics*, Pearson Education • Laura P. Hartman & Joe AIDJardins, *Business Ethics: Decision Making for Personal Integrity and Social Responsibility*, McGraw-Hill Education • Gary AIDsler, *Human Resource Management*, Pearson Education • V.S.P. Rao, *Human Resource Management: Text and Cases*, Excel Books • K. Aswathappa, *Human Resource Management*, McGraw-Hill Education • Michael Armstrong, *A Handbook of Human Resource Management Practice*, Kogan Page

OE571CEE : ECONOMICS OF INNOVATION	
Course Objectives:	• To understand the role of innovation in economic growth and industrial competitiveness. • To explore the economics behind R&D investment, knowledge spillovers, and intellectual property. • To analyze innovation systems, market structures, and technology policy. • To equip students with economic tools to evaluate innovation strategies in firms and nations. • To understand the relationship between innovation, entrepreneurship, and sustainability.
Course Contents:	**UNIT I Introduction to Innovation and Economic Growth (10 Hrs)** Definitions: Innovation, invention, diffusion, and R&D, Schumpeterian theory of innovation and creative AIDtruction, Innovation and productivity growth, Linear and non-linear models of innovation, Historical evolution of industrial innovation (1st to 5th industrial revolution)
	UNIT II Economics of R&D and Firm-Level Innovation (10 Hrs) R&D as an investment: uncertainty, risk, and returns, Firm size, market structure, and innovation behavior, Patents, licensing, and appropriability of innovation, Internal vs external sources of innovation (open innovation), Innovation in SMEs and startups
	UNIT III Knowledge Spillovers, Networks, and IPRs (10 Hrs) Knowledge as a public good and externalities, Spillovers and clustering (Silicon Valley, innovation hubs), IPRs: patents, copyrights, trade secrets – economic rationale and impact, Innovation networks and collaboration: universities, labs, firms, Limitations of strong IPR regimes – TRIPS, patent races

	UNIT IV National Innovation Systems and Policy Instruments (11 Hrs) National and regional innovation systems (NIS/RIS),Role of government: subsidies, tax incentives, regulation, Innovation policy tools: mission-oriented R&D, public procurement, standards, International comparison: US, EU, India, China, Japan, Evaluation of public R&D programs and innovation outcomes
	UNIT V Innovation, Entrepreneurship, and Emerging Issues (11 Hrs) Innovation and entrepreneurship: Schumpeter vs Kirzner, Disruptive innovation and business model innovation, Innovation and sustainable development (green innovation, social innovation), Digital economy, platform innovation, and Industry 4.0, Inclusive innovation, frugal innovation, and innovation in developing countries
Reference Books:	1. Fagerberg, Jan, Mowery, David C., and Nelson, Richard R. *The Oxford Handbook of Innovation* – Oxford University Press 2. Schumpeter, Joseph A.*Capitalism, Socialism and Democracy* – Harper 3. Martin, Ben R. *Research and Innovation: Concepts, Theories and Perspectives* – Edward Elgar Publishing 4. Nathan Rosenberg *Inside the Black Box: Technology and Economics* – Cambridge University Press 5. Hall, Bronwyn H., and Rosenberg, Nathan (Eds.) *Handbook of the Economics of Innovation* – Elsevier 6. Freeman, Christopher *Technology Policy and Economic Performance: Lessons from Japan* – Pinter Publishers 7. OECD Reports – *Science, Technology and Innovation Outlook* (Latest Editions), www.oecd.org/sti 8. World Intellectual Property Organization (WIPO) – *Global Innovation Index Report*

OE573STR: FINANCIAL MANAGMENT	
Course Objectives:	**By the end of this course, students will be able to:** • Understand the principles of financial management and their relevance to engineering projects. • Learn financial planning, budgeting, and risk analysis methods tailored to engineering projects. • Gain knowledge of project financing options, working capital management, and cash flow forecasting. • Apply cost control techniques and financial appraisal tools in Engineering projects.

	• Analyze financial performance, make informed decisions under uncertainty, and evaluate real-world case studies.
Course Contents:	**Unit1:** Introduction to Financial Management: Scope and objectives of financial management, Functions and role of financial manager in engineering organisations, Financial statements: balance sheet, income statement, cash flow statement. Ratio analysis: liquidity, profitability, solvency, and efficiency ratios. Time value of money: Present value, future value, annuity. **(10 Hours)**
	Unit2: Financial Planning and Budgeting for Projects: Project cost estimation and budgeting methods, Preparation of detailed project reports (DPR), Risk analysis in financial planning, Capital budgeting: Payback period, NPV, IRR, benefit-cost ratio, Engineering project investment evaluation examples. **(10 Hours)**
	Unit3: Project Financing and Working Capital Management: Capital structure: concepts, theories, and practical considerations. Long-term and short-term sources of finance, Sources of finance: Equity, debt, bonds, leasing, Public-Private Partnerships (PPP), Venture capital, start-up funding, and project financing in technology sectors. Working capital: Meaning, need, determinants, cash flow forecasting and fund flow analysis. **(10 Hours)**
	Unit 4: Cost Control and Financial Appraisal: Cost control techniques: Earned Value Management (EVM), S-curve, Break-even analysis and profitability analysis. Internal financial audits and reporting. Accounting systems and cost coAID. Introduction to fintech, blockchain, and digital payment systems in industry **(11 Hours)**
	Unit5: Financial Decision-Making and Case Studies: Investment analysis for infrastructure and structural projects. Financial performance indicators: ROI, ROE, profitability ratios. Decision-making under uncertainty. Case studies: Financial failures and success in major projects, Real-world examples of financial decision making in engineering firms. **(11 Hours)**

Reference Books:	• Prasanna Chandra, Financial Management: Theory and Practice, McGraw-Hill • Leland Blank & Anthony Tarquin, Engineering Economy, McGraw-Hill • Harold Kerzner, Project Management: A Systems Approach, Wiley • I.M. Pandey, Financial Management, Vikas Publishing • Bhabatosh Banerjee, Fundamentals of Financial Management, PHI • M.Y. Khan & P.K. Jain, Financial Management, Tata McGraw-Hill

OE571PED: ENTREPRENEURSHIP DEVELOPMENT	
Course Objectives:	• To develop an entrepreneurial mindset among postgraduate engineering students. • To equip students with knowledge of business planning, funding, and venture creation. • To familiarise students with innovation, IPR, and start-up ecosystem relevant to technology ventures. • To prepare students for launching and managing sustainable enterprises.
Course Contents:	**Unit I: Introduction to Entrepreneurship (10 Hours)** • Concept and definition of entrepreneurship • Types of entrepreneurs: technopreneurs, social entrepreneurs, intrapreneurs • Characteristics of successful entrepreneurs • Role of entrepreneurship in economic development • Barriers to entrepreneurship and strategies to overcome them • Entrepreneurial ecosystem in India – national and state-level initiatives
	Unit II: Entrepreneurial Motivation and Opportunity Identification (10 Hours) • Creativity, innovation, and idea generation techniques • Opportunity identification and evaluation • Market research for business ideas • Feasibility analysis: technical, financial, and market feasibility • Case studies of technology-based start-ups
	Unit III: Business Planning and Project Management (10 Hours) • Components of a business plan • Preparing business models using tools like Business Model Canvas (BMC) • Basics of project planning and scheduling (PERT, CPM) • Risk assessment and mitigation in start-up ventures • Cost estimation and break-even analysis for start-ups
	Unit IV: Funding and Financial Management for Entrepreneurs (12 Hours) • Sources of finance: self-financing, angel investors, venture capital, bank loans, government schemes • Crowd funding and alternative financing • Basics of financial statements for entrepreneurs

	• Working capital management in start-ups • Pricing strategies for products and services
	Unit V: Scaling, Sustainability, and Emerging Trends in Entrepreneurship (10 Hours) • Scaling up: growth strategies for start-ups • Social and green entrepreneurship • Entrepreneurship for Industry 4.0 and emerging technologies • Role of incubators, accelerators, and innovation hubs • Contemporary trends: digital entrepreneurship, gig economy, and platform-based business models
Reference Books:	• S.S. Khanka, *Entrepreneurial Development*, S. Chand Publishing. • Vasant AIDai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House. • Hisrich, R.D., Peters, M.P., and Shepherd, D.A., Entrepreneurship, McGraw-Hill Education. • Donald F. Kuratko, Entrepreneurship: Theory, Process, and Practice, Cengage Learning. • Peter F. Drucker, Innovation and Entrepreneurship, Harper Business. • Rajeev Roy, Entrepreneurship, Oxford University Press. • David H. Holt, Entrepreneurship: New Venture Creation, Prentice Hall of India. • Poornima M. Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education.
Course Outcomes	Upon completion of the course, students will be able to: 1. Explain the fundamentals of entrepreneurship and the entrepreneurial ecosystem. 2. Identify and evaluate potential business opportunities. 3. Prepare business plans and manage projects effectively. 4. Select appropriate funding sources and manage start-up finances. 5. Implement growth strategies and adapt to emerging trends in entrepreneurship.

Semester II
MLC542AID: Sustainable Engineering and Circular Economy

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
MLC542AID (Non-credit)	**2**	**50**	**50**	**--**	**--**	**100**	**--**

Course Objectives:	• Understand the relevance and the concept of sustainability and the global initiatives • Explain the different types of environmental pollution problems and their sustainable Solutions • Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles • Contrive skilled manpower and entrepreneurship in the field of Circular Economy • Enhance interaction of students with the senior/experienced manpower who have real time knowledge / experience in the technology development, research, innovation, entrepreneurship deployment and circular business models
Course Contents:	**UNIT I** Sustainability- need and concept, technology and sustainable Development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable urbanization, concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection. **(10 Hours)**
	UNIT II Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM). Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R, Circular economy, Bio-mimicking, Environment Impact Assessment (EIA) **(10 Hours)**
	UNIT III

	Resources and its utilization: General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy. Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in thermal utilities and electrical utilities. **(10 Hours)**
	UNIT IV Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs Circular Economy Material recovery, Waste Reduction, reducing negative externalities, Explaining Butterfly diagram, Concept of Loops **(11 Hours)**
	UNIT V Solid Waste Management / Wastewater, Plastics: A case study, EPR: polluters pay principle, Industrial symbiosis/ Eco-parks Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG, Zero waste: Waste Management in context of Circular Economy, Circular AIDign, Circular Business Models **(11 Hours)**
Reference Books:	• Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, AIDign and Case Studies, Prentice Hall. • Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable AIDign and development, Cengage learning • Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS). • Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication • The Circular Economy Handbook: Realizing The Circular Advantage , Peter Lacy, Jessica Long, , Wesley Spindler , Palgrave Macmillan UK • Towards Zero Waste: Circular Economy Boost, Waste to Resources María-Laura Franco-García, Jorge Carlos Carpio-Aguilar, Hans Bressers. Springer International Publishing 2019 • Circular Economy: Global Perspective Sadhan Kumar Ghosh, Springer, 2020 • The Circular Economy A User's Guide, Walter R Stahel , Routledge; 1st Edition (24 June 2019)

	• Circular Economy: (Re) Emerging Movement , Shalini Goyal Bhalla , Invincible Publisher
Course Outcomes:	• Understand the relevance and the concept of sustainability and the global initiatives in this Direction • Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles • Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles • Use the principles of circularity for application to sustainable development • Apply complexity aspects of circular economy for creating circular business models

SEMESTER III

Semester III
VSE611AID: Dissertation Phase – I

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Pr Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
VSE611AID	**15**	**--**	**--**	**100**	**50**	**150**	**6**

DISSERTATION WORK:

The dissertation work shall be based on the knowledge acquired by the student during the coursework and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Dissertation Phase – I

Dissertation Phase – I is the integral part of the project Work. In this, the student shall complete the partial work of the Project that will consist of problem statement, literature review, project overview, scheme of implementation (UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. The candidate shall deliver a presentation as a part of the progress report of Project work Stage-I, on the selected dissertation topic.

The student shall submit the progress report of Project Work Stage-I in standard format duly certified for satisfactory completion of the work by the concerned guide. The report must undergo plagiarism screening using anti-plagiarism software, and the similarity index shall not exceed 25%.

Semester III

SLC621AID: Massive Open Online Course -I

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
SLC621AID	**3**	**50**	**50**	**--**	**--**	**100**	**4**

Students shall select a MOOC course related to current trends in their respective engineering discipline, preferably aligned with their area of specialization. The course must be at the postgraduate level and should be selected in consultation with the assigned guide and approved by the designated authority. It may be taken from recognized MOOC platform such as NPTEL. Students are required to submit hard copies of all course assignments. The student is expected to register for the examination and obtain the certificate from competent authority.

Evaluation Guidelines: Students will be evaluated progressively for a total 100 Marks.

Sr. No.	Parameter	Marks
1	Presentation of the Selected topic	20
2	Assignment Scores	50 (The total marks obtained in the assignments shall be proportionally converted to an equivalent score out of 50.)
3	Certification Granted Based on the MOOC Provider's Examination	30
Total Marks		**100**

Semester III

VSE-612-DES: Internship/On Job Training

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Pr Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
VSE612AID	**16**	**--**	**--**	**100**	**100**	**200**	**8**

TERNSHIP/ ON JOB TRAINING:

Each student shall undertake an internship/ On job training of **8–10 weeks** in an industry, research institute, or consultancy firm under the guidance of an allocated faculty supervisor. The faculty guide shall be responsible for monitoring and evaluating the student's progress, in coordination with the industry/research supervisor.

Students must maintain a detailed project diary recording tasks performed, data collected, observations made, and challenges encountered. Progress shall be demonstrated through regular reporting, presentations, and proper documentation. The student is required to meet with the institute supervisor fortnightly to discuss and record progress.

Three progress reviews will be conducted during the internship:

Review–I: Understanding of the organization, assigned tasks, and work plan. (20 Marks)

Review–II: Mid-term progress, skill application, and problem-solving approach. (20 Marks)

Review–III: Completion status, demonstration of outcomes, and final feedback. (20 Marks)

The documentation comprising training report, project diary will carry 40 Marks.

Upon completion, the student shall submit a comprehensive internship report summarizing skills acquired, activities undertaken, challenges faced, and results achieved. A completion certificate from the host organization is mandatory. The final evaluation will be based on the internship report, feedback from the industry/research guide, and an oral examination.

Semester III

MLC643AID: HUMAN RIGHTS

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
MLC643AID	2	50	--	--	--	50	2

Course Objectives:	• Understand the concept, evolution, and values underpinning human rights. • Learn constitutional provisions and state mechanisms for human rights in India. • Recognize human rights issues in social, industrial, and engineering contexts. • Appreciate the role of citizens, NGOs, and civil society in protecting rights. • Gain awareness of international human rights instruments and systems.
Course Outcomes:	On completion, students will be able to: • Explain the foundations and values of human rights. • Interpret constitutional safeguards for human rights in India. • Evaluate the role of state institutions in rights protection. • Analyze human rights challenges in industrial and environmental contexts. • Assess the role of citizens and NGOs in human rights advocacy. • Compare national and international human rights frameworks.
Course Contents:	**UNIT I Human Rights – Concept, Development, Evolution** Basic Concept: a) Human Values- Dignity, Liberty, Equality, Justice, Unity in Diversity, Ethics and Morals, b) Meaning and significance of Human Rights; Education Philosophical, sociological and political debates, benchmarks of human rights movement. **(6 Hours)**
	UNIT II Human Rights and the Indian Constitution Constitutional framework, Fundamental Rights & Duties, Directive Principles of State Policy, Welfare State & Welfare Schemes **(6 Hours)**
	UNIT III Human Rights & State Mechanisms Police & Human Rights, Judiciary & Human Rights, Prisons & Human Rights, National and State Human Rights Commissions **(6 Hours)**

	UNIT IV Human Rights of the Different Sections and contemporary issues Unorganized Sector, Right to Environment, particularly Industrial sectors of Civil Engineering and Mechanical Engineering, Globalization and Human Rights, Right to Development **Citizens' Role and Civil Society** Social Movements and Non-Governmental Organizations, Public Interest Litigation, Role of Non-Government organizations in implementation of Human rights. - Right to Information **(6 Hours)**
	UNIT V Human Rights and the international scene Primary Information with reference to Engineering Industry, UN Documents, International Mechanisms (UN & Regional), International Criminal Court, Fundamental Rights & Duties, Directive Principles of State Policy, Welfare State & Welfare Schemes **(6 Hours)**
Reference Books:	• Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing • Human Rights in India: A Mapping, Usha Ramanathan: free download from http://www.ielrc.org/content/w0103.pdf • Study material on UNESCO, UNICEF web site • Information, by Toby Mendel - UNESCO, 2008

Semester III
MLC602DES: Introduction to Constitution

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
MLC601AID	2	50	--	--	--	50	2

Course Objectives:	This course introduces students to the Constitution of lndia. The Constitution, being supreme law of the land, must be known to every citizen of India. It begins with the Preamble, which indicates the source and objects of it. We, the people of India, are the source of the Constitution and have resolved to constitute India into a sovereign, socialist, secular, democratic and republic. The Course has been designed for everyone to make acquaint themselves with their fundamental rights and of others. No right is absolute one; it is subject to others right, as well. Directive Principles of State Policy are nothing but rights, though not enforceable by any court. These Directive Principles are basically ' Fundamental Principles' in the governance of the country. Powers and freedoms come with responsibility, State's responsibility to implement Directive Principles and citizens must perform their duties towards others, society and nation.
Course Outcomes:	• To introduce the philosophy of Constitution of India to students. • To acquaint them with their freedoms and responsibilities.
Course Contents:	**UNIT I: PHILOSOPHY OF THE INDIAN CONSTITUTION** a) Constitutional History of India b) Role of Dr. B.R. Ambedkar in Constituent Assembly c) Preamble - Source and Objects d) Sovereign and Republic e) Socialist and Secular f) Democratic - Social and Economic Democracy g) Justice - Social, Economic and Political h) Liberty - Thought, Expression, Belief, Faith and 'vVorship i) Equality - Status and Opportunity j) Fraternity, Human Dignity, Unity and Integrity of the Nation **(07 Hours)**
	UNIT 2: FUNDAMENTAL RIGHTS **.**a) Right to equality b) Right to freedoms c) Right against exploitation d) Right to freedom of religion e) Cultural and educational rights f) Right to property g) Right to constitutional remedies **(07 Hours)**
	UNIT 3: DIRECTIVE PRINCIPLES OF STATE POLICY

	a) Equal Justice and free legal aid b) Right to work and provisions for just and humane conditions of work c) Provision for early childhood, Right to education and SC,ST, weaker section d) Unifonn Civil Code e) Standard of Living, nutrition and public health f) Protection and improvement of environment g) Separation of Judiciary from executive h) Promotion of International peace and security. **(08 Hours)**
	UNIT 4: FUNDAMENTAL DUTIES a) Duty to abide by the Constitution b) Duty to cherish and follow the noble ideals c) Duty· to defend the country and render national service d) Duty to value and preserve the rich heritage of our composite culture e) Duty to develop scientific temper, humanism ,the spirit of inquiry & reform f) Duty to safeguard public prope1ty and abjure violence g) Duty to strive towards excellence. **(08 Hours)**
Reference Books:	• D. D. Basu, Introduction to the Constitution of India, LexisNexis • Granville Austin, The Constitution of India: Cornerstone of a Nation, Oxford University Press • Subhash Kashyap, Our Constitution, National Book Trust • M.P. Jain, Indian Constitutional Law, LexisNexis • V.N.Slmkla, Constitution of lndia, Eastern Book Company • P.M. Bakshi, The Constitution of India, Universal Law Publishing • M.V.Pylee, Constitutional Government in India, S. Chand • V. S. Khare, Dr. B.R.Ambedkar and India's National Security

Semester III
SLC621AID: Massive Open Online Course -I

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
SLC621AID	**3**	**50**	**50**	**--**	**--**	**100**	**3**

MOOC COURSE SELECTION AND EVALUATION GUIDELINES:

Students shall select a MOOC course related to current trends in their respective engineering discipline, preferably aligned with their area of specialization. The course must be at the postgraduate level and should be selected in consultation with the assigned guide and approved by the AIDignated authority. The course duration expected is minimum 8 weeks. It may be taken from recognized MOOC platform such as NPTEL/Course era/Udemy. Students are required to submit hard copies of all course assignments. The student is expected to register for the examination and obtain the certificate from competent authority.

Evaluation Guidelines and Rubrics:

- Students will be evaluated progressively for a total 100 Marks.

Sr. No.	Rubrics	Marks
1	Presentation of the Selected topic	20
2	Assignment Scores	50
3	Certification Granted Based on the MOOC Provider's Examination	30
Total Marks		**100**

Semester III
MMC-602-AID: Introduction to Constitution

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
MMC-601-AID	2	50	--	--	--	50	2

Course Objectives:	This course introduces students to the Constitution of lndia. The Constitution, being supreme law of the land, must be known to every citizen of India. It begins with the Preamble, which indicates the source and objects of it. We, the people of India, are the source of the Constitution and have resolved to constitute India into a sovereign, socialist, secular, democratic and republic. The Course has been AIDigned for everyone to make acquaint themselves with their fundamental rights and of others. No right is absolute one; it is subject to others right, as well. Directive Principles of State Policy are nothing but rights, though not enforceable by any court. These Directive Principles are basically ' Fundamental Principles' in the governance of the country. Powers and freedoms come with responsibility, State's responsibility to implement Directive Principles and citizens must perform their duties towards others, society and nation.
Course Outcomes:	• To introduce the philosophy of Constitution of India to students. • To acquaint them with their freedoms and responsibilities.
Course Contents:	**UNIT I: PHILOSOPHY OF THE INDIAN CONSTITUTION** a) Constitutional History of India b) Role of Dr. B.R. Ambedkar in Constituent Assembly c) Preamble - Source and Objects d) Sovereign and Republic e) Socialist and Secular f) Democratic - Social and Economic Democracy g) Justice - Social, Economic and Political h) Liberty - Thought, Expression, Belief, Faith and 'vVorship i) Equality - Status and Opportunity j) Fraternity, Human Dignity, Unity and Integrity of the Nation **(07 Hrs)**
	UNIT 2: FUNDAMENTAL RIGHTS **.**a) Right to equality b) Right to freedoms c) Right against exploitation d) Right to freedom of religion e) Cultural and educational rights f) Right to property g) Right to constitutional remedies**(07 Hrs)**

	UNIT 3: DIRECTIVE PRINCIPLES OF STATE POLICY a) Equal Justice and free legal aid b) Right to work and provisions for just and humane conditions of work c) Provision for early childhood, Right to education and SC,ST, weaker section d) Unifonm Civil Code e) Standard of Living, nutrition and public health f) Protection and improvement of environment g) Separation of Judiciary from executive h) Promotion of International peace and security.
	UNIT 4: FUNDAMENTAL DUTIES (08 Hrs) a) Duty to abide by the Constitution b) Duty to cherish and follow the noble ideals c) Duty· to defend the country and render national service d) Duty to value and preserve the rich heritage of our composite culture e) Duty to develop scientific temper, humanism, the spirit of inquiry & reform f) Duty to safeguard public prope1ty and abjure violence g) Duty to strive towards excellence. **(08 Hrs)**
Reference Books:	• D. D. Basu, Introduction to the Constitution of India, LexisNexis • Granville Austin, The Constitution of India: Cornerstone of a Nation, Oxford University Press • Subhash Kashyap, Our Constitution, National Book Trust • M.P. Jain, Indian Constitutional Law, LexisNexis • V.N.Slmkla, Constitution of lndia, Eastern Book Company • P.M. Bakshi, The Constitution of India, Universal Law Publishing • M.V.Pylee, Constitutional Government in India, S. Chand • V. S. Khare, Dr. B.R.Ambedkar and India's National Security

SEMESTER IV

Semester IV
VSE613AID: Dissertation Phase – II

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Pr.Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
VSE613AID	**24**	**--**	**--**	**200**	**100**	**300**	**12**

Dissertation Phase – II, the student shall complete the balance part of the Project that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis & validation of results and conclusions.

e student shall prepare the final report of Project work in standard format duly certified for satisfactory completion of the work by the concerned guide. The dissertation must undergo plagiarism screening using anti-plagiarism software, and the similarity index shall not exceed 25%. It is mandatory to publish **one paper in conference** and **one paper in peer reviewed journal** before submission of the dissertation.

Semester IV
SLC622AID: Massive Open Online Course -II

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	Lect/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
SLC622AID	**4**	**--**	**--**	**100**	**--**	**100**	**4**

Students shall select a MOOC course related to current trends in their respective engineering discipline, preferably aligned with their area of specialization. The course must be at the postgraduate level and should be selected in consultation with the assigned guide and approved by the designated authority. It may be taken from recognized MOOC platform such as NPTEL. Students are required to submit hard copies of all course assignments. The student is expected to register for the examination and obtain the certificate from competent authority.

Evaluation Guidelines: Students will be evaluated progressively for a total 100 Marks.

Sr. No.	Parameter	Marks
1	Presentation of the Selected topic	20
2	Assignment Scores	50 (The total marks obtained in the assignments shall be proportionally converted to an equivalent score out of 50.)
3	Certification Granted Based on the MOOC Provider's Examination	30
Total Marks		**100**

Semester IV
CCA-631-AID: Co-curricular & Extracurricular Activities

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	PR/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
CCA-631-AID	**4**	--	--	**50**	**50**	**100**	**2**

Students are expected to OPT one out of the following:

- Seminar on any advanced topic selected from program specific elective.

  Guidelines:

  - Topic Selection: Choose a recent/advanced topic from the elective list, approved by guide; no duplication allowed.
  - Report: 8–12 pages, Times New Roman 12pt, 1.5 spacing; include Abstract, Introduction, Literature Review (minimum 15-20 papers from peer reviewed journals), Main Content, Future Scope, References (IEEE/APA); plagiarism < 20%.
  - Presentation: 12–15 min + 5 min Q&A; 10–15 slides; clear visuals; proper citations.
  - Submission: Hard & soft copy (PPT + PDF) before presentation.

  TW Evaluation (50 Marks):

Sr. No.	Parameter	Marks
1	Literature Review & Understanding	15
2	Content Quality	10
3.	Report & Writing	10
4.	Presentation	10
5.	Question and answers	05
Total Marks		**50**

- Present and publish a paper in a reputed conference (IEEE/Scopus/ASME) and submit a certificate.
- Patent filling. (Presentation based on patent to be prepared and presented.). The student must produce documents related to patent filing for evaluation.
- Copyright publication (Presentation based on Copyright to be prepared and presented). A copyright grant certificate must be produced at the time of evaluation.

Semester IV
MLC641AID: Introduction to Cybersecurity

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
	PR/Week	Paper		TW	Oral/ Presentation	Total	
		CCA	ESE				
MLC641AID	**4**	**50**	**50**	**--**	**--**	**100**	**4**

Course Objectives:	• To give an introduction to cybersecurity. • To help to understand the security requirements of Databases. • To instruct about social networking, fundamental Operating system security. • To give an exposure to practical security methods in cyber domain • To inform about the significance of cyber-crime, tools and methods regarding security aspects.
Course Outcomes:	• Explain cyber security concepts, threats, and challenges in protecting critical infrastructure. • Identify types of hackers, cyber-attacks, and malware with associated vulnerabilities. • Apply ethical hacking, vulnerability assessment, and social engineering defense strategies. • Perform basic cyber forensics investigations and understand auditing standards (ISO 27001:2013). • Interpret cyber laws, ethics, and legal frameworks governing cyberspace activities.
Course Contents:	**UNIT I Introduction** Introduction to Cyber Security, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyberwarfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cybersecurity - Organizational Implications. **(10 Hours)**
	UNIT II Hackers and Cyber Crimes Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors. **(10 Hours)**
	UNIT III Ethical Hacking and Social Engineering Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering,

	Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defense Strategies. **(10 Hours)**
	UNIT IV Cyber Forensics and Auditing Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013 **(11 Hours)**
	UNIT V Cyber Ethics and Laws Introduction to Cyber Laws, Security tools, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. **(11 Hours)**
Reference Books:	• Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., • Enterprise Cybersecurity -How to Build a Successful Cyber Defense Program Against Advanced Threats, A-press • Nina Godbole, Sumit Belapure, Cyber Security, Willey • Hacking the Hacker, Roger Grimes, Wiley • Cyber Law By Bare Act, Govt Of india, It Act 2000.

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