

As Per NEP 2020

**ANJUMAN-I-ISLAM'S
KALSEKAR TECHNICAL CAMPUS
SCHOOL OF ENGINEERING & TECHNOLOGY
(AN AUTONOMOUS INSTITUTE AFFILIATED TO UNIVERSITY OF MUMBAI)**



**Syllabus for Major
Vertical – 1, 4 & 6**

Name of the Programme – B.Tech. (<u>Electrical and Computer Engineering</u>)		
Faculty of <u>Engineering</u>		
Board of Studies in <u>Electrical and Computer Engineering</u>		
U.G. Third Year Programme	Exit Degree	Three Year U.G. Degree in <u>Electrical and Computer Engineering.</u>
Semester		V & VI
From the Academic Year		2026-27



(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B.Tech. (<u>Electrical and Computer Engineering</u>)
2	Exit Degree	Three Year U.G. Degree in <u>Electrical and Computer Engineering.</u>
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R: _____	Attached herewith
6	Semesters	Sem. V & VI
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2026-27

Sd/-
Dr. Afzal Shaikh
BoS-Chairman – ECE
AIKTC-SoET

Sd/-
Dr. Rajendra Magar
Principal, AIKTC - SoET

Sd/-
Dr. Ramjan Khatik
Director, AIKTC

Preamble

In alignment with the **National Education Policy (NEP) 2020**, the Department of Electrical and Computer Engineering is committed to ensuring academic excellence through a structured and outcome-based approach to teaching and learning. Accreditation remains the key mechanism for assuring quality in higher education, with a primary focus on evaluating program outcomes. Reflecting this philosophy, the **Faculty of Science and Technology, University of Mumbai**, has pioneered the integration of NEP 2020 principles into curriculum design and implementation.

The **Third-Year Engineering Program** serves as a foundation for developing scientific reasoning, analytical thinking, and problem-solving skills among learners. Students are offered a flexible choice of subjects from **Program Core Courses, Program Elective Subjects, Multidisciplinary Minors, and Vocational Skill-Enhanced Courses**, ensuring holistic development. In line with NEP 2020, the curriculum emphasizes the essential knowledge and skills required in modern engineering, while also providing exposure to emerging technologies and industry practices.

To support a **stress-free and learner-centric pedagogy**, a **choice-based subject pool** has been introduced for the 5th and 6th semesters. These include **Core Courses, Open Electives, and Multidisciplinary Minors**, designed to nurture creativity and align with current industry trends. Vocational and skill-enhancement modules further provide hands-on experience in contemporary industrial practices, ensuring learners acquire both academic knowledge and practical expertise.

The program structure ensures learners have the **freedom to pursue courses of their interest**, enabling a personalized and interdisciplinary learning experience. Alongside core engineering courses, emphasis is placed on **Design Thinking** introduced in the First Semester to encourage innovation and transition learners from rote learning to becoming creative professionals. Additionally, the NEP 2020 framework provides for **multiple exit options** with Certificates and Diplomas, supported by vocational skill pools aligned with industry demands.

The faculty has resolved that **clear Course Objectives and Course Outcomes** be defined for every subject to ensure consistency and depth across affiliated institutes. The **NEP 2020 grading system** brings a paradigm shift from teacher-centric to learner-centric education, focusing on time invested in learning rather than teaching. It emphasizes **continuous internal assessment**, integrating revision sessions, tutorials, guest lectures, and advanced content delivery within the 15-week teaching framework (12–13 weeks for teaching and 2–3 weeks for reinforcement).

Importantly, the Third-year syllabus is designed to be **balanced and stress-free**, ensuring that learners can smoothly transition into college life and build strong bonds with faculty mentors. The revised curriculum will be implemented for the **Third Year of Engineering from the academic year 2026–27**.

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Under Graduate Diploma in Engineering- Electrical and Computer Engineering.

Credit Structure (Sem. V & VI)

Level	Semester	R: _____ C									Degree/ Cum. Cr.
		Major		Minor	OE	BSEC	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP	Cum. Cr. / Sem.	
		Mandatory	Electives								
5.0	V	PCC501:3 PCC502:3 PCL501:1 PCL502:1	PEC501x:3 PEL501x:1	MDC503:3 MDL503:1	OE5 02:2	SEC501:2	VSL501:2	--	MIP:1	23	Three Year UG Degree: 45
	R: _____ D										
	VI	PCC601:3 PCC602:2 PCL601:1 PCL602:1	PEC602x:3 PEL602x:1	MDC604:3 MDL604:1	OE6 03:2	SEC601:2	VSL601:2	--	MIP:1	22	
	Cum Cr.	15	08	08	04	04	04	--	02	45	

Exit option: Award of Three Year UG Degree in Major with 45 credits and additional 8 credits, out of which 4 credits in work based vocational courses or internship/apprenticeship during summer vacation and 4 credits from skill-based courses to be earned during Fifth and Sixth semester.

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, BSEC- Basic Science & Engineering Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Letter Grades and Grade Points:

U.G and P.G Program				
Sr. No.	Letter Grade	Percentage of Marks	Grade Points	Performance
1	0	80 and above	10	Outstanding
2	A	75:00 – 79.99	9	Excellent
3	B	70:00 – 74.99	8	Very Good
4	C	60:00 – 69.99	7	Good
5	D	50:00 – 59.99	6	Fair
6	E	45:00 – 45.99	5	Average
7	P	40:00 – 44.99	4	Pass
8	F	< 40.00	0	Fail

Semester - V									
Course Code	Course Name	Course Abbr	Teaching Contact Hours			Credits			
			Theory	Tutorial	Practical	Theory	Tutorial	Practical	Total
25ECEPCC501	Power Electronics and Machine Drives	PEMD	3	-	-	3	-	-	3
25ECEPCC502	Machine Learning	ML	3	-	-	3	-	-	3
25ECEPEC501X	PE-1	PE-1	3	-	-	3	-	-	3
25ECEMDC503	Multidisciplinary Minor Course III	MDC-3	3	-	-	3	-	-	3
25OE502X	Open Elective-2	OE-2	2	-	-	2	-	-	2
25ECEVSL501	Cloud Computing Lab	CC- L	2	-	2	-	-	2	2
25ECEPCL501	Power Electronics and Machine Drives Lab	PEMD-L	-	-	2	-	-	1	1
25ECEPCL502	Machine Learning Lab	ML-L	-	-	2	-	-	1	1
25ECEPEL501X	PE-1 Lab	PEL-1	-	-	2	-	-	1	1
25ECEMDL503X	Multidisciplinary Minor Course Lab III	MDL-3	-	-	2	-	-	1	1
25ECESEC501	Communication & Personality Dev III	CPD-III	2	-	-	2	-	-	2
25ECEMIP501	Mini Project - 1	MP-1	-	-	2	-	-	1	1
TOTAL			30 Hours			23 Credits			

Semester - V								
Course Code	Course Name	Course Abbr	Internal Assessment		External Assessment		TOTAL	
			CIA	MSE	ESE	Prac / Pres / Oral		
25ECEPCC501	Power Electronics and Machine Drives	PEMD	20	30	50	-	100	
25ECEPCC502	Machine Learning	ML	20	30	50	-	100	
25ECEPEC501X	PE-1	PE-1	20	30	50	-	100	
25ECEMDC503	Multidisciplinary Minor Course III	MDC-3	20	30	50	-	100	
25OE502X	Open Elective-2	OE-2	20	20	40	-	80	
25ECEVSL501	Cloud Computing Lab	CC - L	50	-	-	25	75	
25ECEPCL501	Power Electronics and Machine Drives Lab	PEMD-L	25	-	-	25	50	
25ECEPCL502	Machine Learning Lab	ML-L	25	-	-	25	50	
25ECEPEL501X	PE-1 Lab	PEL-1	25	-	-	25	50	
25ECEMDL503	Multidisciplinary Minor Course Lab III	MDL-3	25	-	-	25	50	
25ECESEC501	Communication & Personality Dev III	CPD-III	25	-	-	25	50	
25ECEMIP501	Mini Project - 1	MP-1	25	-	-	25	25	
TOTAL			440		415		855	

Semester - VI									
Course Code	Course Name	Course Abbr	Teaching Contact Hours			Credits			
			Theory	Tutorial	Practical	Theory	Tutorial	Practical	Total
25ECEPCC601	Data Analysis and Visualization	DAV	3	-	-	3	-	-	3
25ECEPCC602	Power System Protection and Switchgear	PSPS	2	-	-	2	-	-	2
25ECEPEC602X	PE-2	PE-2	3	-	-	3	-	-	3
25ECEMDC604	Multidisciplinary Minor Course IV	MDC-4	3	-	-	3	-	-	3
25OE603X	Open Elective-3	OE-3	2	-	-	2	-	-	2
25ECEVSL601	Industrial Automation	AEC	2	-	2	-	-	2	2
25ECEPCL601	Data Analysis and Visualization Lab	DAV-L	-	-	2	-	-	1	1
25ECEPCL602	Power System Protection and Switchgear	PSPS-L	-	-	2	-	-	1	1
25ECEPEL602X	PE-2 Lab	PEL-2	-	-	2	-	-	1	1
25ECEMDL604	Multidisciplinary Minor Course Lab IV	MDL-4	-	-	2	-	-	1	1
25ECESEC601	Problem Solving & Aptitude Building – III	PSAB-III	2	-	-	2	-	-	2
25ECEMIP602	Mini Project – 2	MIP-2	-	-	2	-	-	1	1
TOTAL			29 Hours			22 Credits			

Semester - VI								
Course Code	Course Name	Course Abbr	Internal Assessment		External Assessment		TOTAL	
			CIA	MSE	ESE	Prac / Pres / Oral		
25ECEPCC601	Data Analysis and Visualization	DAV	20	30	50	-	100	
25ECEPCC602	Power System Protection and Switchgear	PSPS	20	20	40	-	80	
25ECEPEC602X	PE-2	PE-2	20	30	50	-	100	
25ECEMDC604	Multidisciplinary Minor Course IV	MDC-4	20	30	50	-	100	
25OE603X	Open Elective-3	OE-3	20	20	40	-	80	
25ECEVSL601	Industrial Automation	AEC	50	-	-	25	75	
25ECEPCL601	Data Analysis and Visualization Lab	DAV-L	25	-	-	25	50	
25ECEPCL602	Power System Protection and Switchgear Lab	PSPS-L	25	-	-	25	50	
25ECEPEL602X	PE-2 Lab	PEL-2	25	-	-	25	50	
25ECEMDL604X	Multidisciplinary Minor Course Lab IV	MDL-4	25	-	-	25	50	
25ECESEC601	Problem Solving & Aptitude Building - III	PSAB-III	50	-	-	-	50	
25ECEMIP602	Mini Project - 2	MP-2	25	-	-	25	50	
TOTAL			455		380		835	

Program Elective Subject:

	Option 1	Option 2	Option 3	Option 4
PEC/Sem	Sustainable Technology	Cyber Security	Database System	Electrical Machines
PEC - 1/V	Energy Storage Systems	Fundamentals of Cyber Security	Advance Database System	Electrical Machine Design
PEC - 2/VI	Motor Control for Electric Mobility	Cyber Physical System	Data ware Housing and Data Mining	Analysis of Electric Machinery

Open Elective Subject:

	Track I	Track II	Track III	Track IV	Track V
OE/Sem	Finance & Economics	Human Dynamics & Leadership	Life Sciences	Law	Management
OE - 2/V	Indian Economy & Policy	Psychology	Health & Nutrition	Personal Law & Civil Rights	Branding & Digital Marketing
OE - 3/VI	Corporate Finance and Taxation	Leadership Principles	Public Health & Epidemic	Media Law	Project Management & Risk Mitigation

Exam Evaluation Scheme:

End Semester Exam:

The **End Semester Examination (ESE)** is conducted at the end of the academic term to assess the overall understanding, analytical ability, and application of concepts learned during the course. The examination generally consists of descriptive, analytical, numerical, and/or objective questions based on the course outcomes and syllabus coverage.

Typical Evaluation Components

- **Theory Examination:** Written exam conducted at the end of the semester.
- **Duration:** Usually 1 and a half to 2 hours.
- **Weightage:** Covering all CO's of the entire syllabus.

Continuous Internal Assessment (CIA):

Theory Course (CIA Rubric)	Activity (Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions)	Online Quiz / Open Book Test / Class Test / Multiple Choice Question / Assignment	Attendance	Total
	Minimum Two (02) of the above-mentioned activities each of 10 marks have to be conducted. The average marks would be considered.	Minimum Two (02) of the above-mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.	As per the rubric provided by the Attendance committee.	
	10	5	5	



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- SCHOOL OF ENGINEERING & TECHNOLOGY
- SCHOOL OF PHARMACY
- SCHOOL OF ARCHITECTURE

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Power Electronics and Machine Drives

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPCC501	Power Electronics and Machine Drives	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE	ESE	Total	
		Theory		20	30	50	100	
		Laboratory		-	-	-	-	

Prerequisite: Basic Electrical and Electronics, Control System and Electrical Machines

Course Objectives:

1. To introduce power semiconductor devices used in power electronic converters.
2. To understand the operation of AC–DC, DC–DC, and DC–AC converters.
3. To study speed control techniques of DC and AC motors using power electronic converters.
4. To analyze the performance of electric drives used in industrial and EV applications.

Course Outcomes (COs): At the End of the course students will be able to

CO1	Explain construction, operation, and characteristics of power semiconductor devices.
CO2	Apply the operation of single and three phase-controlled rectifiers.
CO3	Demonstrate the operation of choppers and control techniques.
CO4	Analyze the operation of Inverters and control techniques of AC motor drives.
CO5	Analyze simple power electronic drive systems for industrial applications.

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Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Power Semiconductor Devices		CO1	L2	8
	1.1	Introduction to Power Electronics: Role of power electronics in energy conversion, Applications in industry, electric vehicles, renewable energy systems, Advantages of power electronic converters.			
	1.2	Power Semiconductor Devices: Power Diodes - Construction and working principle, V-I characteristics, Types: General purpose, Fast recovery, Schottky diode. Silicon Controlled Rectifier (SCR) - Construction and two transistor analogy, V-I characteristics, Modes of operation, Turn-on and turn-off characteristics. TRIAC and DIAC - Construction and working principle, Triggering methods, Applications in AC power control. Power Transistors - Power BJT, Power MOSFET, Insulated Gate Bipolar Transistor (IGBT)			
	1.3	Device Characteristics: Static characteristics, Switching characteristics, Power losses in semiconductor devices			
	1.4	Gate Drive Circuits: Isolation techniques (Pulse transformer, Opto-isolator), SCR triggering circuits (R, RC and UJT triggering).			
<i>Self-Learning Topics</i>		Wide bandgap semiconductor devices (SiC and GaN)			
2	Controlled Rectifiers		CO2	L3	8
	2.1	Introduction to Phase Controlled Rectifiers: Principle of phase control, Effect of firing angle on output voltage.			
	2.2	Single Phase Controlled Rectifiers: Single phase half wave-controlled rectifier with R load, Single phase half wave-controlled rectifier with RL load, Single phase fully controlled bridge rectifier, Single phase semi-controlled rectifier.			

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	2.3	Three phase-controlled rectifiers: Three phase half wave-controlled rectifier, three phases full wave-controlled rectifier, Six pulse converter.			
	2.4	Performance Analysis: Average output voltage, Ripple factor, Input power factor, Effect of source inductance.			
	2.5	Applications: Battery chargers, DC motor drives, Controlled DC power supplies.			
<i>Self-Learning Topics</i>		Harmonic analysis in controlled rectifiers			
3	DC-DC Converters (Choppers)		CO3	L3	8
	3.1	Introduction to Choppers: Principle of DC-DC conversion, Classification of choppers.			
	3.2	Types of Choppers: Step-down chopper (Buck converter), Step-up chopper (Boost converter), Buck-Boost converter, Multi-quadrant choppers.			
	3.2	Control Techniques: Pulse Width Modulation (PWM) control, Constant frequency operation, Variable frequency control.			
	3.3	Commutation Techniques: Load commutation, Current commutation, Voltage commutation.			
	3.4	Applications: DC motor speed control, Electric vehicle propulsion, Switched mode power supplies (SMPS)			
<i>Self-Learning Topics</i>		Multilevel DC-DC converters			
4	Inverters and AC Voltage Controllers		CO4	L4	9
	4.1	DC-AC Inverters: Principle of inverter operation, Classification of inverters.			
	4.2	Single Phase Inverters: Half bridge inverter, Full bridge inverter, Output voltage waveform analysis.			
	4.3	Three Phase Inverters: Three phase bridge inverter, 120° conduction mode, 180° conduction mode.			

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	4.4	PWM Techniques: Sinusoidal Pulse Width Modulation (SPWM), Basic concept of Space Vector PWM.			
	4.5	AC Voltage Controllers: Single phase AC voltage controller with resistive load, AC voltage controller with inductive load.			
	4.6	Cyclo-converters: Principle of cyclo-converter operation, Step-down cyclo-converter, Industrial applications.			
<i>Self-Learning Topics</i>		Multilevel inverters			
5	Electric Drives (DC and AC Motor Drives)		CO5	L4	9
	5.1	Fundamentals of Electric Drives: Components of electric drive system, Advantages of electric drives, Load torque characteristics.			
	5.2	DC Motor Drives: Speed torque characteristics of DC motors, Armature voltage control, Field control method, Converter fed DC drives, Four quadrant operation of DC drives.			
	5.3	AC Motor Drives: Induction motor drives - Stator voltage control, Variable frequency (V/f) control. Variable Frequency Drives (VFD) - Principle and operation, Advantages and applications.			
	5.4	Synchronous Motor Drives: Self-controlled synchronous motor drives, Permanent Magnet Synchronous Motor (PMSM) drives.			
	5.5	Applications: Electric vehicles, Industrial automation, HVAC systems and robotics.			
<i>Self-Learning Topics</i>		AI-based intelligent motor drives			
Total Hours				42*	
*Note: Total of 42 hours does not include self-study hours.					

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DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Text Books:

1	Power Electronics: Converters, Applications and Design – Ned Mohan, Publisher: John Wiley & Sons Popular Editions: 3rd Edition (2002), 4th Edition (2017) ISBN (4th Ed.): 9781118734742
2	Power Electronics – M. D. Singh & K. B. Khanchandani, Publisher: McGraw Hill Education, Edition: 2nd Edition (2006), ISBN: 9780070583894
3	Fundamentals of Electric Drives – G. K. Dubey, Publisher: Narosa Publishing House, Popular Editions: 1994, 2001 editions, ISBN: 9788173190414

Reference Books:

1	Power Electronics: Circuits, Devices and Applications – Muhammad H. Rashid, Publisher: Pearson Education, Popular Editions: 3rd Edition, 4th Edition, ISBN (4th Edition): 9780133125900
2	Electric Motor Drives: Modeling, Analysis and Control – R. Krishnan, Publisher: Prentice Hall / Pearson, Edition: 1st Edition (2001), ISBN: 9780130910141
3	Modern Power Electronics and AC Drives – Bimal K. Bose, Publisher: Prentice Hall / Pearson, Edition: 1st Edition (2002), ISBN: 9780130167439

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MACHINE LEARNING

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPCC502	Machine Learning	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE		ESE	Total
		Theory		20	30		50	100
		Laboratory		-	-		-	-

Prerequisite: Python Programming, Data Structures, Basic Probability and Statistics, Algorithms

Course Objectives:

1. To introduce the fundamental concepts and workflow of machine learning.
2. To understand data pre-processing and feature engineering techniques.
3. To study supervised learning algorithms for prediction and classification.
4. To explore unsupervised learning techniques for discovering patterns in data.
5. To design neural network models for intelligent engineering applications.

Course Outcomes (COs): At the End of the course students will be able to

CO1	Explain the fundamental concepts and workflow of machine learning.
CO2	Apply data pre-processing and feature engineering techniques to prepare datasets.
CO3	Implement supervised learning algorithms for prediction and classification tasks.
CO4	Analyze clustering and dimensionality reduction techniques for data analysis.
CO5	Design neural network models for solving engineering problems.

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Module No.	Detailed Contents	CO Mapped	BL	Hrs
1	Introduction to Machine Learning	CO1	L2	7
	1.1 Fundamentals of Machine Learning: Introduction to Artificial Intelligence, Data Science and Machine Learning, Difference between AI, ML, and Deep Learning, Applications of Machine Learning in engineering and industry.			
	1.2 Types of Machine Learning: Supervised learning, Unsupervised learning, Semi-supervised learning (overview), Reinforcement learning (basic concept).			
	1.3 Machine Learning Workflow: Steps in developing a machine learning system, Data collection and pre-processing, training dataset, testing dataset, validation dataset.			
	1.4 Model Generalization: Overfitting and underfitting, Bias-variance trade-off, Cross-validation techniques.			
	1.5 Performance Evaluation Metrics: Confusion matrix, Accuracy, precision, recall, F1 score, ROC curve and AUC, RMSE.			
<i>Self-Learning Topics</i>	History and evolution of Machine Learning. Comparison between Machine Learning, Deep Learning, and Data Science. Applications of Machine Learning in: Healthcare, Finance, Autonomous vehicles, Smart grids.			
2	Data Pre-processing and Feature Engineering	CO2	L3	8
	2.1 Data Pre-processing and Feature Engineering: Sources of data, Structured vs unstructured data, Data quality issues.			
	2.2 Data Cleaning Techniques: Handling missing data, handling noisy data, Removing duplicates, Outlier detection.			
	2.3 Data Transformation: Normalization, Standardization, Feature scaling, Encoding categorical variables (label encoding, one-hot encoding).			

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	2.4	Feature Engineering: Feature selection methods, Filter methods, Wrapper methods, Embedded methods.			
	2.5	Feature Extraction: Dimensionality reduction concept, Introduction to PCA.			
<i>Self-Learning Topics</i>	Data visualization techniques for exploratory data analysis. Feature scaling techniques: Min-Max normalization, Z-score normalization.				
3	Supervised Learning Algorithms		CO3	L3	10
	3.1	Regression Techniques: Introduction to regression analysis, Simple linear regression, Multiple linear regression, Least squares estimation.			
	3.2	Regularization Techniques: Overfitting in regression, Ridge regression (L2 regularization), Lasso regression (L1 regularization).			
	3.3	Classification Algorithms: Logistic regression, k-Nearest Neighbour (KNN), Decision tree classifier.			
	3.4	Ensemble Learning: Random Forest (overview)			
	3.5	Support Vector Machines: Linear separable and non-separable data, Maximum margin hyperplane, Kernel concept.			
	3.6	Model Evaluation: Precision-recall trade-off, Cross-validation.			
<i>Self-Learning Topics</i>	Hyperparameter tuning techniques: Grid search, Random search. Ensemble learning methods: Bagging, Boosting, AdaBoost.				
4	Unsupervised Learning Techniques		CO4	L4	8
	4.1	Introduction to Unsupervised Learning: Difference between supervised and unsupervised learning, Applications of clustering.			
	4.2	Distance and Similarity Measures: Euclidean distance, Manhattan distance, Cosine similarity.			
	4.3	K-Means Clustering: K-Means algorithm, Initialization techniques, Convergence criteria, Advantages and limitations.			

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	4.4	Hierarchical Clustering: Agglomerative clustering, Divisive clustering, Dendrogram representation.			
	4.5	Expectation Maximization Algorithm: Concept of EM algorithm, Application in clustering.			
	4.6	Cluster Validation: Silhouette coefficient, Within-cluster sum of squares.			
<i>Self-Learning Topics</i>	Density-based clustering algorithms: DBSCAN (overview). Applications of clustering in: Customer segmentation, Power consumption pattern analysis.				
5	Neural Networks and Dimensionality Reduction		C05	L5	9
	5.1	Artificial Neural Networks: Biological neuron vs artificial neuron, McCulloch-Pitts neuron model, Neural network architecture.			
	5.2	Perceptron Model: Single layer perceptron, Perceptron learning rule, Limitations of perceptron.			
	5.3	Activation Functions: Binary step function, Sigmoid function, Hyperbolic tangent, ReLU.			
	5.4	Multilayer Neural Networks: Multilayer perceptron architecture, Feedforward neural networks, Weight initialization.			
	5.5	Backpropagation Algorithm: Error calculation, Gradient descent learning, Weight update process.			
	5.6	Dimensionality Reduction: Curse of dimensionality, Principal Component Analysis (PCA), Applications of PCA.			
<i>Self-Learning Topics</i>	Introduction to Deep Learning . Convolutional Neural Networks (CNN) – basic concept. Recurrent Neural Networks (RNN) – overview.				
Total Hours			42*		
*Note: Total of 42 hours does not include self-study hours.					

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Text Books:	
1	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Popular Editions: 3rd Edition (2014), 4th Edition (2020), ISBN (4th Ed.): 9780262043793.
2	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow , O'Reilly, Popular Editions: 2nd Edition (2019), 3rd Edition (2022), ISBN (3rd Ed.): 9781098125974.
3	Marc Peter Deisenroth, Mathematics for Machine Learning , Cambridge University Press, Edition: 1st Edition (2020), ISBN: 9781108455145.
Reference Books:	
1	Tom M. Mitchell, —Machine Learning, McGraw Hill, Edition: 1st Edition (1997) ISBN: 9780070428072
2	Kevin P. Murphy, —Machine Learning — A Probabilistic Perspective, MIT Press, Edition: 1st Edition (2012), ISBN: 9780262018029
3	Stephen Marsland, —Machine Learning an Algorithmic Perspective, CRC Press, Popular Editions: 2nd Edition (2014), 3rd Edition (2023), ISBN (2nd Ed.): 9781466583283

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Program Elective Subject: Energy Storage System

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEC5011	Energy Storage System	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE	ESE	Total	
		Theory		20	30	50	100	
		Laboratory		-	-	-	-	

Prerequisite: Basic Electrical and Electronics and Power System

Course Objectives:

The objectives of this course are:

1. To introduce the importance and role of energy storage technologies in modern electrical power systems and renewable energy integration.
2. To understand the operating principles and characteristics of electrochemical energy storage systems such as batteries and supercapacitors.
3. To explain the working principles of mechanical and thermal energy storage technologies.
4. To analyze the applications of energy storage systems in electric vehicles, smart grids and renewable energy systems.
5. To develop knowledge of modelling, sizing, control and performance evaluation of energy storage systems.

Course Outcomes (COs): At the End of the course students will be able to

CO1	Explain the need, classification and characteristics of energy storage systems.
CO2	Analyze the working principles and performance of electrochemical energy storage systems.
CO3	Explain mechanical and thermal energy storage technologies.
CO4	Analyze the role of energy storage in renewable energy systems, microgrids and electric vehicles.
CO5	Apply modelling and sizing methods for energy storage systems in electrical applications.

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Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Introduction to Energy Storage systems		CO1	L2	8
	1.1	Need for Energy Storage: Energy demand and supply imbalance, Grid stability and reliability, Renewable energy intermittency.			
	1.2	Role of Energy Storage in Power Systems: Load leveling, Peak shaving, Frequency regulation, Power quality improvement.			
	1.3	Classification of Energy Storage Systems: Electrochemical storage, Mechanical storage, Electrical storage, Thermal storage, Chemical storage.			
	1.4	Key Performance Parameters: Energy density, Power density, Round-trip efficiency, Cycle life, Depth of discharge (DoD).			
	1.5	Economic and Environmental Considerations: Cost of storage technologies, Environmental impact, Life cycle analysis.			
<i>Self-Learning Topics</i>		Global energy storage trends Government policies for energy storage			
2	Electrochemical Energy Storage Systems		CO2	L3	10
	2.1	Fundamentals of Electrochemical Storage: Electrochemical reactions, Charging and discharging processes, Battery characteristics.			
	2.2	Battery Technologies: Lead-acid batteries, Nickel-Cadmium batteries, Nickel-Metal Hydride batteries, Lithium-ion batteries, Sodium-Sulphur batteries, Solid-state batteries.			
	2.3	Battery Performance Characteristics: Capacity and state of charge (SOC), State of health (SOH), Efficiency and lifespan.			
	2.4	Battery Management Systems (BMS): Monitoring parameters, Thermal management, Protection systems.			
	2.5	Supercapacitors / Ultracapacitors: Construction and			

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		working principle, Types of supercapacitors, Advantages and limitations, Applications in power systems and EVs.			
<i>Self-Learning Topics</i>		Battery recycling technologies Emerging battery chemistries			
3	Mechanical and Thermal Energy Storage		CO3	L2	8
	3.1	Mechanical Energy Storage: Pumped Hydro Energy Storage (PHES) - Working principle, Components and operation Compressed Air Energy Storage (CAES) - Types of CAES systems, Applications and limitations. Flywheel Energy Storage Systems (FESS) - Construction and operation, Advantages and applications. Gravity-based Energy Storage Systems.			
	3.2	Thermal Energy Storage: Sensible heat storage, Latent heat storage, Phase change materials (PCM), Molten salt storage systems, Cryogenic energy storage. Comparison of Mechanical and Thermal Storage System			
4	Energy Storage for Renewable Energy and Electric Vehicles		CO4	L4	8
	4.1	Energy Storage in Renewable Energy Systems: Solar photovoltaic energy storage, Wind energy storage systems, Hybrid renewable systems.			
	4.2	Energy Storage in Microgrids: Microgrid architecture, Grid-connected and islanded mode operation.			
	4.3	Energy Storage in Electric Vehicles: Battery pack design, EV charging technologies, Fast charging methods.			
	4.4	Vehicle-to-Grid (V2G) Technology: Concept and benefits. Grid support applications.			
	4.5	Grid Applications of Energy Storage: Frequency regulation, Voltage support, Backup power systems.			
<i>Self-Learning Topics</i>		Second-life batteries in EV applications Energy storage for smart cities			
5	Modelling, Sizing and Applications of Energy Storage Systems		CO5	L3	8
	5.1	Battery Modelling Techniques: Mathematical models, Equivalent circuit models.			

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	5.2	Energy Storage System Sizing: Sizing for renewable energy systems, Storage capacity calculation.			
	5.3	Power Electronics Interface: DC-DC converters for energy storage, Inverters and grid interfacing.			
	5.4	Control Strategies for ESS: Charge-discharge control, Energy management systems.			
	5.5	E-mobility storage applications- Electric vehicles (EVs), batteries, super-capacitors and fuel cells, future technologies. Electric vehicle: V2X, G2V and V2G modes of operation. Hybrid Energy storage systems: configurations and applications			
<i>Self-Learning Topics</i>	Artificial intelligence in battery management Large-scale grid energy storage projects				
Total Hours			42*		
*Note: Total of 42 hours does not include self-study hours.					

Text Books:	
1	Robert Huggins, Fundamentals, Materials and Applications Second Edition, Springer Nature, Edition: 2nd Edition (2016), ISBN: 9783319212395
2	Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications, Wiley, Edition: 2nd Edition (2011), ISBN: 9780470747063
3	Leo J.M.J. Blomen and Michael N. Mugerwa, "Fuel Cell System", New York, Plenum Press, Edition: 1993, ISBN: 9780306443824
Reference Books:	
1	S. Kalaiselvam and R. Parameshwaran , Thermal Energy Storage Technologies for Sustainability Systems Design, Academic Press, Edition: 1st Edition (2014) ISBN: 9780124172913.
2	Trevor M. Letcher, Storing Energy with Special Reference to Renewable Energy Source, Elsevier, Edition: 1st Edition (2016), ISBN: 9780444626165.
3	Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook, CRC Press, Edition: 1st Edition (2011), ISBN: 9781439808719

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Program Elective Subject: Fundamentals of Cybersecurity

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEC5012	Fundamentals of Cybersecurity	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE		ESE	Total
		Theory		20	30		50	100
		Laboratory		-	-		-	-

Prerequisite: Basic knowledge of Computer Networks and Operating Systems.

Course Objectives:

1. To introduce students to fundamental concepts of cyber security and network security.
2. To understand various cyber threats, vulnerabilities, and attack techniques.
3. To study security mechanisms such as authentication, firewalls, VPNs, and IDS.
4. To familiarize students with basic vulnerability assessment and security tools.

Course Outcomes (COs): At the End of the course students will be able to

C01	Explain fundamental cyber security concepts including threats, vulnerabilities, authentication, access control, and cryptography
C02	Analyze different types of web-based attacks such as browser attacks, email attacks, and user-targeted attacks.
C03	Examine network vulnerabilities and perform basic vulnerability scanning using security tools.
C04	Demonstrate the use of network defence mechanisms such as firewalls, VPNs, and intrusion detection systems.
C05	Evaluate security tools and techniques used for protecting computer networks and information systems.

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Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Introduction to Cyber Security		CO1	L2	8
	1.1	Fundamentals of Cyber Security: Introduction to Cyber Security, Importance of Cyber Security in modern computing, Computer Security concepts, Types of cyber threats, Harm caused by cyber-attacks, Security vulnerabilities, Security controls and countermeasures			
	1.2	Security Mechanisms: Authentication concepts, Types of authentication methods, Access control mechanisms, Role-based access control, Basics of cryptography, Encryption and decryption concepts			
<i>Self-Learning Topic</i>	History and evolution of cyber security Cyber security frameworks (NIST Cybersecurity Framework, ISO 27001 basics)				
2	Web Attacks and Security Threats		CO2	L4	6
	2.1	Browser Attacks: Malicious scripts, Drive-by downloads, Browser exploitation.			
	2.2	Web Attacks Targeting Users: Phishing attacks, Social engineering attacks, Clickjacking, Session hijacking.			
	2.3	Data Theft Attacks: Obtaining user credentials, Website data theft techniques, Cookie theft, Password attacks.			
	2.4	Email Attacks: Email spoofing, Phishing emails, Malware attachments, Spam attacks.			
<i>Self-Learning Topic</i>	Cross-Site Scripting (XSS) attacks, SQL Injection attacks, Cross-Site Request Forgery (CSRF)				
3	Network Vulnerabilities and Scanning		CO3	L4	10
	3.1	Overview of Network Vulnerabilities: Definition of vulnerability, Types of network vulnerabilities, Vulnerability assessment process.			
	3.2	Vulnerability Scanning Techniques: Open port identification, Service identification, Banner grabbing, Version checking, Traffic probing,			

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		Vulnerability probing.			
	3.3	Vulnerability Examples: Misconfigured servers, Weak authentication systems, Unpatched software vulnerabilities.			
	3.4	Vulnerability Scanning Tools: OpenVAS, Metasploit Framework.			
	3.5	Network Scanning and Monitoring Tools: Netcat, Socat, Network sniffers, Packet injection tools.			
<i>Self-Learning Topic</i>		Port scanning techniques (TCP Scan, SYN Scan), Network mapping using tools like Nmap, Vulnerability databases (CVE, NVD)			
4	Network Defence Tools		C04	L3	8
	4.1	Firewalls and Packet Filters: Firewall basics, Types of firewalls, Packet filtering concepts, Packet filter vs firewall, how a firewall protects a network, Packet characteristics used for filtering, Stateless vs stateful firewalls.			
	4.2	Network Address Translation: NAT concepts, Types of NAT, Role of NAT in security.			
	4.3	Port Forwarding: Port forwarding concepts, Port forwarding configuration.			
	4.4	Virtual Private Networks (VPN): Basics of VPN, VPN architecture, Tunneling protocols, Advantages of VPN.			
	4.5	Firewall Implementations: Linux firewall concepts, Windows firewall configuration.			
	4.6	Intrusion Detection System: Introduction to IDS, Types of IDS, Signature-based detection, Snort intrusion detection system.			
<i>Self-Learning Topic</i>		Next-generation firewalls (NGFW), Intrusion Prevention Systems (IPS), VPN protocols (IPSec, SSL VPN)			
5	Security Tools and Case Studies		C05	L5	10
	5.1	Network Monitoring: Network monitoring concepts, Log monitoring and analysis.			

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	5.2	Security Tools: Packet analysis tools, Network monitoring utilities, Vulnerability detection tools.			
	5.3	Cyber Security Case Studies: Famous cyber-attacks, Data breach incidents, Lessons learned from cyber incidents.			
	5.4	Ethical Hacking Overview: Concept of ethical hacking, Penetration testing basics, Responsible disclosure.			
<i>Self-Learning Topic</i>		Cyber security incident response process Digital forensics basics			
Total Hours					42*
*Note: Total of 42 hours does not include self-study hours.					

Text Books:

1	William Stallings and Lawrie Brown, <i>Computer Security: Principles and Practice</i>, Publisher: Pearson Education, Popular Editions: 3rd, 4th, and 5th Editions, ISBN (5th Edition): 9780134794105
2	William Stallings, <i>Network Security Essentials: Applications and Standards</i>, Publisher: Pearson Education, Popular Editions: 5th and 6th Editions, ISBN (6th Edition): 9780134527338
3	Cryptography and Network Security: Principles and Practice, Author: William Stallings, Publisher: Pearson Education, Popular Editions: 7th and 8th Editions

Reference Books:

1	Linux System Security: The Administrator's Guide to Open Source Security Tools – Scott Mann, Publisher: Prentice Hall, Edition: 1st Edition, ISBN: 9780130090454
2	Nina Godbole and Sunit Belapure, <i>Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives</i> , Wiley, Edition: 1st Edition, ISBN: 9788126521791
3	Chuck Easttom, <i>Computer Security Fundamentals</i> , Pearson, Popular Editions: 2nd and 3rd Editions, ISBN (3rd Ed.): 9780135774779
4.	Michael Whitman and Herbert Mattord, <i>Principles of Information Security</i> , Cengage Learning, Popular Editions: 5th and 6th Editions, ISBN (6th Ed.): 9781337102063

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Program Elective Subject: Advance Database System

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEC5013	Advance Database System	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE	ESE	Total	
		Theory		20	30	50	100	
		Laboratory		-	-	-	-	

Prerequisite: Database Management Systems

Course Objectives:

1. To introduce advanced concepts and architectures of modern database systems.
2. To study advanced SQL techniques and query optimization methods.
3. To understand transaction management and concurrency control in databases.
4. To explore distributed databases and modern data storage technologies.
5. To provide knowledge of NoSQL databases and big data data-management platforms.

Course Outcomes (COs): At the End of the course students will be able to

CO1	Explain advanced database architectures and data models.
CO2	Apply advanced SQL queries, indexing and optimization techniques.
CO3	Analyze transaction management and concurrency control mechanisms.
CO4	Design distributed database and NoSQL based data management solutions.
CO5	Evaluate database performance, security and recovery strategies.

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Module No.	Detailed Contents	CO Mapped	BL	Hrs	
1	Advanced Data Models and Database Architecture		CO1	L2	8
	1.1	Review of Relational Database Concepts: Relational model fundamentals, Relational schema and integrity constraints, Limitations of relational databases in modern applications.			
	1.2	Advanced Data Models: Object-Oriented Data Model, Object Identity and Object Structure, Encapsulation and Methods, Object Relational Database Model (ORDBMS).			
	1.3	Semi-Structured Data Models: Characteristics of semi-structured data, XML data model and schema definition, JSON data representation in databases, Querying XML and JSON data.			
	1.4	Database System Architecture: Centralized database systems, Client-Server database architecture, Three-tier architecture, Parallel database architecture, Cloud based database systems.			
	1.5	Applications of Advanced Databases: Databases for IoT applications, Databases for AI and machine learning systems, Data storage for real-time applications.			
<i>Self-Learning Topics</i>	Graph databases and knowledge graphs				
2	Advanced SQL and Query Processing		CO2	L3	10
	2.1	Advanced SQL Queries: Nested queries and correlated subqueries, Set operations (UNION, INTERSECT, EXCEPT), Common Table Expressions (CTE), Recursive queries.			
	2.2	SQL Programming Features: Stored procedures, User defined functions, Database triggers, Database views and materialized views.			
	2.3	Analytical SQL: Window functions, Ranking functions, Aggregation and grouping operations.			
	2.4	Query Processing: Query parsing and translation, Query execution strategies, Query evaluation methods.			

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	2.5	Query Optimization: Cost-based query optimization, Heuristic optimization techniques, Query execution plan analysis.			
	2.6	Indexing Techniques: B-Tree indexing, B+ Tree indexing, Hash indexing, Bitmap indexing, Index selection strategies.			
<i>Self-Learning Topics</i>	SQL window functions and analytical queries				
3	Transaction Management and Concurrency Control		CO3	L4	8
	3.1	Database Transactions: Definition of transactions, ACID properties, Transaction states and lifecycle.			
	3.2	Concurrency Control Concepts: Need for concurrency control, Serializability concepts, Conflict serializability, View serializability.			
	3.3	Concurrency Control Techniques: Lock based protocols, Two Phase Locking (2PL), Timestamp ordering protocols, Optimistic concurrency control.			
	3.4	Deadlocks in Database Systems: Deadlock conditions, Deadlock detection techniques, Deadlock prevention methods, Deadlock recovery techniques.			
	3.5	Database Recovery Techniques: Failure classification in DBMS, Log based recovery, Checkpoint mechanisms, Shadow paging technique.			
<i>Self-Learning Topics</i>	Multi-Version Concurrency Control (MVCC)				
4	Distributed and Parallel Databases		CO4	L6	8
	4.1	Introduction to Distributed Databases: Characteristics of distributed databases, Advantages and challenges of distributed systems.			
	4.2	Distributed Database Design: Data fragmentation - Horizontal fragmentation, Vertical fragmentation, Hybrid fragmentation. Data replication techniques, Data allocation strategies			
	4.3	Distributed Query Processing: Query decomposition, Localization of queries, Global query optimization.			

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	4.4	Distributed Transactions: Distributed transaction management, Two Phase Commit Protocol (2PC), Distributed concurrency control mechanisms.			
	4.5	Parallel Databases: Shared memory architecture, Shared disk architecture, Shared nothing architecture, Parallel query processing.			
	4.6	Cloud Databases: Database as a Service (DBaaS), Cloud storage and scalability, Fault tolerance in cloud databases.			
<i>Self-Learning Topics</i>	Google Spanner and distributed cloud databases				
5	NoSQL and Modern Database Systems		CO5	L5	8
	5.1	Introduction to NoSQL Databases: Limitations of relational databases for big data, Characteristics of NoSQL systems, CAP theorem (Consistency, Availability, Partition tolerance).			
	5.2	Types of NoSQL Databases: Key-value databases, Document-oriented databases, Column family databases, Graph databases.			
	5.3	Big Data Storage Systems: Distributed file systems, Hadoop Distributed File System (HDFS) overview, MapReduce programming model.			
	5.4	Modern Data Platforms: Data lakes and data warehouses, Real-time databases and streaming data, Time-series databases.			
	5.5	Applications of Modern Databases: Big data analytics platforms, Databases for machine learning, Real-time industrial data management systems.			
<i>Self-Learning Topics</i>	Blockchain based databases				
Total Hours			42*		
*Note: Total of 42 hours does not include self-study hours.					

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Text Books:

1	Elmasri & Navathe – <i>Fundamentals of Database Systems</i> , Publisher: Pearson Education, Popular Editions: 6th and 7th Editions, ISBN (7th Ed.): 9780133970777
2	Silberschatz, Korth & Sudarshan – <i>Database System Concepts</i> , Publisher: McGraw Hill Education, Popular Editions: 6th and 7th Editions, ISBN (7th Ed.): 9780078022159
3	Raghu Ramakrishnan & Johannes Gehrke – <i>Database Management Systems</i> , Publisher: McGraw Hill Education, Edition: 3rd Edition, ISBN: 9780072465631

Reference Books:

1	Carlos Coronel – <i>Database Systems: Design, Implementation & Management</i> , Publisher: Cengage Learning, Popular Editions: 12th and 13th Editions, ISBN (13th Ed.): 9780357673034
2	Pramod J. Sadalage – <i>NoSQL Distilled</i> , Publisher: Addison-Wesley Professional, Edition: 1st Edition (2012), ISBN: 9780321826626
3	Eric Redmond – <i>Seven Databases in Seven Weeks</i> , Publisher: Pragmatic Bookshelf Edition: 2nd Edition, ISBN: 9781680502534
4	Tom White – <i>Hadoop: The Definitive Guide</i> , Publisher: O'Reilly Media , Popular Editions: 4th Edition, ISBN: 9781491901632

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Program Elective Subject: Electrical Machine Design

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEC5014	Electrical Machine Design	3	0	0	3	0	0	3
		Evaluation Scheme						
		Component		CIA	MSE		ESE	Total
		Theory		20	30		50	100
		Laboratory		-	-		-	-

Prerequisite: Electrical Machine

Course Objectives:

1. Understand the fundamental principles and constraints involved in electrical machine design.
2. Analyze magnetic, electrical, thermal, and mechanical considerations in machine design.
3. Develop the ability to design key components of DC machines, transformers, and AC machines.
4. Apply analytical and computational methods for optimal machine design.
5. Use modern design tools and simulation techniques for electrical machine analysis.

Course Outcomes (COs): At the End of the course students will be able to

C01	Explain the fundamental principles, materials, and standards used in electrical machine design.
C02	Apply the main dimensions and windings of DC Machines.
C03	Analyze the main dimensions and windings of Transformers.
C04	Design major components of Induction Machines.
C05	Design major components of Synchronous Machines.

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Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Fundamentals of Electrical Machine Design		CO1	L2	08
	1.1	Introduction to electrical machine design, Factors influencing the design of electrical machines, Output equation of rotating electrical machines, Specific magnetic loading and specific electric loading, Choice of speed and number of poles.			
	1.2	Magnetic circuit calculations, Selection of materials used in electrical machines, Magnetic materials, conducting materials, Insulating materials.			
	1.3	Insulation classification and standards (IS/IEC), Heating and cooling of electrical machines, Types of losses in electrical machines, Methods of cooling and ventilation systems.			
<i>Self-Learning Topics</i>		IEC and IS standards used in machine design Modern insulation systems used in machines			
2	Design of DC Machines		CO2	L3	09
	2.1	Output equation for DC machines, Choice of specific magnetic loading and electric loading, Determination of main dimensions of DC machines.			
	2.2	Design of armature core, Design of armature winding, Selection of number of slots and conductors.			
	2.3	Design of commutator, Design of brushes and brush gear, Design of field winding, Calculation of armature reaction, Estimation of losses and efficiency of DC machines.			
<i>Self-Learning Topics</i>		Modern brushless DC machines Permanent magnet DC motor design concepts			
3	Design of Transformers		CO3	L3	08
	3.1	Output equation of transformers, Choice of specific magnetic loading and current density, Design of transformer core, Determination of core dimensions.			

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	3.2	Design of primary and secondary windings, Window space factor and window dimensions, Leakage reactance calculation, Design of insulation system.			
	3.3	Cooling methods in transformers, Transformer tank design and cooling ducts, Estimation of core losses and copper losses.			
<i>Self-Learning Topics</i>		Dry type transformers Amorphous core transformers			
4	Design of Induction Machines		C04	L3	09
	4.1	Output equation of induction motors, Choice of specific magnetic loading and electric loading, Determination of stator dimensions, Design of stator slots and stator winding			
	4.2	Rotor design considerations, Design of squirrel cage rotor, Design of rotor bars and end rings, Selection of air gap length			
	4.3	Leakage reactance estimation, Calculation of losses and efficiency, Thermal considerations in induction motors			
<i>Self-Learning Topics</i>		High efficiency IE3 and IE4 induction motors Design considerations for EV traction motors			
5	Design of Synchronous Machines		C05	L3	08
	5.1	Output equation of synchronous machines, Determination of main dimensions			
	5.2	Design of stator core and stator winding, Design of rotor poles, Design of field winding, Design of damper winding.			
	5.3	Cooling methods in synchronous machines, Estimation of losses, Performance analysis and efficiency calculation.			
<i>Self-Learning Topics</i>		Permanent magnet synchronous machines (PMSM) Synchronous generators used in renewable energy systems			
Total Hours			42*		

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***Note: Total of 42 hours does not include self-study hours.**

Text Books:

1	A. K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai and Sons, Edition: 6th Edition, Publication Year: 2017, ISBN-13: 9788177001013
2	M.G. Say, Theory & Performance & Design of A.C. Machines, ELBS London, CBS Publishers and Indian reprints, Publication Year: 2002
3	S. K. Sen, Principles of Electrical Machine Design with computer programmes, Oxford and IBH Publishing, Publication Year: 2006, ISBN-13: 9788120415218

Reference Books:

1	K. L. Narang, A Text Book of Electrical Engineering Drawings, Satya Prakashan, 1969
2	Shanmugasundaram, G. Gangadharan and R. Palani, Electrical Machine Design Data Book, New Age International, Edition: 2nd Edition, Publication Year: 2015, ISBN-13: 9788122437683.
3	Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

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Vocational Skill Based Lab: Cloud Computing Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEVSL501	Cloud Computing Lab	0	0	2*+2	0	0	2	2
		Evaluation Scheme						
		Component		CIA		ESE (Oral & Practical)		Total
		Theory		-		-		-
		Laboratory		50		25		75

Prerequisite: Hardware and Networking Lab

Course Objectives: The course will enable students to:

1	To make students familiar with key concepts of virtualization.
2	To make students familiar with various deployment models of cloud such as private, public, hybrid and community so that they start using and adopting appropriate types of cloud for their application.
3	To make students familiar with various service models such as IaaS, SaaS, PaaS, Security as a Service (SECaaS) and Database as a Service.
4	To make students familiar with security and privacy issues in cloud computing and how to address them.

Course Outcomes (COs): At the end of the course, students will be able to:

CO 1	Implement different types of virtualization and containerization techniques used in cloud environments.
CO 2	Analyze and apply various cloud service models (IaaS, PaaS, SaaS, SECaaS, DBaaS) to solve real-world problems.
CO 3	Design, develop, and deploy real-world web applications on commercial cloud platforms.
CO 4	Explain major security and privacy issues in cloud computing and implement appropriate mechanisms to address them.

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CO5	Explore and evaluate commercially available cloud services and recommend the most suitable cloud solution for a given application.
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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	Introduction to Cloud Computing. Overview of cloud computing, NIST model, cloud characteristics, deployment models (Public, Private, Hybrid, Community), service models (IaaS, PaaS, SaaS), advantages & limitations.	CO1	L2	4
2	Virtualization Concepts. Types of virtualization, hosted & bare-metal hypervisors, VirtualBox & KVM demonstration, comparison of virtualization parameters.	CO1	L2	4
3	Bare-Metal Hypervisors. Installation & configuration of bare-metal hypervisors, creating and managing VMs, load balancing, auto-scaling, security features.	CO1	L3	4
4	Infrastructure as a Service (IaaS) Create and manage Linux/Windows VMs on AWS EC2/Azure VM. Configure security groups and access via RDP/SSH	CO2	L3	4
5	Platform as a Service (PaaS) Deploy web applications using AWS Elastic Beanstalk/Azure App Service. Monitor and scale applications.	CO2	L3	4
6	Storage as a Service Implement AWS S3/Glacier/Azure Storage/OwnCloud. Upload, retrieve and manage cloud storage objects.	CO2	L3	4
7	Database as a Service (DBaaS) Implement AWS RDS/Azure SQL/MongoDB/Firebase. Create and connect applications with cloud databases.	CO2	L3	4
8	Security as a Service Implement threat detection, encryption, firewall rules, data protection services in AWS/Azure.	CO3	L3	4
9	Identity & Access Management (IAM) Create IAM users, roles, policies. Implement role-based access control scenarios.	CO4	L4	4
10	Containerization using Docker Install Docker, create images, run containers, compare VM vs	CO5	L4	4

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	container. Deploy containerized applications.			
11	Container Orchestration using Kubernetes Install Kubernetes cluster, deploy pods/services, create YAML configuration files, manage deployments	CO5	L4	4
12	Mini Project – Cloud Application Deployment Design and deploy a web application on public cloud using IaaS, PaaS, DBaaS, Storage & Security services.	CO1-CO5	L5	4

Note: It is appreciated if the faculty choose different problem statements for different student batches.

SEMESTER ASSESSMENT

Total 10 Experiments including Mini-Projects need to be completed.

1. Continuous Internal Assessment – (50 Marks)

1.1 Internal Practical Exam (Average of IPE-1 & IPE-2 = 30 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, which carries 15 marks.

1.2 Activity: - (05 marks)

1.3 Experiment Performance (10 Marks)

1.4 Attendance: 05 marks

2. End Semester Examination (25 Marks)

An External Oral & Practical exam will be held based on the above syllabus.

Text Books:	
1	Cloud Computing: Concepts, Technology & Architecture, Author: Thomas Erl, Publisher: Pearson Education, Edition: 2nd Edition, Publication Year: 2023/2024, ISBN-13 (Paperback): 9780138052256
2	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej Goscinski, Publisher: Wiley Publishing, Edition: 1st Edition, Publication Year: 2011, ISBN-13: 9780470887998
3	Cloud Computing: A Practical Approach, Authors: Toby Velte, Anthony Velte, Robert Elsenpeter, Publisher: McGraw Hill Education, Edition: 1st Edition, Publication Year: 2009, ISBN-13 (Print): 9780071626941

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Reference Books:

1	Mastering Cloud Computing, Authors: Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Publisher: Elsevier / Morgan Kaufmann, Edition: 2nd Edition, Publication Year: 2026, ISBN-13: 9780443404351
2	Cloud Computing Bible, Author: Barrie Sosinsky, Publisher: Wiley Publishing, Edition: 1st Edition, Publication Year: 2011, ISBN-13: 9781118255674.
3	Cloud Computing for Dummies, Authors: Judith Hurwitz et al, Publisher: For Dummies / Wiley, Edition: 2nd Edition, Publication Year: 2020, ISBN-13: 9780470484708

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Power Electronics and Machine Drives Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPCL501	Power Electronics and Machine Drives Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (OR & PR)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Prerequisite: Basic Electrical and Electronics and Electrical Machine

Course Objectives: The course will enable students to:

1	Understand the operation and characteristics of basic power electronic devices and converters.
2	Perform experiments on controlled rectifiers, choppers, and inverters used in electric drives.
3	Analyze the performance of DC and AC motor drives using power electronic converters.
4	Develop practical skills in simulation, measurement, and analysis of drive systems.

Course Outcomes (COs): At the end of the course, students will be able to:

CO1	Explain the basic operation and characteristics of various semi controllable and fully controllable devices
CO2	Demonstrate DC to DC converter circuits and their applications.
CO3	Apply the dynamic performance and braking of AC drives and DC drives.
CO4	Analyze the control aspects and the performance of power electronic drives with simulation or hardware

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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	To study V-I characteristics of SCR, DIAC and TRIAC	CO1	L3	2
2	To study V-I characteristics of IGBT.	CO1	L3	2
3	To study different triggering circuits for SCR R Triggering circuit RC triggering circuit	CO1	L3	2
4	To study Half wave-controlled rectifiers using SCR.	CO1	L3	2
5	Study of DC to DC converter	CO2	L3	2
6	Study of UJT triggering circuit of SCR	CO2	L3	2
7	To analyze the plugging performance of a DC motor.	CO3	L4	2
8	To analyze the dynamic braking of DC motor	CO3	L4	2
9	To analyze the plugging performance of three phase induction motor	CO3	L4	2
10	Single phase/ three phase fully-controlled rectifier fed DC drives-controlled rectifier fed DC drives	CO4	L4	2
11	Variable Frequency Drive of AC three phase IM	CO4	L4	2
12	Simulation of V/F method of induction motor	CO4	L4	2

Note: It is appreciated if the faculty choose different problem statements for different student batches.

SEMESTER ASSESSMENT

Total of 10 Experiments need to be completed.

1. Continuous Internal Assessment - (25 Marks)

1.1 Internal Practical Exam (Average of IPE-1 & IPE-2 = 15 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, which carries 15 marks.

1.2 Activity: - (3 marks)

1.3 Experiment Performance (5 Marks)

1.4 Attendance: 2 marks

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2. End Semester Examination (25 Marks)

An External Oral & Practical exam will be held based on the above syllabus.

Text Books:	
1	Power Electronics: Converters, Applications and Design – Ned Mohan, Publisher: John Wiley & Sons Popular Editions: 3rd Edition (2002), 4th Edition (2017) ISBN (4th Ed.): 9781118734742
2	Power Electronics – M. D. Singh & K. B. Khanchandani, Publisher: McGraw Hill Education, Edition: 2nd Edition (2006), ISBN: 9780070583894
3	Fundamentals of Electric Drives – G. K. Dubey, Publisher: Narosa Publishing House, Popular Editions: 1994, 2001 editions, ISBN: 9788173190414
Reference Books:	
1	Power Electronics: Circuits, Devices and Applications – Muhammad H. Rashid, Publisher: Pearson Education, Popular Editions: 3rd Edition, 4th Edition, ISBN (4th Edition): 9780133125900
2	Electric Motor Drives: Modeling, Analysis and Control – R. Krishnan, Publisher: Prentice Hall / Pearson, Edition: 1st Edition (2001), ISBN: 9780130910141
3	Modern Power Electronics and AC Drives – Bimal K. Bose, Publisher: Prentice Hall / Pearson, Edition: 1st Edition (2002), ISBN: 9780130167439

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Machine Learning Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPCL502	Machine Learning Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (OR & PR)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Prerequisite: Python Programming	
Course Objectives: The course will enable students to:	
1	To familiarize students with machine learning tools and programming environments.
2	To implement supervised and unsupervised machine learning algorithms.
3	To analyze datasets and evaluate the performance of machine learning models.
4	To apply machine learning techniques to solve engineering problems.
Course Outcomes (COs): At the end of the course, students will be able to:	
CO 1	Apply Python-based tools and libraries for data pre-processing and visualization.
CO 2	Implement supervised machine learning algorithms for regression and classification problems.
CO 3	Implement unsupervised learning techniques such as clustering and dimensionality reduction.
CO 4	Evaluate machine learning models using appropriate performance metrics and visualization techniques.

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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	Introduction to Machine Learning programming environment Installation and setup of Python, Anaconda / Jupyter Notebook, Introduction to NumPy and Pandas.	CO1	L3	2
2	Data pre-processing techniques <ul style="list-style-type: none"> ● Handling missing data ● Data normalization and standardization. 	CO1	L3	2
3	Exploratory Data Analysis (EDA) <ul style="list-style-type: none"> ● Data visualization using Matplotlib and Seaborn. 	CO1	L3	2
4	Feature engineering techniques <ul style="list-style-type: none"> ● Feature scaling ● Feature selection methods. 	CO1	L3	2
5	Implementation of Simple Linear Regression .	CO2	L3	2
6	Implementation of Multiple Linear Regression and evaluation using error metrics.	CO2, CO4	L3	2
7	Implementation of Logistic Regression for classification.	CO2, CO4	L4	2
8	Implementation of K-Nearest Neighbour (KNN) classifier.	CO2, CO4	L3	2
9	Implementation of Decision Tree Classifier .	CO2, CO4	L4	2
10	Implementation of Support Vector Machine (SVM) for classification.	CO2, CO4	L4	2
11	Implementation of K-Means Clustering .	CO3, CO4	L4	2
12	Implementation of Principal Component Analysis (PCA) for dimensionality reduction.	CO3, CO4	L5	2

Note: It is appreciated if the faculty choose different problem statements for different student batches.

SEMESTER ASSESSMENT

Total 10 Experiments need to be performed.

1. Continuous Internal Assessment – (25 Marks)

1.1 Internal Practical Exam (Average of IPE-1 & IPE-2 = 15 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

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Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, which carries 15 marks.

- 1.2 Activity: - (3 marks)**
- 1.3 Experiment Performance (5 Marks)**
- 1.4 Attendance: 2 marks**

2. End Semester Examination (25 Marks)

An External Oral & Practical exam will be held based on the above syllabus.

Text Books:	
1	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Popular Editions: 3rd Edition (2014), 4th Edition (2020), ISBN (4th Ed.): 9780262043793.
2	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow , O'Reilly, Popular Editions: 2nd Edition (2019), 3rd Edition (2022), ISBN (3rd Ed.): 9781098125974.
3	Marc Peter Deisenroth, Mathematics for Machine Learning , Cambridge University Press, Edition: 1st Edition (2020), ISBN: 9781108455145.
Reference Books:	
1	Tom M. Mitchell, —Machine Learning, McGraw Hill, Edition: 1st Edition (1997) ISBN: 9780070428072
2	Kevin P. Murphy, —Machine Learning — A Probabilistic Perspective, MIT Press, Edition: 1st Edition (2012), ISBN: 9780262018029
3	Stephen Marsland, —Machine Learning an Algorithmic Perspective, CRC Press, Popular Editions: 2nd Edition (2014), 3rd Edition (2023), ISBN (2nd Ed.): 9781466583283

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Program Elective Subject: Energy Storage System Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEL5011	Energy Storage System Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (Oral)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Prerequisite: Basic Electrical and Electronics, Electrical Machine

Course Objectives: The course will enable students to:

1	To provide fundamental understanding of different energy storage technologies and their role in renewable and distributed energy systems.
2	To develop modelling and simulation skills for energy storage systems such as batteries, supercapacitors, and hybrid storage using simulation tools.
3	To analyze power electronic interfaces such as bidirectional converters used for integrating energy storage devices with renewable sources.
4	To analyze battery health, state of charge, and life estimation techniques with their characteristics for improving reliability and efficiency of energy storage systems.

Course Outcomes (COs): At the end of the course, students will be able to:

CO 1	Explain the working principles and characteristics of various energy storage technologies used in modern power systems.
CO 2	Develop and simulate models for battery state-of-charge estimation and battery life prediction.
CO 3	Design and simulate bidirectional DC-DC converters for battery and supercapacitor energy storage systems.
CO 4	Evaluate hybrid energy storage systems and analyze their performance for improving energy management and system reliability.

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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	To study and analyze the charging and discharging characteristics of a battery under different operating conditions.	CO1	L4	2
2	To compare different energy storage technologies based on parameters such as efficiency, capacity, cost, and applications.	CO1	L4	2
3	To simulate and estimate the State of Charge (SOC) of a battery using appropriate modelling techniques.	CO2	L3	2
4	To simulate the operation of a bidirectional DC-DC converter used in a battery energy storage system.	CO3	L3	2
5	To simulate and analyze the performance of a bidirectional converter used with a supercapacitor energy storage system.	CO3	L4	2
6	To simulate the integration of a battery energy storage system with a solar photovoltaic (PV) system.	CO4	L3	2
7	To simulate and study the operation of a hybrid energy storage system combining multiple storage technologies.	CO4	L3	2
8	To study the working principle and operation of a battery tester used for testing battery performance.	CO1	L2	2
9	To simulate and analyze the working of a micro-hydro energy storage system.	CO4	L4	2
10	To simulate and estimate the life cycle of a battery under different operating conditions.	CO2	L3	2
11	To study the various factors that affect the lifespan and performance of battery energy storage systems.	CO2	L3	2
12	To study and analyze different energy storage systems and their real-world applications.	CO1	L4	2

Note: It is appreciated if the faculty choose different problem statements for different student batches.

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SEMESTER ASSESSMENT

Total 10 Experiments need to be completed.

1. Continuous Internal Assessment – (25 Marks)

1.1 Internal Practical Exam (Average of IPE-1 & IPE-2 = 15 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, which carries 15 marks.

1.2 Activity: - (3 marks)

1.3 Experiment Performance (5 Marks)

1.4 Attendance: 2 marks

2. End Semester Examination (25 Marks)

An External Oral exam will be held based on the above syllabus.

Text Books:	
1	Robert Huggins, Fundamentals, Materials and Applications Second Edition, Springer Nature, Edition: 2nd Edition (2016), ISBN: 9783319212395
2	Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications, Wiley, Edition: 2nd Edition (2011), ISBN: 9780470747063
3	Leo J.M.J. Blomen and Michael N. Mugerwa, "Fuel Cell System", New York, Plenum Press, Edition: 1993, ISBN: 9780306443824
Reference Books:	
1	S. Kalaiselvam and R. Parameshwaran , Thermal Energy Storage Technologies for Sustainability Systems Design, Academic Press, Edition: 1st Edition (2014) ISBN: 9780124172913.
2	Trevor M. Letcher, Storing Energy with Special Reference to Renewable Energy Source, Elsevier, Edition: 1st Edition (2016), ISBN: 9780444626165.
3	Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook, CRC Press, Edition: 1st Edition (2011), ISBN: 9781439808719

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**Program Elective Subject: Fundamentals of Cybersecurity
Lab**

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEL5012	Fundamentals of Cybersecurity Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (Oral)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Prerequisite: Python Programming

Course Objectives: The course will enable students to:

1	Provide hands-on experience with fundamental cybersecurity tools and techniques.
2	Develop skills to identify vulnerabilities and security threats in computer systems and networks.
3	Introduce practical implementation of cryptography, authentication and access control mechanisms.
4	Enable students to understand ethical hacking concepts and security testing practices.
5	Familiarize students with network monitoring and system security tools used in real-world cybersecurity environments.

Course Outcomes (COs): At the end of the course, students will be able to:

CO 1	Understand and use basic cybersecurity tools for system and network security analysis.
CO 2	Perform vulnerability scanning and security assessment of computer systems.
CO 3	Implement cryptographic techniques for data protection and authentication.
CO 4	Analyze common cyber-attacks and demonstrate basic defence mechanisms.

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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	Study of Cybersecurity concepts, threats, vulnerabilities and security principles	CO1	L2	2
2	Installation and configuration of a cybersecurity testing environment using Kali Linux / Virtual Machines	CO1	L2	2
3	Network scanning and host discovery using Nmap	CO1	L3	2
4	Packet capture and network traffic analysis using Wireshark	CO1	L3	2
5	Password strength analysis and cracking techniques using John the Ripper / Hydra (educational purpose)	CO2	L3	2
6	Vulnerability scanning using OpenVAS / Nessus Essentials.	CO2	L3	2
7	Implementation of symmetric encryption using AES algorithm	CO3	L3	2
8	Implementation of asymmetric encryption using RSA algorithm	CO3	L3	2
9	Demonstration of Digital Signature and Hashing (SHA-256) for data integrity	CO3	L3	2
10	Simulation of Phishing attack and awareness mechanisms	CO4	L4	2
11	Study and demonstration of Web Application Security testing using OWASP ZAP	CO4	L4	2
12	Case Study / Mini Lab Exercise on Cyber Attack Detection and Prevention Techniques	CO4	L4	2

Note: It is appreciated if the faculty choose different problem statements for different student batches.

SEMESTER ASSESSMENT

Total 10 Experiments need to be completed.

1. Continuous Internal Assessment – (25 Marks)

1.1 Internal Oral Exam (Average of IPE-1 & IPE-2 = 15 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

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Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, which carries 15 marks.

- 1.2 Activity: - (3 marks)**
- 1.3 Experiment Performance (5 Marks)**
- 1.4 Attendance: 2 marks**

2. End Semester Examination (25 Marks)

An External Oral exam will be held based on the above syllabus.

Recommended Software / Tools

Students will perform experiments using the following cybersecurity tools:

- Kali Linux
- Nmap
- Wireshark
- Metasploit Framework
- John the Ripper
- Hydra
- OWASP ZAP
- OpenVAS / Nessus Essentials
- Python (for cryptography demonstrations)
- VirtualBox / VMware

Text Books:	
1	William Stallings and Lawrie Brown, <i>Computer Security: Principles and Practice</i>, Publisher: Pearson Education, Popular Editions: 3rd, 4th, and 5th Editions, ISBN (5th Edition): 9780134794105
2	William Stallings, <i>Network Security Essentials: Applications and Standards</i>, Publisher: Pearson Education, Popular Editions: 5th and 6th Editions, ISBN (6th Edition): 9780134527338
3	Cryptography and Network Security: Principles and Practice, Author: William Stallings, Publisher: Pearson Education, Popular Editions: 7th and 8th Editions
Reference Books:	
1	Linux System Security: The Administrator's Guide to Open Source Security Tools – Scott Mann, Publisher: Prentice Hall, Edition: 1st Edition, ISBN: 9780130090454
2	Nina Godbole and Sunit Belapure, <i>Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives</i> , Wiley, Edition: 1st Edition, ISBN: 9788126521791

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3	Chuck Easttom, <i>Computer Security Fundamentals</i> , Pearson, Popular Editions: 2nd and 3rd Editions, ISBN (3rd Ed.): 9780135774779
4.	Michael Whitman and Herbert Mattord, <i>Principles of Information Security</i> , Cengage Learning, Popular Editions: 5th and 6th Editions, ISBN (6th Ed.): 9781337102063

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Program Elective Subject: Advance Database System Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEL5013	Advance Database System Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (Oral)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Prerequisite: Database Management System, SQL Fundamentals	
Course Objectives: The course will enable students to:	
1	To provide hands-on experience in advanced SQL queries and relational database design.
2	To develop database programming skills using procedures, functions, triggers and views.
3	To analyze database performance using indexing, query optimization and transaction control.
4	To introduce modern data storage systems including NoSQL databases.
Course Outcomes (COs): At the end of the course, students will be able to:	
CO 1	Apply advanced SQL queries, joins and aggregation operations to solve database problems.
CO 2	Develop database programs using stored procedures, triggers, views and user-defined functions.
CO 3	Analyze database performance using indexing techniques, query optimization and transaction control.
CO 4	Implement basic operations on NoSQL databases for handling semi-structured data.

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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	Installation and configuration of a database system (MySQL/PostgreSQL) and creation of databases.	CO1	L3	2
2	Design and implementation of relational database tables with: Primary keys, Foreign keys, Integrity constraints	CO1	L3	2
3	Implementation of SQL queries using different types of joins: Inner Join, Left Join, Right Join, Full Join.	CO1	L3	2
4	Implementation of advanced SQL queries using: Nested queries, Correlated subqueries, Set operations (UNION, INTERSECT, EXCEPT).	CO1	L3	2
5	Implementation of aggregate functions and grouping operations: COUNT, SUM, AVG, MIN, MAX, GROUP BY clause, HAVING clause.	CO1	L3	2
6	Creation and implementation of database views and materialized views.	CO2	L3	2
7	Development of stored procedures and user-defined functions.	CO2	L3	2
8	Implementation of database triggers for enforcing business rules.	CO2	L3	2
9	Implementation of indexing techniques and performance comparison: <ul style="list-style-type: none"> ● B-Tree Index ● Hash Index 	CO3	L4	2
10	Study and analysis of query execution plans and query optimization.	CO3	L4	2
11	Implementation of transaction control commands: <ul style="list-style-type: none"> ● COMMIT ● ROLLBACK ● SAVEPOINT Demonstration of ACID properties.	CO3	L4	2
12	Introduction to NoSQL database (MongoDB): <ul style="list-style-type: none"> ● Creating collections ● Inserting documents ● Updating and deleting documents 	CO4	L3	2

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	● Querying JSON-based data		
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Note: It is appreciated if the faculty choose different problem statements for different student batches.

SEMESTER ASSESSMENT

Total 10 Experiments need to be completed.

1. Continuous Internal Assessment – (25 Marks)

1.1 Internal Practical Exam (Average of IPE-1 & IPE-2 = 15 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, which carries 15 marks.

1.2 Activity: - (3 marks)

1.3 Experiment Performance (5 Marks)

1.4 Attendance: 2 marks

2. End Semester Examination (25 Marks)

An External Oral exam will be held based on the above syllabus.

Recommended Tools / Software

Students should practice using the following tools:

- MySQL
- PostgreSQL
- Oracle Database Express Edition
- MongoDB
- SQLite
- Apache Cassandra
- Python (MySQL Connector / PyMongo)
- Jupyter Notebook
- MongoDB Compass

Text Books:	
1	Elmasri & Navathe – <i>Fundamentals of Database Systems</i> , Publisher: Pearson Education, Popular Editions: 6th and 7th Editions, ISBN (7th Ed.): 9780133970777
2	Silberschatz, Korth & Sudarshan – <i>Database System Concepts</i> , Publisher: McGraw Hill Education, Popular Editions: 6th and 7th Editions, ISBN (7th Ed.): 9780078022159
3	Raghu Ramakrishnan & Johannes Gehrke – <i>Database Management Systems</i> , Publisher: McGraw Hill Education, Edition: 3rd Edition, ISBN: 9780072465631

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Reference Books:

1	Carlos Coronel – <i>Database Systems: Design, Implementation & Management</i> , Publisher: Cengage Learning, Popular Editions: 12th and 13th Editions, ISBN (13th Ed.): 9780357673034
2	Pramod J. Sadalage – <i>NoSQL Distilled</i> , Publisher: Addison-Wesley Professional, Edition: 1st Edition (2012), ISBN: 9780321826626
3	Eric Redmond – <i>Seven Databases in Seven Weeks</i> , Publisher: Pragmatic Bookshelf Edition: 2nd Edition, ISBN: 9781680502534
4	Tom White – <i>Hadoop: The Definitive Guide</i> , Publisher: O'Reilly Media, Popular Editions: 4th Edition, ISBN: 9781491901632

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Program Elective Subject: ELECTRICAL MACHINE LAB

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECEPEL5014	Electrical Machine Lab	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (Oral)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Prerequisite: Basic Electrical and Electronics and Electrical Machine	
Course Objectives: The course will enable students to:	
1	To understand the basic design principles of electrical machines such as transformers, DC machines and induction machines.
2	To apply analytical calculations and design equations for determining machine parameters.
3	To utilize software tools and computational techniques for machine design analysis.
4	To develop the ability to analyze and optimize machine performance parameters such as efficiency, losses and magnetic loading.
Course Outcomes (COs): At the end of the course, students will be able to:	
CO 1	Understand and compute basic design parameters of electrical machines such as magnetic loading, electric loading and flux density.
CO 2	Design key components of electrical machines such as transformer core, windings, armature and stator using standard design equations.
CO 3	Analyze performance parameters of electrical machines such as losses, efficiency and thermal limits.
CO 4	Use computational tools (MATLAB/Excel/Design software) to model and optimize electrical machine design parameters.

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Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	Study of design considerations and output equation of electrical machines	CO1	L2	2
2	Calculation of specific magnetic loading and electric loading for different machines	CO1	L3	2
3	Design of single-phase transformer core dimensions	CO2	L3	2
4	Design of transformer winding and calculation of turns per volt	CO2	L3	2
5	Estimation of transformer copper losses and core losses	CO3	L4	2
6	Design calculation of DC machine armature parameters	CO2	L3	2
7	Design of commutator and brush arrangement for DC machines	CO2	L3	2
8	Design of stator and rotor parameters of a three-phase induction motor	CO2	L3	2
9	Estimation of induction motor efficiency and losses	CO2	L4	2
10	Thermal considerations and cooling methods in electrical machine design	CO3	L4	2
11	MATLAB/Excel based analysis of transformer design parameters	CO3	L3	2
12	Optimization of induction motor design parameters using computational tools	CO4	L4	2

Note: It is appreciated if the faculty choose different problem statements for different student batches.

SEMESTER ASSESSMENT

Total 10 Experiments need to be completed.

1. Continuous Internal Assessment - (25 Marks)

1.1 Internal Practical Exam (Average of IPE-1 & IPE-2 = 15 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, which carries 15 marks.

Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the

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academics, which carries 15 marks.

- 1.2 Activity: - (3 marks)**
- 1.3 Experiment Performance (5 Marks)**
- 1.4 Attendance: 2 marks**

2. End Semester Examination (25 Marks)

An External Oral exam will be held based on the above syllabus.

Recommended Software / Tools

Students will use the following tools:

- **MATLAB / Simulink**
- **ANSYS Maxwell (basic exposure)**
- **Microsoft Excel / Google Sheets**
- **Electrical Machine Design Charts & Data Tables**
- **Scientific Calculator**
- **Design Handbooks**

Text Books:	
1	A Course in Electrical Machine Design – A.K. Sawhney, Dhanpat Rai & Co., New Delhi.
2	Design of Electrical Machines – K.G. Upadhyay , New Age International Publishers.
3	Electrical Machine Design – V.N. Mittle and A. Mittal , Standard Publishers Distributors.
Reference Books:	
1	Performance and Design of AC Machines – M.G. Say , CBS Publishers.
2	Electrical Machine Design Data Book – A. Shanmugasundaram, G. Gangadharan, R. Palani , New Age International Publishers.
3	Electrical Machine Design – Rajput R.K. , Laxmi Publications.
4	Design of Rotating Electrical Machines – Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova , Wiley.
Additional Design Tools / Data Sources	
Students may also refer to:	
<ul style="list-style-type: none"> ● Standard Electrical Machine Design Charts ● Manufacturer Data Sheets of Transformers and Motors ● MATLAB / Excel based Design Templates ● IEEE papers related to electrical machine design 	

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**DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
Communication & Personality Development - III**

Course Code	Course Name	Teaching Scheme (Hrs./week)			Credits Assigned			
		L	T	P	L	T	P	Total
25ECESEC501	Communication & Personality Development - III	2	-	-	2	-	-	2
		Evaluation Scheme						
		Component		CIA	MSE	ESE	Total	
		Theory / Practical		25	--	25	50	

Prerequisite: Speaking, Listening, Reading & Writing English	
Course Objectives: The course will enable students to:	
1	To discern and develop an effective style of writing technical documents.
2	To develop students' ability to prepare effective business proposals and conduct professional meetings.
3	To equip students with essential employment skills.
4	To develop students' understanding of corporate values and ethics.
Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	Apply principles of report writing to classify, structure, and present formal reports using appropriate language, formatting standards, and referencing styles.
CO2	Develop and present effective business proposals and conduct professional meetings.
CO3	Demonstrate employment readiness by preparing effective cover letters, resumes, and SOPs, and performing confidently in interviews.
CO4	Analyze and apply corporate values and ethics by understanding branding, cultural awareness, and intellectual property rights.

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Module	Detailed Contents		CO Mapped	BL	Hrs.
01	TECHNICAL WRITING		1	L2	10
	1.1	Report Writing: 1) Objective 2) Classification: Subject Matter, Time Interval & Function 3) Parts of Formal Report: Prefatory Parts, Report Main Body, Appended Parts 4) Language and Style: Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections, Figures, Tables and Equations, Referencing Styles in APA & MLA Format, Plagiarism Checkers			
Self-Learning Topic: Students will browse the reports of BE students in library and share the observation amongst the students.					
02	BUSINESS PROPOSALS & MEETINGS		2	L2	5
	2.1	Definition, Purpose & Types of Proposals: Solicited (in conformance with RFP) & Unsolicited Proposals, Types (Short and Long proposals) Parts of a Proposal: Elements, Scope and Limitations, Conclusion			
	2.2	Conducting Business Meetings: Types of Meetings, Roles and Responsibilities of Chairperson, Secretary and Members, Meeting Etiquette Documentation: Notice, Agenda, Minutes		L2	
Self-Learning Topic: Students will work in groups to plan an event and will share the planning through a meeting.					
03	EMPLOYMENT SKILLS		3	L3	10
	3.1	Cover Letter & Resume: Parts and Content of a Cover Letter, Essential Parts of a Resume, Types of Resume Statement of Purpose: Importance of SOP, Tips for Writing an Effective SOP			
	3.2	Personal Interviews: Planning and Preparation, Types of Questions, Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based), Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic & Virtual		L3	

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	3.3	Formal Dressing & Body Language		L1	
Self-Learning Topic: Students will prepare a resume, cover letter, and SOP for a chosen opportunity based on their personal details and visiting profiles from LinkedIn.					
04	CORPORATE VALUES & ETHICS		4		3
	4.1	Corporate Image & Reputation: 1) Branding strategies 2) Visual identity 3) Cultural awareness		L2	
	4.2	Intellectual Property Rights: Copyrights, Trademarks, Patents, Industrial Designs, Geographical Indications, Integrated Circuits, Trade Secrets (Undisclosed Information)		L2	
Self-Learning Topic: Students will interact with a professional working in corporate sharing his profile and present it by applying branding strategies and IPR concepts.					

Continues Internal Assessment (CIA):

Theory Course (CIA Rubric)	Activity (Assignment)	Test (Personal Interview)	Attendance	Total
	10	10	5	25

List of Assignments:

Sr. No.	Assignments
1	Report Synopsis
2	Writing a Technical Proposal
3	Meeting Documentation
4	Cover Letter and Resume
5	IPR
6	Project / Book Report should contain minimum 40 Pages.

Note: End Sem Exam (Oral) will be based on personal interview.

Textbooks:

Sr. No.	Title	Author(s)	Publisher
1	Humanities for Engineering Curriculum: Technical Writing & Professional Communication	V. M. Arms	McGraw-Hill, Boston
2	Business Communication Today	C. L. Bovee & J. V. Thill	Pearson, New Jersey

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Sr. No.	Title	Author(s)	Publisher
3	Verbal Communication: Soft Skills for A Digital Workplace	J. Butterfield	Cengage Learning, Boston
4	Personal Development for Life & Work	L. A. Masters, H. R. Wallace & L. Harwood	South-Western Cengage Learning
5	Technical Communication, Principles and Practice	Meenakshi Raman & Sangeeta Sharma	Oxford University Press, New Delhi
6	Communication Skills: A Workbook	Sanjay Kumar & Pushp Lata	Oxford University Press, New Delhi

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Mini Project - 1

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CEMIP501	Mini Project - 1	0	0	2	0	0	1	1
		Evaluation Scheme						
		Component		CIA		ESE (Presentation & Oral)		Total
		Theory		-		-		-
		Laboratory		25		25		50

Course Objectives: The course will enable students to:

1	Identify and define a real-world engineering problem relevant to Electrical & Computer Engineering.
2	Apply basic engineering concepts, tools, and techniques to design a feasible solution.
3	Develop teamwork, project planning, and communication skills.
4	Demonstrate prototype development, testing, and documentation skills.

Course Outcomes (COs): At the end of the course, students will be able to:

CO 1	Formulate a problem statement with clear objectives and constraints.
CO 2	Design and implement a basic solution using appropriate tools/technologies.
CO 3	Work effectively in a team and manage project tasks.
CO 4	Present results through reports, presentations, and demonstrations.

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Sr. No.	Detailed Contents	CO Mapped	BL	No. of Week Required
1	Orientation, domain selection, Problem identification & literature survey, Problem definition & objective setting	C01	L3	2
2	Feasibility study (technical, economic), System design (block diagram, methodology), Tool/technology selection.	C02	L4	2
3	Initial implementation / simulation, Prototype development, Testing & debugging, Performance analysis.	C03	L4	6
4	Documentation preparation, Presentation & demo preparation, Final evaluation & viva.	C04	L3	4
Total Number of Weeks				14

Project Execution Framework

Step 1: Problem Identification (C01)

- Select domain: EV, IoT, Power Systems, Embedded Systems, AI, etc.
- Define real-world problem
- Literature review (minimum 3–5 papers)

Step 2: Planning & Design (C02)

- Define objectives and scope
- Draw block diagram/system architecture
- Select hardware/software tools

Step 3: Implementation (C02)

- Simulation (MATLAB/Python/Proteus etc.)
- Hardware/Software development
- Integration of modules

Step 4: Testing & Analysis (C02)

- Test cases
- Performance evaluation
- Result validation

Step 5: Teamwork & Management (C03)

- Task distribution
- Weekly progress tracking
- Guide interaction

Step 6: Documentation & Presentation (C04)

- Report writing
- PPT preparation

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- Demonstration

Guidelines for Mini Project -1

1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2	Interdisciplinary project is also allowed.
3	Students should do survey and identify needs, which shall be converted into problem statement for project in consultation with faculty supervisor.
4	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of project.
5	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6	Faculty supervisor may give inputs to students during project activity; however, focus shall be on self-learning.
7	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
8	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
9	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
10	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the project.

SEMESTER ASSESSMENT

1. Continuous Internal Assessment – (25 Marks)

1.1 Internal Progress Presentation (Average of IPE-1 & IPE-2 = 20 Marks)

Assessment 1 (IPE-1): This assessment will be conducted in the 6th week of the academics, based on the progress and status of Project work which carries 20 marks.

Assessment 2 (IPE-2): This assessment will be conducted in the 12th week of the academics, based on the progress and status of Project work which carries 20 marks.

1.2 Attendance: 5 marks

2. End Semester Examination (25 Marks)

A Demonstration and Presentation of Mini Project - 1 in front of the External Examiner.

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