BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (Electrical & Computer): (2023 COURSE)

Module I

Sr. No	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	IA	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	**PEC-II/III**	3	2	-	60	40	25	-	25	150	3	1	-	04
2.	**Seminar**	-	4	-	-	-	50	-	50	100	-	2	-	02
3.	**Internship**	-	-	-	-	-	150	-	100	250	-	14	-	14
	Total	**3**	**6**	**-**	**60**	**40**	**225**	**-**	**175**	**500**	**3**	**17**	**-**	**20**

Module II

Sr. No	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	IA	TW	PR	OR	Total	Th	Pr/Or	Tut	**Total**
1.	**Industrial Drives & Applications**	3	2	-	60	40	25	-	25	150	3	1	-	04
2.	**Power System Stability & Control**	3	2	-	60	40	25	-	25	150	3	1	-	04
3.	**PEC-II/III**	3	2	-	60	40	25	-	25	150	3	1	-	04
4.	**Project Work**	-	16	-	-	-	50	-	50	100	-	8	-	08
	Total	**9**	**22**	**-**	**180**	**120**	**125**	**-**	**125**	**550**	**9**	**11**	**-**	**20**

Program Elective Course: II/III	
Software Testing and Quality Assurance	High Voltage Engineering
Blockchain Technology	Computer Aided Power System
Information Storage and Retrieval	Natural Language Processing
Industrial Control System-II	Introduction to Devops
Power Quality Issues & Mitigation Techniques	Quantum Computing

Instructions

1. Students shall be permitted to register for either Module I or Module II in a given term. A student is not allowed to register for both modules simultaneously.

2. Student has to take one PEC course in semester VII and another in Semester VIII from the above Program Elective Course basket.

PROGRAM ELECTIVE COURSE-II/III: SOFTWARE TESTING AND QUALITY ASSURANCE

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term work: 25 Marks Oral: 25 Marks	Total: 04

Course Pre-requisites:

The Students should have knowledge of Software Engineering Fundamentals, Programming Fundamentals.

Course Objectives:

- Understand Software Testing Fundamentals.
- Apply Quality & Reliability Concepts
- Develop Test Planning Skills.
- Use Test Case Design Techniques.
- Analyze Defects & System Behavior

Course Outcomes:

1.	Explain fundamental concepts of software testing, defects, failures, and quality management in engineering systems.
2.	Apply software quality assurance and quality control principles to embedded, real-time, and hardware–software integrated systems.
3.	Design effective test plans, test strategies, test cases, and test metrics considering electrical system constraints and reliability requirements.
4	Evaluate and apply Software Quality Assurance (SQA) and Software Quality Control (SQC) models, quality metrics, and standards for ensuring reliability and quality in engineering systems.”
5	Analyze defects, failures, and system behaviour in industrial automation, power monitoring, and PLC-based applications.
6	Evaluate and apply software quality frameworks, Agile quality practices, statistical quality techniques, and process improvement models for ensuring reliability and quality in engineering systems.

UNIT -I	**Introduction to Software Testing**	**(06Hours)**
	Foundations of Software Testing,Software Errors, Defects & Failures,Quality Assurance & Quality Management, Software Development Context,Total Quality Management (TQM) & Continuous Improvement,Domain-Specific Quality & Testing Concepts,Metrics, Problem Solving & Tools Exemplar / Case Studies Students should analyze testing & quality scenarios from: • Embedded system failures • Smart grid / power monitoring software issues • PLC & industrial automation software defects	
UNIT – II	**Test Planning and Quality Management**	**(06 Hours)**
	Test Planning Fundamentals, Roles &Responsibilities, Test Plan & Strategy Electrical Context Additions, Test Cases & Test Data, Entry& Exit Criteria, Test Execution &Scheduling, Functional Testing Approaches, Electrical& System-Level Additions, Test Monitoring &Control, Test Metrics, Defect & Failure Analysis Test Reporting & Configuration Management, Quality Assurance & Quality Management Exemplar / Case Studies Students should evaluate planning & quality scenarios from: • Embedded controller testing • Power system monitoring software • Industrial automation / PLC logic testing	
UNIT – III	**Test Case Design Techniques**	**(06 Hours)**
	Software Testing Methodologies, Test Case Design Techniques1.Static Testing Techniques,2. Dynamic Testing Techniques, I. Structural (White Box) Techniques, II. Black Box Techniques III. Experience-Based Techniques, Levels of Testing, Special Testing Perspectives for Electrical Systems Exemplar / Case Studies Students analyze testing scenarios from:	

	• Embedded controller logic • Industrial control / PLC systems • Power monitoring & protection software	
UNIT - IV	**Software Quality Assurance and Quality Control**	**(06 Hours)**
	Software Quality Assurance (SQA):Introduction to Software Quality Assurance, Software Product Quality Considerations, Software Development & Product Context, Defects & Quality Challenges, Software Quality Management Software Quality Control (SQC):Software Quality Models, Quality Measurement & Metrics, Quality Planning & Implementation, Quality Tools &Techniques, Reliability& Quality Control, Quality Management System Models, Complexity Metrics & Customer Satisfaction, International Quality Standards Exemplar / Case Studies Students should evaluate SQA & SQC scenarios from: • Power system monitoring software • Safety-critical control software issues	
UNIT - V	**Automation Testing Tools / Performance Testing Tools**	**(06 Hours)**
	Introduction to Automation Testing,Automation Frameworks, Benefits & Limitations of Automation,Selecting Automation Testing Tools,Selenium Automation Tools (Web-Based Testing), Other Automation Tools, Performance & System Behavior Testing ,8. Automation in Embedded & Hardware-Integrated Systems Exemplar / Case Studies Students analyze automation scenarios from: • Embedded controller validation • IoT device communication testing • Industrial automation interfaces	
UNIT - VI	**Testing Framework & Agile Quality Practices**	**(06 Hours)**
	Foundations of Software Quality, Software Quality Assurance (SQA),Statistical Software Quality Assurance,Six Sigma & Quality Management,Quality Standards & Models,SQA Plan & Quality Management, Quality Metrics & Measurement,Software Maintenance & Quality,Ishikawa's 7 Basic Quality Tools. Agile Quality Principles: Introduction, Testing in Agile Lifecycle, Agile Testing Planning & Strtegy, Defect Management in Agile, Automation & Continuous integration, Quality Metrics in Agile, Agile & Six Sigma Synergy. Exemplar / Case Studies Students analyze quality & framework scenarios from: • Embedded controller reliability issues • Real-time system failures • Hardware–software integration challenges	

Term Work: (Students Should Perform at least 08 experiments from the following list)Minimum 8 experiments

1. Write Test Scenarios for Industrial Control System Interface Login
2. Write Test Scenarios for IoT Device Monitoring Dashboard Login
3. Write Test Cases for Smart Meter Monitoring System/ Sensor Data Visualization Portal
4. Create Defect Report for Automation / Control System Fault
5. Installation of Automation Environment Setup
6. Prepare SRS for Industrial Automation System/ Sensor-Based Safety System
7. Design test scenarios for Event-driven systems
8. Develop test cases for Minimum / Maximum sensor limits
9. Test conceptual failure conditions Power failure,Network failure&Invalid device response
10. Analyze Response-time constraints, Real-time behaviour expectations
    Note.

Note: Subject teacher can add more assignments.

Text Books:

1. Kshirasagar Naik & Priyadarshi Tripathy, Wiley India Pvt. Ltd.
2. Dorothy Graham, Erik Van Veenendaal, Isabel Evans & Rex Black, Cengage Learning.
3. Srinivasan Desikan & Gopalaswamy Ramesh, Pearson Education.

4. Paul Ammann & Jeff Offutt, Cambridge University Press.
5. Lisa Crispin & Janet Gregory, Addison-Wesley.
Reference Books:
1. The Art of Software Testing,Authors: Glenford J. Myers, Corey Sandler, Tom Badgett
2. ISBN: 978-1118031964
3. Foundations of Software Testing,Authors: Rex Black, Erik van Veenendaal, Dorothy GrahamISBN: 978-1473764798
4. Software Testing Techniques,Author: Boris Beizer,ISBN: 978-0442206727

Syllabus for Internal Assessment:	
Internal Assessment -1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment -2	UNIT – IV, UNIT – V, UNIT - VI

PROGRAM ELECTIVE COURSE-II/III: BLOCKCHAIN TECHNOLOGY

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term work: 25 Marks Oral: 25 Marks	Total: 04

Course Pre-requisites:

The Students should have knowledge of

	Computer Fundamentals & Programming Basics, Data Structures

Course Objectives:

	To equip students with a comprehensive understanding of blockchain fundamentals, cryptographic principles, consensus mechanisms, smart contracts (including Ethereum architecture and EVM concepts), and real-world applications in IoT, energy systems, and ECE domains.

Course Outcomes:

1.	Explain blockchain fundamentals, key characteristics, evolution, and differences between centralized and distributed systems
2.	Describe blockchain data structures including blocks, transactions, hash linking, and mechanisms ensuring immutability
3.	Apply cryptographic concepts such as hash functions, SHA-256, public key cryptography, digital signatures, and Merkle trees in blockchain contexts.
4	Analyze consensus mechanisms (PoW, PoS, PoA, DPoS) and evaluate their security assumptions, trade-offs, and vulnerabilities.
5	Demonstrate understanding of smart contracts, Ethereum architecture, EVM, gas mechanism, and basic Solidity constructs.
6	Evaluate blockchain applications across domains including finance, IoT, energy systems, and smart grids with engineering relevance.

UNIT -I	**Blockchain Fundamentals & Evolution**	**(06 Hours)**
	What is Blockchain: Definition & Core Concepts, Key Characteristics (Decentralization, Immutability, Transparency) Historical Back ground: Origin of blockchain, Evolution: Blockchain 1.0 → 2.0 → 3.0, **Purpose of Blockchain**: Limitations of Traditional Databases, Centralizedvs Distributed Systems, Trustless Systems &Immutability, Types of Blockchains: Public (Permissionless),Private / Consortium (Permissioned),Comparative Features	
UNIT – II	**Blockchain Data Structure & Architecture**	**(06 Hours)**
	Blocks & Transactions: Transaction basics, Block formation concept, Block Structure: Block Header Components, Nonce& Timestamp, Previous Hash, Hash Pointers &Linking: Hash linking mechanism, Chain formation logic, Immutability Mechanism: How tampering is detected, Role of cryptographic hashes.	
UNIT – III	**Cryptography & Security Foundations**	**(06 Hours)**
	Cryptographic Hash Functions :Security Properties, Determinism& Avalanche Effect,SHA-256 Concept & Usage, Hash Puzzles & Mining Logic: Proof-based validation, Difficulty & Nonce Concept, **Public Key Cryptography:** Public vs Private Keys, Address Generation, Key Management Concepts, Digital Signatures:Signing&Verification,Integrity&Authentication,Blockchain Transactions Security, Merkle **Trees**: Tree Structure, Efficient Verification, Role in Blocks & SPV	
UNIT - IV	**Consensus Mechanisms & Network Security**	**(06 Hours)**
	Consensus in Distributed Systems:Agreement Problem,Need for Consensus Protocols Proof of Work (PoW): Mining Mechanism, Computational Puzzle, Security Assumptions Proof of Stake (PoS):Stake-based Validation, Comparison with PoW, Benefits &Tradeoffs, Other Consensus Models: Proof of Authority (PoA),Delegated Proof of Stake (DPoS),Security Threats & Attacks:51% Attack (Conceptual),Double Spending Problem,Network & Incentive Issues.	
UNIT - V	**Smart Contracts & Ethereum Platform**	**(06 Hours)**
	Smart Contracts: Definition & Working Principle, Lifecycle of Smart Contracts, Advantages & Limitations, Ethereum Fundamentals: Ethereum Virtual Machine (EVM), Ether (ETH) & Gas Concept,Accounts & Transactions, **Introduction to Solidity:** Structure of a Contract, Basic Data Types, Functions& State Variables, **Decentralized Applications (DApps):** Architecture Overview, Interaction with Smart Contracts.	

UNIT - VI	Applications & Practical Exposure (ECE Focus)	(06 Hours)
	Blockchain Applications: Finance (Cryptocurrency & Wallets), IoT Systems (Device Security & Trust),Energy & Smart Grids (P2P Energy Trading),Other Use Cases (Supply Chain, E-Governance, Healthcare), Practical Orientation:Importance of wallets & test networks, Blockchain development tools overview.	

Term Work: (Students Should Perform at least 08 experiments from the following list) Minimum 8 experiments

1. To perform one Ether transaction, and record the Gas Fee and Transaction Hash by Installing MetaMask, connect to the Sepolia test network.
2. To Create your own wallet using MetaMask and identify the Wallet Address while explaining the concept of the Private Key
3. To Explain the concepts of Public Key and Private Key, and justify why the Private Key must remain secret.
4. Write a Solidity smart contract implementing Deposit, Withdraw, and Show Balance functions for a simple bank account.
5. Compile and deploy a Solidity smart contract using Remix IDE (JavaScript VM) and execute at leastone function
6. Write a Solidity program using a Structure (Student) and an Array to store details of multiple students.
7. Explain the Fallback Function in Solidity and describe the conditions under which it is executed.
8. Deploy a smart contract using Remix IDE and record the Gas Consumed and Transaction Fee for the transaction.
9. Write short notes on Public, Private, and Consortium Blockchains, including one example for each.
10. Explain Hyperledger, define a Business Network, and discuss the usefulness of permissioned blockchains

Note: Subject teacher can add more assignments.

Text Books:

1. Mastering Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, O'Reilly Media.
2. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress Publications.
3. Mastering Ethereum: Building Smart Contracts and DApps, Andreas M. Antonopoulos & Gavin Wood, O'Reilly Media.

Reference Books:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies – Andreas M. Antonopoulos Publisher: O'Reilly Media 1st Edition ISBN-10: 1449374042, ISBN-13: 9781449374044.
2. Mastering Ethereum: Building Smart Contracts and DApps – Andreas M. Antonopoulos & Gavin Wood Publisher: O'Reilly Media, 1st Edition (2018) ISBN-10: 1491971940, ISBN-13: 9781491971949
3. Blockchain Basics: A Non-Technical Introduction in 25 Steps – Daniel Drescher Publisher: Apress 1st Edition (2017), ISBN-10: 1484226038, ISBN-13: 9781484226032

Syllabus for Internal Assessment :	
Internal Assessment -1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment -2	UNIT – IV, UNIT – V, UNIT - VI

PROGRAM ELECTIVE COURSE-II/III: INFORMATION STORAGE AND RETRIEVAL

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term Work: 25 Marks & Oral: 25 Marks	Total: 04

Course Pre-requisites: The Students should have

1.	. Data Structures and Files, Database management systems

Course Outcomes:

1.	Gain a clear understanding of the fundamental concepts of Information Retrieval.
2.	Understand the processes involved in storing and retrieving both text and multimedia data.
3.	Analyze and evaluate the performance of information retrieval systems.
4.	Design and develop effective user interfaces for retrieval systems.
5.	Recognize the significance and applications of recommended systems.
6.	Understand the concepts and applications of multimedia and distributed information retrieval systems.

UNIT - I	**Introduction**	**(06 Hours)**
	Basic Concepts of IR, Data Retrieval & Information Retrieval, text mining and IR relation, IR system block diagram. **Automatic Text Analysis:** Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighing, Probabilistic Indexing Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing, Clustered files, Hypertext and XML data structures.	
UNIT - II	**Classification and Retrieval Search Strategies**	**(06 Hours)**
	Retrieval strategies: Vector Space model, Probabilistic retrieval strategies, Language models, Inference networks, Extended Boolean retrieval, Latent semantic indexing, neural networks,Fuzzy set retrieval. **Retrieval utilities:** Relevance feedback, Cluster Hypothesis, **Clustering Algorithms:** Single Pass Algorithm, Single Link Algorithm.	
UNIT - III	**Retrieval performance evaluation and Visualization**	**(06 Hours)**
	Performance evaluation: Precision and recall, MRR, F-Score, NDCG, user oriented measures, cross fold evaluation. **Visualisation in Information System:** Starting points, document context, User relevance judgement, Interface support for search process.	
UNIT - IV	**Distributed and Multimedia IR**	**(06 Hours)**

	Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, web issues. **MULTIMEDIA IR:** Introduction, Data Modeling, Query languages, Generic multimedia indexing approach, One dimensional time series, two dimensional color images, Automatic feature extraction.	
UNIT - V	**Web Searching**	**(06 Hours)**
	Searching the Web: Challenges, Characterizing the Web, Search Engines, Browsing, Matasearchers, Web crawlers, Meta-crawler, Web data mining, Finding needle in the Haystack, Searching using Hyperlinks, Page ranking algorithms: Pagerank, Rank SVM.	
UNIT - VI	**Applications of Information Retrieval**	**(06 Hours)**
	Applications: Signal and Pattern Retrieval, Smart Grid Data Analysis, IoT Data Search & Filtering**,** Biomedical Signal Retrieval .**Emerging Areas:** Semantic Web & Knowledge Graphs, Multimedia Information Retrieval, Cross-Lingual Retrieval, AI-powered Intelligent Search Systems	

TERMWORK: (Students should perform at least 08 experiments from the following list)

Minimum 8 experiments

1. Model inventory data and use MongoDB multi-document ACID transactions to ensure that updating stock during a purchase does not result in a negative inventory or overselling.
2. To implement single pass algorithm for clustering
3. To implement a program Retrieval of documents using inverted files.
4. Sort data and manage large result sets.(Mongo DB)
5. Implement full-text search on product descriptions.(Mongo DB)
6. Extract features from input image and plot histogram for the features.
7. Write a program to recommend a product / learning course based on person preferences /education details.
8. Design a "Customer" document that aggregates information from multiple legacy systems into a single, nested JSON structure. Implement MongoDB Atlas Search to allow quick lookup by partial name or phone number.
9. Write a program using any algorithm to retrieve documents. Evaluate the algorithm using all evaluation methods.
10. Design a MongoDB collection for a product catalog. Use a flexible schema to store common fields (name, price) and varying attributes (e.g., "screen size" for TVs, "fabric" for shirts) in a nested document or array..

Text Books:

1. Yates & Neto, Modern Information Retrieval, Pearson Education, ISBN:81-297-0274-6
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk)., 2ndISBN:978- 408709293.
3. David Grossman, Ophir Frieder, Information Retrieval - Algorithms and Heuristics, Springer International Edition, ISBN: 978-1-4020-3004-8.
4. Grigoris Antoniou and Frank van Harmelen, A semantic Web Primer, Massachusetts
5. Institute of Technology, ISBN: 978-0-262-01242-3.
6. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, Foundations of Semantic Web

Technologies, Chapman & Hall/CRC, ISBN: 9781420090505.

7. Hang Li, Learning to Rank forInformation Retrievaland Natural Language.
8. Processing, Morgan & Claypool, ISBN: 9781608457076.

Reference Books :

1. Yates & Neto, "Modern Information Retrieval", Pearson Education.
2. C.J. Rijsbergen, "Information Retrieval", (www.dcs.gla.ac.uk).
3. R. C. Gonzalez, R. E. Woods, “Digital Image Processing”, Pearson Education.
4. Zhang, Jin, “Visualization for Information Retrieval”, Springer-Verlag Berlin Heidelberg.
5. V. S. Subrahamanian, Satish K. Tripathi, “Multimedia information System”, Kulwer Academic Publisher.
6. Ricci, F, Rokach, L. Shapira, B.Kantor, “Recommender Systems Handbook”

Syllabus for Internal Assessment:

Internal Assessment-1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment-2	UNIT – IV, UNIT – V, UNIT - VI

PROGRAM ELECTIVE COURSE-II/III: INDUSTRIAL CONTROL SYSTEM -II		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours/ Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours/Week	Continuous Assessment: 40 Marks	Practical:01
	Term work: 25 Marks Oral: 25 Marks	Total: 04

Course Prerequisites:		
The students should have knowledge of		
	Linear Control System, Methods of Stability Analysis, Matrix Algebra	
Course Objectives :		
	This course introduces state space modeling and stability analysis of system. It includes phase plane and describing function method of stability analysis of non-linear system. It also, introduces fundamental mathematical concepts and stability analysis of digital control system and adaptive control systems.	
Course Outcomes: After learning this course the students will be able to		
1.	Represent the systemequation in various state space models (physical, phase and canonical variables)	
2.	Draw block diagram and signal flow graph from state space model of system. Calculate the solution of state equation; calculate transfer function from state space model.	
3.	Recognize various nonlinearities and its effect on system stability. Principle and operations of Describing Function with its merits and demerits.	
4.	Compare between linear and nonlinear, analog and digital, state space and transfer function model, Z-transform and Inverse Z-transform	
5.	Calculate pulse transfer function of digital system. Explain the mathematical model of digital systemand select appropriate sampling frequency.	
6.	Applications of adaptive control, robust control, Artificial neural network and Fuzzy logic	
UNIT I	**State Variable Representation**	**(06 Hours)**
	Comparison of Transfer Function and State Variable Analysis, Concept of State, State Space, State Vector, State Equation, Output Equation, State Space Representation Using :Physical Variable, Phase Variable and Canonical Variables with Block Diagram, Decomposition of Transfer Function, Eigen Values and Eigen Vectors, Diagonalization of the System Matrix with Distinct & Repeated Eigen values.	
UNIT II	**State Variable Analysis and Design**	**(06 Hours)**
	Solution of State Equation, State Transition Matrix (STM), Methods to Determine STM: Infinite Series Method, Laplace Transform, Caley Hamilton Theorem. Definition of Controllability, Observability, Kalman’s Test, Gilbert’s Test, Determination of Transfer Functions from State Model. State Feedback Control, Pole Placement Design through State Feedback.	
UNIT III	**Nonlinear system**	**(06 Hours)**
	Introduction, Classification, Peculiar Behaviour of Nonlinear System: Sub-Harmonics Response, Jump Resonance, Limit Cycle: Stable and Unstable, Amplitude as Function of Frequency Oscillation, Non-linear Spring Mass System, Sub-Harmonic Oscillation, Asynchronous Quenching, Frequency Phase Plane Method, Singular Points, Phase Plane Plots using Delta Method Determination Stability from State Trajectory, Relation with Time Domain Analysis. Concept of Describing Function, Derivation of Describing Function of Various non-linear Elements, Stability Analysis using Describing Function, Existence of Limit Cycle, Merits and Demerits of Describing Function Method.	
UNIT IV	**Discrete time system**	**(06 Hours)**
	Basic Elements of Discrete Data System, Merits of Discrete System, Sampling and Selection of Sampling Period, Sample and Hold Circuit, A/D and D/A Converter, Modeling of Zero Order Hold, Reconstruction of Signals from Samples, Shannon’s Sampling Theorem. Z-Transform: Definition, Simple Functions, Inverse Z-transform, Linear Difference Equations and Solutions.	
UNIT V	**Analysis of Discrete time system**	**(06 Hours)**

	Derivation of Pulse Transfer function, Pulse Transfer Function of Closed Loop System, Bilinear Transformation, Stability in Z-Plane, Jury's Test, Routh's Criteria, State Space Representation of Discrete Time Systems, State Space Models from Pulse Transfer Function.	
UNIT VI	**Introduction to advances in control system**	**(06 Hours)**
	Adaptive Control, Model Reference Adaptive Control Block Diagram and Working With Practical Applications, Robust Control, Fuzzy Logic, Artificial Neural Network Algorithm and Learning Architecture	

Term work: The term work shall consist of record of minimum eight experiments .To ensure that at least one experiment on each unit.

1. To convert transfer function into state model i) phase variable form ii) canonical form
2. To derive state model of DC servo motor from physical variables and observe step response, i.e. to solve state equation of DC servo motor
3. To determine Eigen values, Eigen vectors and diagonalise the system.
4. To determine controllability and observability by Kalman's test and Gilbert's test.
5. Design of state feedback gain matrix by pole placement.
6. To plot phase plane trajectory of system with nonlinear elements using SIMULINK.
7. To analyze stability of nonlinear system using describing function.
8. To convert continuous time system to discrete time system and to observe effect of sampling time on step response.
9. To determine the gain for stability in Z domain.
10. To study adaptive control and robust control applications with MATLAB demos.

Text Books:

1. I.J. Nagrath, M. Gopal," Control System Engineering", New Age International Publishers–Fourth edition.
2. Katsuhiko Ogata, "Digital control system", Prentice Hall, 2010.
3. M. Gopal, "Digital control system".
4. Dorf and Bishop, "Modern Control systems"-Pearson education.

Reference Books:

1. Nise N.S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011.
2. D. Roy Choudhary, "Modern Control Engineering", PHIL earning Pvt. Ltd., 2005.
3. Geir E. Dullered, F.G. Paganini-"A course in robust control theory"- Springer.
4. Jan Jantzen-'Foundation of Fuzzy control– a practical approach–Wiley.

Syllabus for Internal Assessment:	
Internal Assessment-1	UNIT–I, UNIT–II, UNIT- III
Internal Assessment-2	UNIT–IV, UNIT–V, UNIT-VI

PROGRAM ELECTIVE COURSE-II/III: POWER QUALITY ISSUES & MITIGATION TECHNIQUES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours/Week	End Semester Examination: 60 Marks	Theory : 03
Practical: 02 Hours/Week	Internal Assessment: 40 Marks	Practical: 01
	TW:25 Marks & OR: 25 Marks	Total: 04

Course Pre-requisites:

The Students should have prior knowledge of

Power System, Electrical Instrumentation and Measurement, Electrical Safety Standards, Indian and International standards.

Course Objectives:

The objective of this course is to introduce the students to the importance of Power Quality, its terms, measurement technique, power quality mitigation techniques and relevant standards.

Course Outcomes: After learning this course students will be able to

1	Understand the basics of Power Quality.
2	Apply the concept and importance of Voltage Sag
3	Understand the concept and consequences of Overvoltage
4	Design, Evaluate, compare Harmonic filters and understand the concept of harmonics.
5	Understand and apply the techniques and importance of Power Quality monitoring
6	Compare and understand the various Power quality measurement systems and its guidelines.

UNIT – I	**Basics of Power Quality**	**(06 Hours)**
	What is Power Quality? Poor and Good Power Quality, Symptoms of poor power quality, Importance of Power Quality, Power Quality evaluation procedure, Power Quality terms- under voltage - over voltage. Concepts of transients – short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation, waveform distortion. International bodies governing Power Quality, CBEMA curve, ITIC curve.	
UNIT - II	**Voltage Sag**	**(06 Hours)**
	Concept of Voltage Sag, Sources of Voltage Sag, Impacts of Voltage Sag, Voltage Sag mitigation techniques, Voltage Sag due to Induction Motor starting. Estimating voltage sag performance - Thevenin's equivalent source.	
UNIT -III	**Over Voltage**	**(06 Hours)**
	Sources of over voltages - Capacitor switching – lightning – ferro resonance. Mitigation of voltage swells - surge arresters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD,EMTP, ETAP, MATLAB etc	
UNIT -IV	**Harmonics**	**(06 Hours)**
	Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion- Voltage and current distortions - Harmonic indices - Inter harmonics. Design of Harmonic filter.	
UNIT - V	**Power Quality Monitoring**	**(06 Hours)**

	Selection criterion for Power Quality measuring devices- Monitoring considerations - monitoring and diagnostic techniques for various power quality problems – power quality analyzer- power line disturbance analyzer – quality measurement equipment – harmonic / spectrum analyzer - flicker meters – Disturbance Analyzer. Applications of expert systems for power quality monitoring.	
UNIT -VI	**Power Quality Measurement**	**(06 Hours)**
	Power quality measurement devices, power quality measurements, Number of test locations, Test duration, Instrument set-up, Instrument set up guidelines. Distributed Generation and Power Quality: Resurgence of DG, Distributed generation technologies, Interface to the utility system, Power quality issues, Operating conflicts.	

Term Work:

The term work shall consist of record of minimum eight experiments and not limited to:

1. Study of Voltage Sag for 3-Phase Induction Motor starting
2. Design of SVC in MATLAB for Reactive Power compensation
3. Design and implementation of Harmonic Filter in ETAP for Harmonic mitigation.
4. Design and implementation of Harmonic Filter in MATLAB for Harmonic mitigation.
5. Design of a capacitor bank in ETAP and its implementation.
6. Study of harmonic distortion limits in agreement with IEEE 519-1992
7. Study of power quality monitoring standards such as IEEE 1159 and IEC 61000-4-30
8. Case study of DG and Power Quality Site
9. Measurement of current harmonics using current probe.
10. Study and calculation of THD and IHD of various types of non-linear loads

Text Books:

1. Electrical Power Systems Quality, Dugan R C, Mc Granaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
2. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley India publications,2011.
3. Power Quality- Shripad Desai- Tech Neo Publications, 2020
4. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, Mc Graw–Hill, 2000.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
4. G.T. Heydt, "Electric Power Quality", 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.

Syllabus for Internal Assessment:

Internal Assessment-1	UNIT–I,UNIT–II, UNIT-III
Internal Assessment-2	UNIT–IV,UNIT–V,UNIT-VI

PROGRAM ELECTIVE COURSE-II/III: HIGH VOLTAGE ENGINEERING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours/ Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours/Week	Internal Assessment: 40 Marks	Practical: 01
	TW: 25 Marks OR: 25 Marks	Total: 04

Course Pre-requisites:

The Students should have prior knowledge of

	Basic Electrical Engineering, Electrical Power System, Electrical Measurement & Instrumentation.

Course Outcomes: After learning this course students will be able to

1	Describe conduction and breakdown in solid, liquid and gases.
2	Describe generation of high DC voltage and current.
3	Learn generation of high alternating voltages and currents.
4	Explain measurements of high DC voltages.
5	Explain measurements of high DC currents.
6	Illustrate design, planning and layout of high voltage laboratories.

UNIT– I	**Introduction: Conduction & break down in solid, liquid and gases**	**(06 Hours)**
	Townsend's current growth equation, Current growth in the presence of secondary processes, Townsend's criterion for breakdown, Breakdown in electronegative gases. Streamers theory of breakdown in gases, Paschen's law, Classification of liquid dielectrics, Pure liquids and commercial liquids, Conduction and breakdown in pure liquids, Conduction and breakdown in commercial liquids, Suspended particle mechanism, Cultivation and bubble theory, Breakdown in solid dielectrics, Intrinsic breakdown, Electromechanical breakdown, Breakdown due to Treeing and Tracking, Breakdown due to internal discharges, Thermal breakdown, Electrochemical breakdown.	
UNIT-II	**Generation of high direct voltages and currents**	**(06 Hours)**
	Requirements of HV generation in Laboratory, voltage stress, testing voltages, generation of direct voltages – AC to DC conversion – single phase rectifier circuits–cascade circuits – voltage multiplier circuits – Cockcroft-Walton circuit – voltage regulation – ripple factor – Electrostatic generator. Generation of high direct current voltages, Half and full wave rectifier circuits, Voltage doublers circuits, Voltage multiplier circuits, Electrostatic machines, Vande Graff generator.	
UNIT-III	**Generation of alternating voltages and currents**	**(06 Hours)**
	Testing transformer – single unit testing transformer, cascaded transformer– equivalent circuit of cascaded transformer–resonant circuits–resonant transformer–voltage regulation. Generation of high alternating voltages, Generation of high frequency AC high voltages, Generation of impulse voltages, Standard impulse wave shape, Circuits for producing impulse waves, Multistage Impulse generator–Marx circuits, Generation of high impulse currents.	
UNIT-IV	**Measurements of high DC Voltages**	**(06 Hours)**
	Measurements of high direct current voltages, High ohmic series resistance with micro ammeter, Resistance potential dividers for dc voltages, Generating voltmeter, Measurements of high AC and impulse voltages, Series impedance voltmeter, Capacitance potential dividers and capacitance voltage transformers, Electrostatic voltmeter. Spark gaps for measurements, Sphere gap for measurements.	

UNIT-V	**Measurements of high DC Currents**	**(06 Hours)**
	Measurements for high direct currents, Hall generators for dc measurements, Measurements of High-Power-frequency alternating currents, Measurements of High frequency and Impulse currents, Cathode-Ray-Oscillograph for voltage and Current measurements. Calibration of the measuring equipment, certification of the equipment.	
UNIT-VI	**Design, Planning and Layout of High Voltage Laboratories**	**(06 Hours)**
	Test facilities provided in high voltage laboratories, Activities and studies in high voltage and UHV laboratories, Classification of high voltage laboratories, Size and rating of large size high voltage laboratories, Size and dimension of the equipment in HV laboratories, Layout of high voltage laboratories, High voltage laboratories in India and abroad, Grounding of impulse testing laboratories, Electromagnetic shielding and earth return in high voltage laboratories.	

Term work: The term work shall consist of record of minimum eight experiments and not limited to

1. Measurement of breakdown strength of solid dielectrics.
2. Measurement of breakdown strength of liquid dielectrics.
3. Measurement of high voltage using sphere gap.
4. Study of breakdown in non-uniform fields and measurement of breakdown voltage (rod-rod, rod-plane, needle plane gap etc.
5. Study of corona and measurement of corona inception voltage.
6. Study of impulse generator.
7. C and tan delta measurement with bridge for HV equipment.
8. High voltage testing of armored cables.
9. Study of horn gap arrestor.
10. Measurement of high resistivity (leakage current).
11. Measurement of flashover voltage and study of flashover along dielectric surface (plane surface, corrugated surface)
12. Testing of surge arrestors gapless type.

Text Books:

1. M S Naidu and V Kamraju, “High Voltage Engineering”, TMC Publishing Company Ltd.
2. C. L Wadhwa, “High Voltage Engineering”, New Age International (P) Ltd, Publishers.
3. V Razevig, Dr.MP Chourasia, “High Voltage Engineering”, Khanna Publications.

Reference Books:

1. V Razevig, Dr.MP Chourasia, “High Voltage Engineering”, Khanna Publications.
2. Dr. RS Jha, “High Voltage Engineering”, Dhanpat Rai and Sons.
3. E Kuffel, W, S Zaengl, “High Voltage Engineering Fundamentals”, Pergamon Press.
4. K Kuffel M Abdulla, “High Voltage Engineering”, Pergamon Press.
5. DV Razevig, “High Voltage Engineering”, Khanna Publication.
6. TJ Gallgher, “High Voltage Measurement, Testing and Design”, John Wiley Publication.
7. Dieter Kind, “An Introduction to High Voltage Experimental Techniques”, Wiley Publication.
8. Adolf J Sohwab, “HV Measurement Technique”, MIT Press Cambridge.
9. LL Alston, “High Voltage Technology”, Harwell Post Graduate Series, Oxford University Press, New York.

Syllabus for Internal Assessment:

Internal Assessment-1	UNIT–I, UNIT–II, UNIT- III
Internal Assessment-2	UNIT–IV, UNIT–V, UNIT-VI

PROGRAM ELECTIVE COURSE-II/III: COMPUTER AIDED POWER SYSTEM

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 03 Hours/Week	End Semester Examination: 60 Marks	Theory : 03
Practical: 02 Hours/Week	Continuous Assessment: 40 Marks	Practical: 01
	TW: 25 Marks OR: 25 Marks	Total: 04

Course Pre-requisites:

The Students should have knowledge of

Fundamentals of Electrical Engineering, Power System Generation, Application Software in Electrical Engineering, MATLAB/ Python Programming, Machine Learning

Course Objectives:

- To develop computational models for modern interconnected power systems.
- To analyze AC, DC and hybrid AC–DC grids.
- To study smart grid monitoring, state estimation & cybersecurity.
- To perform optimal, secure and renewable-integrated power flow studies.
- To apply AI/ML tools for power system analysis and prediction.

Course Outcomes: Students will be able to

1.	Model modern power system components including renewable and inverter-based resources and formulate the bus admittance matrix.
2.	Analyze AC load flow using various numerical methods and assess voltage performance in interconnected power systems.
3.	PerformAC–DC and hybrid grid load flow studies using sequential and simultaneous approaches.
4	Evaluate symmetrical and unsymmetrical faults and examine stability aspects in renewable-integrated power systems.
5	Formulate and solve optimal power flow problems for economic and secure operation of power systems.
6	Assess power system security using state estimation, contingency analysis, and wide area monitoring concepts.

UNIT - I	**Modern Power System Modeling & Digital Simulation:**	**(06 Hours)**
	Role of digital simulation in modern smart grids, Per-unit system and network representation, Modeling of: Transmission lines (π-model), Transformers (two winding, tap-changing), Synchronous generators, Inverter-Based Resources (Solar PV, Wind), Load modeling (static & ZIP model), Bus Admittance Matrix formation (Y_{bus}), Introduction to hybrid AC–DC grids and micro-grid modeling, **Industry Focus:** Renewable penetration modeling, grid code overview (CEA concept), real-time simulation basics.	
UNIT - II	**Advanced Load Flow Analysis:**	**(06 Hours)**
	Power flow equations (Polar form), Classification of buses (Slack, PV, PQ), Gauss-Seidel Method (concept & limitations), Newton-Raphson Method (algorithm & advantages), Fast Decoupled Load Flow, Load flow with: Generator reactive power limits, Tap changing transformers, FACTS devices (basic modeling), **Industry Focus:** Voltage stability indices, PV/QV curves, renewable integrated load flow.	
UNIT - III	**AC–DC & Hybrid Grid Load Flow:**	**(06 Hours)**
	Introduction to HVDC transmission, LCC-HVDC basic equations, VSC-HVDC modeling (steady state), Sequential AC–DC load flow approach, Simultaneous AC–DC load flow approach, Multi-terminal DC & renewable evacuation concepts, **Industry Focus:** VSC-HVDC for offshore wind, Green Energy Corridors, hybrid AC–DC grids.	
UNIT - IV	**Fault Analysis & Stability with Renewable Integration:**	**(06 Hours)**
	Symmetrical & unsymmetrical faults, Formation of Z_{bus} matrix, Fault analysis (L-G, L-L, L-L-G, 3-Phase fault), Fault analysis with inverter-based generation, Short circuit levels in renewable rich grids, Introduction to transient stability & Fault Ride	

	Through (FRT), **Industry Focus:** Grid-forming vs grid-following inverter behavior, impact of DER on protection.	
UNIT - V	**Optimal Power Flow & AI Applications:**	**(06 Hours)**
	Formulation of Optimal Power Flow (OPF), Economic Dispatch with losses, Reactive Power Optimization, Security Constrained OPF (concept), Multi-objective optimization (cost & emission), Introduction to AI/ML in power systems (load forecasting, OPF), **Industry Focus:** Metaheuristic methods (PSO/GA overview), renewable dispatch optimization, carbon reduction.	
UNIT - VI	**Power System Security, State Estimation & Cybersecurity:**	**(06 Hours)**
	Operating states of power system, State Estimation (WLS method concept), PMU-based state estimation, Contingency analysis & sensitivity factors (LODF, GSF), Static & transient security assessment, Introduction to cybersecurity in smart grids & WAMS, **Industry Focus:** Wide Area Monitoring Systems (WAMS), digital- twins concept, online security monitoring.	

Term work: The term work shall consist of record of minimum eight experiments but not limited to:

1. Representation of Single line diagram of power system Using ETAP
2. AC Load flow studies using ETAP
3. AC-DC Load flow studies using ETAP
4. To perform short circuit analysis using ETAP
5. Fault Analysis using ETAP
6. Transient Stability Analysis using ETAP
7. Motor Acceleration Analysis using ETAP
8. Study of online security assessment and major components of online security analysis
9. Study of algorithm for contingency analysis
10. Study of state transition diagram

Text Books:

1. Hadi Saadat – *Power System Analysis*
2. J. Duncan Glover – *Power System Analysis & Design*
3. Allen J. Wood – *Power Generation, Operation and Control*
4. D. P. Kothari & J. S. Dhillon – *Power System Optimization*

Reference Books:

1. Prabha Kundur – *Power System Stability and Control*
2. K. R. Padiyar – *HVDC Power Transmission Systems*
3. Ali Keyhani – *Smart Power Grid*
4. S. S. Rao – *Engineering Optimization*

Syllabus for Internal Assessment:

Internal Assessment -1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment -2	UNIT – IV, UNIT – V, UNIT - VI

PROGRAM ELECTIVE COURSE-II/III: NATURAL LANGUAGE PROCESSING

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term Work: 25 Marks & Oral: 25 Marks	Total: 04

Course Pre-requisites: The Students should have

1.	Discrete Mathematics, Theory of Computation, Data science ans Big Data Analytics

Course Outcomes:

1.	Develop a strong foundation in the fundamental concepts and techniques of Natural Language Processing (NLP)
2.	Gain knowledge of morphological, syntactic, and semantic tasks involved in NLP.
3.	Design and implement various language modeling techniques used in NLP.
4.	Applysuitable tools and methods for processing natural language data effectively.
5.	Understand advanced real-world applications within the NLP domain.
6.	Explain the applications of NLP, including machine translation systems.

UNIT - I	**Introduction to Natural Language Processing**	**(06 Hours)**
	Introduction: Natural Language Processing, Why NLP is hard? Programming languages Vs Natural Languages, Are natural languages regular? Finite automata for NLP, Stages o NLP,Challenges and Issues(Open Problems) in NLP **Basics of text processing:** Tokenization, Stemming, Lemmatization, Part of Speech Tagging	
UNIT - II	**Language Syntax and Semantics**	**(06 Hours)**
	Morphological Analysis: What is Morphology? Types of Morphemes, Inflectiona morphology &Derivational morphology, Morphological parsing with Finite State Transducers (FST) **Syntactic Analysis:** Syntactic Representations of Natural Language, Parsing Algorithms, Probabilistic context-free grammars, and Statistical parsing **Semantic Analysis:** Lexical Semantic, Relations among lexemes & their senses – Homonymy,Polysemy, Synonymy, Hyponymy, WordNet, Word Sense Disambiguation (WSD), Dictionary based approach, Latent Semantic Analysis	
UNIT - III	**Language Modelling**	**(06 Hours)**
	Probabilistic language modeling, Markov models, Generative models of language, Log-Line Models, Graph-based Models **N-gram models:** Simple n-gram models, Estimation parameters and smoothing, Evaluatin language models, Word Embeddings/ Vector Semantics: Bag-of-words, TFIDF word2vec,doc2vec, Contextualized representations (BERT) **Topic Modelling:** Latent Dirichlet Allocation (LDA), Latent Semantic Analysis, Non Negative Matrix Factorization	
UNIT - IV	**Information Retrieval using NLP**	**(06 Hours)**
	Information Retrieval: Introduction, Vector Space Model **Named Entity Recognition:** NER System Building Process, Evaluating NER System Entity Extraction,Relation Extraction,Reference Resolution,Coreference resolution,Cross Lingual Information Retrieval	
UNIT - V	**NLP Tools and Techniques**	**(06 Hours)**

	Prominent NLP Libraries: Natural Language Tool Kit (NLTK), spaCy, TextBlob, Gensim etc. **Linguistic Resources:** Lexical Knowledge Networks, WordNets, Indian Language WordNet(IndoWordnet), VerbNets, PropBank, Treebanks, Universal Dependency Treebanks **Word Sense Disambiguation:** Lesk Algorithm Walker's algorithm, WordNets for Word Sense Disambiguation	
UNIT - VI	**Applications of NLP**	**(06 Hours)**
	Machine Translation: Rule based techniques, Statistical Machine Translation (SMT), Cross Lingual Translation Sentiment Analysis, Question Answering, Text Entailment, Discourse Processing, Dialog and Conversational Agents, Natural Language Generation	

TERMWORK: (Students should perform at least 08 experiments from the following list)

Minimum 8 experiments

1. Develop a program to eliminate stop-words using nltk.
2. Develop a program to perform tokenization by word.
3. Develop a program to perform stemming using nltk.
4. Develop a program to perform Parts of Speech tagging using nltk.
5. Develop a program to perform Named Entity Recognition using nltk.
6. Develop a program to find Term Frequency and Inverse Document Frequency (TF-IDF).
7. Develop a program to find all unigrams, bigrams and trigrams present in the given corpus.
8. Find the probability of the given 31 statement "This is my cat" by taking the an exmple corpus into consideration.
9. Perform sentiment analysis using NLP.
10. Develop Spam Filter using NLP.
11. Create a model to detect Fake News using NLP.

Text Books:

1. Jurafsky, David, and James H. Martin, "Speech and Language Processing: AnIntroduction to Natural Language Processing", Computational Linguistics and SpeechRecognition‖, ,PEARSON Publication.
2. Manning, Christopher D., and nrich Schütze,"Foundations of Statistical NaturalLanguage Processing", Cambridge, MA: MIT Press

Reference Books and Papers:

1. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python –Analyzing Text with the Natural Language Toolkit", O'Reilly Publication
2. Dipanjan Sarkar , "Text Analytics with Python: A Practical Real-World Approach toGaining Actionable Insights from your Data", Apress Publication ISBN: 9781484223871
3. Alexander Clark, Chris Fox, and Shalom Lappin, "The Handbook of ComputationalLinguistics and Natural Language Processing", Wiley Blackwell Publications
4. Jacob Eisenstein, "Natural Language Processing", MIT Press
5. Jacob Eisenstein, "An Introduction to Information Retrieval", Cambridge University Press

Syllabus for Internal Assessment:

Internal Assessment-1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment-2	UNIT – IV, UNIT – V, UNIT - VI

PROGRAM ELECTIVE COURSE-II/III: INTRODUCTION TO DEVOPS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term work: 25 Marks Oral: 25 Marks	Total: 04

Course Pre-requisites:	
The Students should have knowledge of	
	Software Engineering and Project Management, Cloud Computing
Course Objectives:	
	This course introduces DevOps as a modern software engineering practice, covering its evolution, CI/CD concepts, continuous deployment, testing, monitoring, reliability engineering, and key tools used in the DevOps lifecycle.
Course Outcomes:	
1.	Develop a strong foundation in the essential concepts and practices of DevOps.
2.	Describe the evolution of DevOps and its relationship with modern technologies.
3.	Understand the principles and processes of Continuous Integration and Continuous Delivery (CI/CD).
4	Compare various stages of continuous deployment and test strategies.
5	Illustrate the importance of monitoring systems and Site Reliability Engineering in maintaining system stability.
6	Apply modern DevOps tools effectively in the software development lifecycle.

UNIT -I	**Overview of DevOps and Collaborative Culture**	**(06 Hours)**
	Overview of DevOps: Definition and Objectives of DevOps, Need and Importance of DevOps in Modern Software Development, Reasons for Adopting DevOps. **Roles and Responsibilities in DevOps:** Role of DevOps Engineer, Responsibilities of Developers and Operations Teams, Stakeholders Involved in DevOps**. DevOps Culture and Collaboration:** Breaking Barriers Between Development and Operations, Changing Coordination and Communication Models, DevOps Culture and Team Collaboration. **Continuous Integration and Continuous Delivery (CI/CD):** Introduction to Continuous Integration, Introduction to Continuous Delivery, CI/CD Policies and Best Practices **DevOps Pipeline and Process Automation:** Introduction to DevOps Pipeline Phases, Defining the Development Pipeline, Centralized Build Servers, Process Automation in DevOps **Agile and Operational Best Practices:** Agile Practices, Monitoring Best Practices.	
UNIT – II	**Microservices Architecture and Cloud Native Development**	**(06 Hours)**
	Application Architecture: Monolithic Applications, Introduction to Microservices Architecture, Characteristics, Advantages, and Limitations of Microservices, Comparison: Monolithic vs. Microservices, Microservices Best Practices. **Microservices Implementation and Deployment:** Implementing Microservices Architecture, Deployment Strategies, Principles of Container-Based Application Design, Introduction to Docker, Orchestration vs. Automation, Introduction to Orchestration Tools. **Cloud Computing Fundamentals:** Introduction to Cloud Computing, Cloud Deployment Models, Cloud Service Models, Benefits and Need for Cloud Computing, Introduction to Serverless Computing.	
UNIT – III	**Continuous Integration and Test-Driven Practices**	**(06 Hours)**
	Fundamentals of CI/CD: Introduction to Continuous Integration, Time to Market and Quality Considerations, Continuous Delivery Overview, Difference Between Continuous Integration and Continuous Delivery, Benefits of CI/CD**. CI/CD Infrastructure and Design:** Code Repository Server, Continuous Integration Server, Designing a CI/CD System, Strategies for Continuous Delivery. **CI/CD Pipeline Implementation:** Building CI and CD Pipelines, Continuous Database Integration, Preparing and Identifying Builds in the Repository, Creating Build Reports, Putting the Build in a Shared Location, Releasing the Build	
UNIT - IV	**Continuous Deployment and Orchestration**	**(06 Hours)**
	Testing Strategy and Quality Management: Implementing a Testing Strategy, Types of Testing (Unit, Integration, Acceptance, etc.), Integration Testing, Managing Defect Backlogs. **Continuous Deployment Concepts:** Introduction to Continuous Deployment, Changes Moving Through the Deployment Pipeline, Trade-offs in the Deployment Pipeline, Basic Deployment Pipeline Structure. **Deployment Pipeline**	

	Practices: Commit Stage and Automated Build, Automated Acceptance Test Gate, Subsequent Testing Stages, Preparing for Release. **Implementing Deployment Pipelines:** Designing and Implementing a Deployment Pipeline, Best Practices in Deployment and Release Management	
UNIT - V	**Continuous Monitoring and Site Reliability**	**(06 Hours)**
	Monitoring Systems: Introduction to Monitoring Systems, Importance and Key Factors in Monitoring, White-Box and Black-Box Monitoring, Monitoring Infrastructure and Applications. **Building and Managing Monitoring Systems:** Data Collection and Logging, Creating Dashboards and Alerts, Behavior-Driven Monitoring. **Site Reliability Engineering (SRE):** Introduction to Site Reliability Engineering, SRE and DevOps Relationship, Roles and Responsibilities of SRE, Common Tools Used by SREs.	
UNIT - VI	**DevOps Tools and Case Studies**	**(06Hours)**
	Continuous Development and Version Control: Version Control using Git. **Containerization and Orchestration:** Container Technology with Docker, Orchestration using Kubernetes.**CI/CD and Automation Tools:** Continuous Integration and Delivery using Jenkins, Continuous Deployment with Ansible, Continuous Testing using Selenium. **Monitoring and Issue Tracking:** Monitoring with Prometheus, Bug Tracking using Jira, Log Management with Elastic Stack. **Case Studies:** Spotify – Adoption of Docker, Siemens – Smart Grid & Digital Substations, Tesla – EV Charging & Energy Storage, General Electric (GE Grid Solutions) – Industrial IoT & Power Systems, Schneider Electric – Energy Management Systems.	

Term Work Assignments: (Students should perform at least 08 Experiments from following List)

1. Write a short report explaining the definition, objectives, and benefits of DevOps, along with the roles and responsibilities of DevOps engineers, developers, and operations teams.
2. Explain DevOps culture and how it removes barriers between development and operations teams. They will also compare Agile and DevOps methodologies with suitable examples.
3. Install Git and create a local repository. Perform basic Git commands such as init, add, commit, status, and log, and understand version control concepts.
4. Draw and explain a basic CI/CD pipeline diagram. Differentiate between Continuous Integration, Continuous Delivery, and Continuous Deployment.
5. Install Jenkins (or use online demo). Create a simple freestyle project. Execute a basic build (Hello World program).
6. Install Docker. Pull a basic image (e.g., Ubuntu or Nginx). Run a container and observe output. Write a simple Dockerfile
7. Compare monolithic and microservices architectures, listing their advantages and disadvantages also drawa simple architecture diagram.
8. Study different types of testing such as unit, integration, and acceptance testing. Also write sample test cases and understand the concept of defect backlogs.
9. Explain monitoring concepts including white-box and black-box monitoring. Design a simple monitoring dashboard layout and understand basic logging concepts.
10. Select one industry case study and prepare a short report explaining how DevOps practices are implemented in that organization and the benefits achieved.

Text Books:

1. PierluigiRiti, “Pro DevOps with Google Cloud Platform”, Apress, ISBN: 978-1-4842-3896-7..
2. Katrina Clokie, “A Practical Guide to Testing in DevOps”, Lean Publishing published on 2017-08-01
3. Jez Humble and David Farley, “Continuous Delivery”, Pearson Education, Inc, ISBN: 978–0–321–60191–9

Reference Books:

1. Viktor Farcic, “The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices”.
2. Jennifer Davis and Katherine Daniels, “Effective DevOps: Building a Culture of Collaboration, Anity, and Tooling at Scale”, O’Reilly Media, Inc., ISBN: 978-1-491-92630-7
3. Sanjeev Sharma and Bernie Coyne, “DevOps for Dummies”, John Wiley & Sons, Inc., 2nd IBM Limited Edition, ISBN: 978-1-119-04705-6

Syllabus for Internal Assessment:	
Internal Assessment -1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment -2	UNIT – IV, UNIT – V, UNIT - VI

PROGRAM ELECTIVE COURSE-II/III: QUANTUM COMPUTING

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term work: 25 Marks Oral: 25 Marks	Total: 04

Course Pre-requisites:

The Students should have knowledge of

Engineering Mathematics, Linear Algebra, Probability and Statistics, Signals and Systems, Digital Logic Design, Programming Fundamentals, Basic Physics

Course Objectives: To introduce fundamental concepts of quantum computing, develop the required mathematical foundations, enable design and simulation of basic quantum circuits, explain quantum information and Quantum Fourier Transform, and apply quantum computing techniques to optimization, signal processing, machine learning, and electrical and computer engineering applications**.**

Course Outcomes:

1.	Understand the basic ideas of quantum computing and qubits.
2.	Understand the basic mathematics and quantum mechanics used in quantum computing.
3.	Understand and implement simple quantum circuits and gates
4	Understand quantum information and basic simulation tools for signals and circuits
5	Understand Quantum Fourier Transform and its applications in electrical and computer engineering.
6	Apply quantum computing to simple optimization, signal processing, and machine learning problems in EE/CE fields.

UNIT -I	**Introduction to Quantum Computing**	**(06 Hours)**
	Introduction to quantum computing, classical vs quantum computers, qubits and superposition, entanglement, basic quantum computation, simple quantum algorithms, importance of quantum computing in electrical and computer engineering.	
UNIT – II	**Mathematical Foundations**	**(06 Hours)**
	Basic linear algebra (vectors, matrices), simple quantum mechanics concepts, quantum states, change of states (evolution), basic measurement, examples of 2-qubit and 3- qubit systems, how math helps in circuits and signal processing.	
UNIT – III	**Quantum Circuits and Gates**	**(06 Hours)**
	Quantum circuits overview, single qubit gates (X, Y, Z, H), controlled gates (CNOT), simple multi-qubit circuits, building small quantum programs, connection to digital logic and classical circuits, examples using simulators like Qiskit	
UNIT - IV	**Quantum Information and Simulation**	**(06 Hours)**
	What is quantum information, storing and reading quantum data, simple quantum simulation, simulating small circuits or signals, using quantum simulation tools, applications to signal processing, optimization, and computer algorithms.	
UNIT - V	**Quantum Fourier Transform and Electrical Applications**	**(06 Hours)**
	Quantum Fourier Transform (QFT) basics, simple phase estimation examples, applications of QFT in electrical engineering: analyzing power system signals, smart grid optimization, fault detection, harmonic analysis, communication signals, secure transmission, optimization in circuits and control systems.	
UNIT - VI	**Quantum Machine Learning and Applications**	**(06 Hours)**
	Introduction to quantum machine learning, simple quantum neural networks, using quantum computing for optimization problems in power systems, control, and communication, applications in cyber security, renewable energy systems, and signal processing, simple example-based problems.	

TERMWORK: (Students should perform at least 08 experiments from the following list)

Minimum 8 experiments

1. Introduction to Qiskit and Quantum Simulator
2. Verification of Superposition.
3. Study of Basic Quantum Gates.
4. Implementation of CNOT Gate
5. Creation and Analysis of Entanglement
6. Measurement and State Collapse
7. 2-Qubit Quantum Circuit Design

8. Quantum Teleportation (Basic Simulation)
9. Introduction to Quantum Fourier Transform (QFT)
10. Simple Quantum Optimization Example

Text Books:

1. **Quantum Computing: A Gentle Introduction by Eleanor Rieffel & Wolfgang Polak** — a solid introductory textbook covering qubits, algorithms, and quantum concepts with accessible explanations.
2. **Quantum Computation and Quantum Information by Michael A. Nielsen & Isaac L. Chuang** — widely considered the foundational text in quantum computing and information theory.
3. **Quantum Computing for the Quantum Curious by Ciaran Hughes et al.** — an open-access introductory book that explains fundamental principles and key ideas in an easy-to-follow format
4. **Quantum Computing Since Democritus by Scott Aaronson** — a thought-provoking book connecting quantum computing with computer science and theoretical ideas

Reference Books:

1. An Introduction to Quantum Computing by Phillip Kaye, Raymond Laflamme & Michele Mosca — clear text on quantum computation basics.
2. Quantum Computing for Computer Scientists by Noson S. Yanofsky & Mirco A. Mannucci — focused on computational aspects and algorithms.
3. Principles of Quantum Computation and Information by Giuliano Benenti, Giulio Casati & Giuliano Strini (World Scientific) — reference covering both basics and more advanced topics
4. Quantum Computation and Quantum Information by Michael A. Nielsen & Isaac L. Chuang — standard comprehensive reference in quantum computing and information theory.

Syllabus for Internal Assessment:	
Internal Assessment -1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment -2	UNIT – IV, UNIT – V, UNIT - VI

SEMINAR

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Practical: 04 Hours/Week	Term Work: 50 Marks & Oral: 50 Marks	Total: 02

Course Pre-requisites:

The Students should have knowledge of

Fundamental and core subjects of Electrical & Computer Engineering, Basics of technical report writing and presentation skills, Exposure to recent trends and emerging technologies

Course Objectives:

- To develop the ability to explore and study advanced topics in Electrical & Computer Engineering.
- To enhance skills in literature survey, technical reading, and critical analysis of research papers.
- To improve technical presentation and communication skills.
- To promote self-learning and awareness of current technological developments.

Course Outcomes: Students will be able to

1.	Identify and select a contemporary topic in Electrical & Computer Engineering through literature review.
2.	Analyze and interpret technical content from research papers, journals, and conference proceedings.
3.	Prepare structured technical reports following standard documentation practices.
4.	Demonstrate effective oral presentation skills using modern presentation tools.
5.	Respond confidently to technical queries during seminar presentations and discussions.

Course Content:

Students shall individually select a seminar topic from emerging and relevant domains of Electrical & Computer Engineering such as:

- Smart Grids and Power Systems
- Renewable Energy Technologies
- Electric Vehicles and Charging Infrastructure
- Power Electronics and Drives
- Artificial Intelligence and Machine Learning Applications
- Internet of Things (IoT)
- Cybersecurity and Computer Networks
- Data Science and Cloud Computing
- Embedded Systems and Automation
- Any other interdisciplinary or industry-relevant topic in the recent trend/ technology

While carrying out the seminar, each student shall perform the following tasks:

- Identification of a current and relevant topic in consultation with the mentor
- Conducting an extensive literature survey using journals, IEEE papers, and other authentic sources
- Understanding and summarizing technical concepts, methodologies, and applications
- Preparing a technical report in standard format
- Designing effective presentation slides (PPT)
- Delivering a seminar presentation before the panel
- Participating in discussions and answering queries confidently
- Incorporating feedback and improving technical understanding

Additional Guidelines:

- The seminar topic should preferably align with recent advancements (last 5 years).
- Students are encouraged to refer to reputed sources such as IEEE, Elsevier, Springer, etc.
- Plagiarism should be strictly avoided in report preparation.
- Students may be encouraged to extend their seminar work towards research publication or project work.

INTERNSHIP		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Duration: 06 Months	Term Work: 150 Marks & Oral: 100 Marks	Total: 14

Course Pre-requisites: The Students should have knowledge of

1.	All the core courses along with the software tools if any

Course Objectives:

1.	To provide exposure to industrial practices and professional work culture.
2.	To bridge the gap between academic knowledge and industry requirements.
3.	To enhance employability skills and technical competency.

Course Outcomes:

1.	Apply fundamental knowledge of Electrical and Computer Engineering to solve real-world industrial problems.
2.	Analyze industrial processes, systems, or operations and identify opportunities for performance improvement, safety enhancement, or cost optimization.
3.	Utilize modern engineering tools, software, hardware platforms, and industry practices for design, testing, implementation, and validation.
4.	Demonstrate professional ethics, workplace discipline, safety standards, and effective teamwork in a multidisciplinary industrial environment.
5.	Communicate technical work effectively through reports, presentations, logbooks, and interaction with industry mentors and faculty supervisors.
6.	Evaluate real-time constraints, project management aspects, and organizational practices in industry settings.

Internship (Industry)

Course Content:

During the six-month industrial internship, the student should actively participate in real-time industrial operations related to Electrical and Computer Engineering, such as understanding plant processes, assisting in design, testing, installation, operation, and maintenance of electrical systems, control systems, embedded platforms, power systems, automation setups, or IT infrastructure etc.

The student should study technical drawings, specifications, standard operating procedures, and safety protocols, and contribute to ongoing projects through data collection, analysis, simulation, troubleshooting, performance evaluation, and documentation.

Students are also expected to use modern engineering tools and software relevant to the industry, maintain a detailed logbook of daily activities, interact professionally with supervisors and multidisciplinary teams, follow ethical and safety standards, and prepare a comprehensive technical report and presentation summarizing the work carried out, learning outcomes achieved, and improvements suggested.

Internship (In-house)

Course Content:

During the in-house internship at the college premises, students shall undergo hands-on training and technical work in advanced domains such as Industrial Automation (PLC/SCADA), Power Electronics and Drives, Power Quality Analysis, Smart Grid and Renewable Energy Systems, Embedded Systems and IoT, Electric Vehicles, Electrical Machine Design using ANSYS Maxwell, Artificial Intelligence and Machine Learning applications in Electrical Engineering, Data Science and Databases, Computer Systems and Networks, Image Processing and Computer Vision, and simulation tools such as MATLAB, ETAP, and ANSYS.

Each student or group shall undertake and complete a structured technical assignment, mini-project, experimental study, or simulation-based investigation using real-time laboratory data, case studies, or experimental results generated within the institute. The students are required to maintain a detailed internship logbook recording daily activities, learning outcomes, tools used, experimental observations, and progress of the assigned work, and submit the same at the completion of the internship for evaluation.

INDUSTRIAL DRIVES & APPLICATIONS

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	Practical: 01
	Term Work: 25 Marks & Oral: 25 Marks	Total: 04

Course Pre-requisites: The Students should have

1.	Construction, Working Principle & Application of AC and DC motors
2.	Introductions to Electronic Components SCR , Diodes, GTO, IGBT, DIAC & TRIAC etc

Course Outcomes:

1.	Explore the basic knowledge of the components and dynamics related to electrical drives and also able to draw certain characteristics related to electric drives.
2.	Explore various electrical braking methods and the characteristics related to DC and Induction motors
3.	Performthe operation of solid state control of DC motors related to converters and chopper operations
4.	Analyze the comparison of voltage source and current source inverters
5.	Explore various energy saving techniques and selection of power ratings for various electrical drives
6.	Explore the requirements and applications of electrical drives as per the industrial point of view

UNIT - I	**Concept of Electrical Drives.**	**(06 Hours)**
	Electric Drives: Definition, Advantages, components. Selection criteria. Latest trends in DC & AC Drives, Dynamics of drive. Equivalent values of drive parameters. Load Torque: Components, Natures and classification. Steady state stability: Speed torque characteristics, criteria. Load equalization	
UNIT - II	**Electrical Braking**	**(06 Hours)**
	Electrical braking methods, characteristics of DC Motors: Rheostatic, Plugging, and Regenerative. Electrical braking method of three phase induction motor: DC Dynamic Braking, Plugging, Regenerative Braking, AC Rheostatic braking	
UNIT - III	**Solid State Controlled D.C. Motors**	**(06 Hours)**
	Fully controlled converter: Single phase, three phase and effect on performance of Shunt excited DC Motor. Open loop and closed loop system. Chopper control converter: Close loop control of DC series & shunt motor in a drive	
UNIT - IV	**Solid State Controlled Induction Motors**	**(06 Hours)**
	Steady State Analysis, Thyristorised stator voltage control, Transistorised stator frequency control: V/f control, voltage source inverter (VSI) control, current source inverter (CSI) control, Steady State Analysis, Relative merits and demerits of VSI and CSI for induction motor drive. Introduction to Multilevel Inverter	
UNIT - V	**Energy Saving Techniques and Power Rating of Drive Motor**	**(06 Hours)**
	Energy Saving in starting of Induction Motor Drive: Types, rotor resistance, reduced voltage. Energy Saving in running of induction motor driving pump and blower: Consideration of load torque characteristics and energy saving calculations. Power Rating: Load diagram, Heating and cooling, Thermal Resistance, Selection of motor power capacity, Derating of motor, effect of harmonic current, short time rating.	
UNIT - VI	**Industrial Applications and Latest trends in Drives**	**(06 Hours)**
	Industrial Applications: Drives for Rolling mills (Four Quadrant Operation), Machine tools (Constant Torque Application), Textile mills (Synchronized operation of Drive in Tandom), Sugar Mills: Centrifuged Drive. Latest trends in Drives: Commutatorless DC Motor, Servo Drives, Stepper motors.	

TERMWORK: (Students should perform at least 08 experiments from the following list)

Minimum 8 experiments

1. Electrical braking of D.C. Shunt motor.
2. Electrical braking of 3-phase Induction Motor.
3. Single phase converter fed separately excited D.C. motor.
4. Three phase converter fed / Dual converter fed/ converter fed separately excited D.C. motor.
5. Chopper fed D.C. series motor.
6. VSIfed 3-phase Induction motor.
7. Solid state stator voltage control of 3-phase Induction motor.
8. Closed loop speed control of D.C. motor.
9. Closed loop speed control of Induction Motor
10. Application of Jones Chopper for speed control/Quadrant operation.
11. Energy saving in soft starting of induction motor.

Text Books:

1. Bimal K Bose, Modern power electronics and AC drives, Pearson education asia
2. G. K. Dubey, Fundamentals of Electrical Drives CRC press 2002
3. VedamSubrahmanyam Electric Drives: Concepts &Appl Tata McGraw-Hill
4. Power electronics convertors, applications and design, Ned Mohan, Tore M Undeland, William P Robbins, Wiley India Pvt. Ltd., 2009
5. E. Acha, Miller & Others, Power Electronic Control in Electrical Systems (Newnes, Oxford publication) – first Edition
6. M. H. Rashid Power Electronics, Prentice Hall of India Pvt. Ltd. New Delhi, (3rd Edition)
7. R Krishnan, Electric motor drives, modeling, analysis and control, PHIlearning Pvt. ltd. 2001
8. S.K. Pillai, A first course in electrical drives, Newage international publishers. 2010

Reference Books and Papers:

1 V. Subrahmanyam, "Electric Drives: Concepts & Application", Tata Mc-Graw Hill

2. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education

3. R. Krishanan, "Electric Motor Drives – Modeling Analysis and Control", PHI India

Syllabus for Internal Assessment:

Internal Assessment-1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment-2	UNIT – IV, UNIT – V, UNIT - VI

POWER SYSTEM STABILITY & CONTROL		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Theory: 03 Hours / Week	End Semester Examination: 60 Marks	Theory: 03
Practical: 02 Hours / Week	Internal Assessment: 40 Marks	Practical: 01
	Term Work: 25 Marks & Oral: 25 Marks	Total: 04

Course Pre-requisites: The Students should have knowledge of	
1.	Basics of Power System
Course Objectives:	
1	To understand the importance of power system stability & control.
2	To suggest the appropriate method of reactive power generation and control.
3	To analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.
4	To analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.
Course Outcomes: After successful completion of course, students will be able to	
1.	Describe the basic concept of reliability, security and transient stability in case of power system.
2.	Explain formulation of unit commitment and economic load dispatch tasks and solve it using optimization techniques.
3.	Illustrate the automatic frequency and voltage control strategies for single and two area case and analyze the effects, knowing the necessity of generation control.
4.	Identify the need for generation and control of reactive power.
5.	Describe various advanced controllers such as FACTs controllers with its evolution, principle of operation, circuit diagram and applications.
6.	Illustrate various ways of interchange of power between interconnected utilities and define reliability aspects at all stages of power system.

UNIT - I	**Power System Transient Stability**	**(06 Hours)**
	Revision of concept of dynamics of synchronous machine and swing curve, Transien stability analysis-Equal Area Criterion for sudden change in mechanical input, effect o clearing time on stability, sudden loss of one of parallel lines and sudden short circuit on one of parallel lines, point by point method, Methods to improve stability, Introduction to multi-machine stability.	
UNIT - II	**Optimal System Operation**	**(06 Hours)**
	Concept of economic load dispatch, System constraints, Economic dispatch neglecting losses, Optimal load dispatch including transmission losses, Exact transmission loss formula, Modified coordination equations, Automatic load dispatching, Concept of unit commitment, Constraints on unit commitment, Method of unit commitment-priority list method, dynamic programming. (Numericals)	
UNIT - III	**Automatic Generation Control (AGC)**	**(06 Hours)**
	Concept of AGC, Block diagram of load-frequency control of isolated power system Steady state & dynamic response, Overview of generation control system, Control area concept-single area load-frequency control, two area load-frequency load, optimal two area load-frequency control, tie-line control, Load-frequency control with generation rate constraints, Effect of speed governor dead band on AGC, Digital load-frequency controllers, Decentralized control.	
UNIT - IV	**Reactive Power Control**	**(06 Hours)**
	System voltage and reactive power, Reactive power generation by synchronous machines, Effect of excitation control, Loading capability curve of a generator, Compensation in power system (Series and shunt compensation using capacitors and reactors), Steady state performance of static VAR compensators, sub synchronous resonance.	
UNIT - V	**Reactive Power Control**	**(06 Hours)**

	Introduction to FACT Controller, Principle of operation, characteristics and applications of SVC, TCSC, STATCOM, SSSC and UPFC, Comparison of FACT controllers.	
UNIT - VI	**Power Interchange**	**(06 Hours)**
	Interchange of power between interconnected utilities, Emergency interchange, Econom interchange evaluation, Interchange evaluation with unit commitment, Type of interchang Capacity interchange, Diversity interchange, Energy banking, Inadvertent power exchang Power pools.	

TERM WORK: (Students should perform at least 08 experiments from the following list)

Minimum 8 experiments

1. Solution of swing equation.
2. Equal area criteria.
3. Stability analysis using point by point method.
4. Optimal dispatch of power.
5. Single area load frequency control.
6. Two area load frequency control.
7. Reactive power compensation by series or shunt compensation.
8. Study and simulation of FACTS Controllers. I.SVC II. TCSC
9. Study and simulation of FACTS Controllers. I. STATCOM II.SSSC
10. Study and Analysis of State Load Dispatch Centre.

Text Books:

1. Electrical Energy System Theory –Olle I Elgerd, Tata McGraw Hill Publication.
2. Modern Power System Analysis-I J Nagrath,D P Kothari, Tata McGraw Hill Publication
3. Power System Operation & Control –PSR Murthy, BS Publications.
4. Reactive Power Management –D M Tagare, Tata McGraw Hill Publication.
5. Electrical Power Systems-C.L.Wadhwa, New Age International Publishers.
6. FACTS controllers in Power Transmission and Distribution-K.R.Padiyar, New Age International Publishers.
7. Electrical power systems-Ashfaq Husain, CBS Publishers & Distributors Pvt Ltd.

Reference Books:

1 Economic Operation of Power Systems-Leon K. Kirchmayer,Jonn Wiley & Sons.

2. Power system analysis-John J.Grainer, William D. Stevenson, Jr.Tata McGraw-Hill Edition
3. Understanding FACTS-NarainG. Hingorani, Laszio Gyugyi, A John Wiley& Sons
4. R. Krishanan, “Electric Motor Drives – Modeling Analysis and Control”, PHI India

Syllabus for Internal Assessment:

Internal Assessment-1	UNIT – I, UNIT – II, UNIT - III
Internal Assessment-2	UNIT – IV, UNIT – V, UNIT - VI

PROJECT WORK		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS ALLOTTED:**
Duration: 06 Months (16 Hours/Week)	Term Work: 50 Marks & Oral: 50 Marks	Total: 08

Course Pre-requisites: The Students should have knowledge of

1.	All the core courses along with the software tools if any

Course Objectives:

1.	To enable students to apply engineering knowledge to solve real-world Electrical & Computer Engineering problems.
2.	To develop research aptitude, design skills, and innovation capabilities.
3.	To enhance teamwork, project management, and documentation skills.
4.	To promote interdisciplinary and industry-oriented project work.

Course Outcomes:

1.	Identify, formulate, and define a real-world engineering problem in the domain of Electrical and Computer Engineering through extensive literature survey.
2.	Design and develop a system/model/prototype using appropriate engineering tools, techniques, software, and hardware components to address the identified problem.
3.	Analyze and interpret experimental/simulation results using modern engineering and computational tools.
4.	Demonstrate effective teamwork, project planning, documentation, and professional ethics while executing the project work.
5.	Communicate technical outcomes effectively through project reports, presentations, and viva-voce examinations.

Course Content:

For their final-year B.Tech group project in Electrical and Computer Engineering, students shall select a project topic in their area of interest covering major domains of Electrical and Computer Engineering such as power systems, control systems, power electronics, renewable energy, electric vehicles, embedded systems, artificial intelligence, data science, computer networks, or related interdisciplinary areas.

While carrying out the project work, each group must systematically perform the following tasks:

- Identification of a real-world problem and conducting an extensive literature survey;
- Defining objectives, scope, methodology, timeline, and feasibility analysis;
- Developing appropriate modeling and simulation using relevant engineering tools;
- Designing the system architecture (hardware, software, or hybrid system);
- Developing and integrating the prototype;
- Conducting testing,
- Validation, and performance evaluation against predefined benchmarks;
- Analyzing results and suggesting improvements; and
- Completing detailed technical documentation, report writing, and effective presentation of the project outcomes during reviews and viva-voce examinations.
- Students are encouraged to publish a research paper based on their project work, which will help them gain academic recognition and showcase their contributions to the research community and society.