VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)

Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

Approved in 13th Meeting of Executive Council held on 27th March 2023 subsequent to the 14th Meeting of Academic Council held on 20th March 2023

(For admission in 2022-23 and onwards)

SYLLABUS

For

B.TECH 2nd, 3rd & 4th Year

(Electrical Engineering)

Effective From Session 2023-24, 24-25 & 25-26 respectively

SEMESTER-III (effective from session 2023-24)

Sl.No.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	CST 003/ AHT 006	ESC/BSC	Data Structures / Advanced Applied Mathematics	3	1	0	30	20	50	100		150	4
2	AHT 007	HSC	Technical Communication/Universal Human Values	2	1	0	30	20	50	100		150	3
	AHT 008			3	0	0							
3	EET 002	DC	Signals, Systems and Networks	3	1	0	30	20	50	100		150	4
4	EET 003	DC	Transformer and DC Machines	3	1	0	30	20	50	100		150	4
5	EET 004	DC	Analog and Digital Circuits	3	1	0	30	20	50	100		150	4
6	EEP 002	DLC	Signals, Systems and Networks Lab	0	0	2		25	25		25	50	1
7	EEP 003	DLC	Transformer and DC Machines Lab	0	0	2		25	25		25	50	1
8	EEP 004	DLC	Electronic Circuits Lab	0	0	2		25	25		25	50	1
9	EEP 005	DLC	Internship-I/Mini Project-I*	0	0	2			50			50	1
10	CST 006/ CST005	MC	Cyber Security/Python Programming	2	0	0	15	10	25	50			
11	GP 03	NC	General Proficiency						50				
			Total									**950**	**23**
12			Minor course (Optional)	3	1	0	30	20	50	100		150	**4**

*The Mini Project-I or Internship-I (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester

MOOCs course: The department may advise the students for any suitable MOOCs course.

SEMESTER-IV (effective from session 2023-24)

Sl.No.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT 008 / AHT 007	HSC	Universal Human Values /Technical Communication	3 / 2	0 / 1	0 / 0	30	20	50	100		150	3
2	AHT 006/ CST 003	BSC	Advanced Applied Mathematics/ Data Structures	3	1	0	30	20	50	100		150	4
3	EET 005	DC	AC Rotating Machines	3	1	0	30	20	50	100		150	4
4	EET 006	DC	Electrical Measurements and Instrumentation	3	1	0	30	20	50	100		150	4
5	EET 007	DC	Electromagnetic Field Theory	3	1	0	30	20	50	100		150	4
8	EEP 006	DLC	AC Rotating Machines Lab	0	0	2		25	25		25	50	1
6	EEP 007	DLC	Electrical Measurements and Instrumentation Lab	0	0	2		25	25		25	50	1
7	EEP 008	DLC	Simulation Lab	0	0	2		25	25		25	50	1
9	CST 005/ CST 006	MC	Python Programming/Cyber Security	2	0	0	15	10	25	50			
10	GP 04	NC	General Proficiency						50				
			Total									**900**	**22**
11			Minor course (Optional)	3	1	0	30	20	50	100		150	**4**
		DLC	Internship-II/ Mini Project-II*	To be completed at the end of fourth semester (during Summer Break) & its evaluation shall be done in V semester.									

MOOCs course: *The department may advise the students for any suitable MOOCs course.*

SEMESTER-V (effective from session 2024-25)

Sl.No.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credits
				L	T	P	T			P			
				L	T	P	CT	TA	Total	TE	PE		
1	EET 008	DC	Electrical Power Generation, Transmission and Distribution	3	1	0	30	20	50	100		150	4
2	EET 009	DC	Control System Engineering	3	1	0	30	20	50	100		150	4
3	EET 010	DC	Power Electronics	3	1	0	30	20	50	100		150	4
4	EET 011-14	DE	Departmental Elective - 1	3	0	0	30	20	50	100		150	3
5	EET 015-18	DE	Departmental Elective - 2	3	0	0	30	20	50	100		150	3
6	EEP 010	DLC	Power System Lab	0	0	2		25	25		25	50	1
7	EEP 011	DLC	Control System Lab	0	0	2		25	25		25	50	1
8	EEP 012	DLC	Power Electronics Lab	0	0	2		25	25		25	50	1
9	EEP 013	DLC	Mini Project- II or Internship-II*	0	0	2			50			50	1
10	AHT 009/ AHT 010	MC	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25	50			
11	GP 05	NC	General Proficiency						50				
			Total	**17**	**3**	**8**						**950**	**22**
12			Minor course (Optional)	3	1	0	30	20	50	100		150	**4**

*The Mini Project-II or Internship-II (4-6 weeks) conducted during summer break after IV semester and assessed during V semester

MOOCs course: *The department may advise the students for any suitable MOOCs course.*

Departmental Elective - 1	**Departmental Elective - 2**
EET 011: Electrical Machine Design	EET 015: Special Electrical Machines
EET 012: Transducers and Signal Conditioning	EET 016: Advance Instrumentation
EET 013: Energy Conservation and Audit	EET 017: Robotics and Automation
EET 014: Electrical Engineering Materials	EET 018: Digital Signal Processing

SEMESTER-VI (effective from session 2024-25)													
Sl.No.	**Subject Codes**	**Category**	**Subject**	**Periods**			**Evaluation Scheme**					**Subject Total**	**Credit**
							Sessional Exam			**ESE**			
				L	**T**	**P**	**CT**	**TA**	**Total**	**TE**	**PE**		
1	EET 019	DC	Embedded Systems	3	1	0	30	20	50	100		150	4
2	EET 020	DC	Power System Analysis	3	1	0	30	20	50	100		150	4
3	EET 021	DC	Power System Protection	3	1	0	30	20	50	100		150	4
4	EET 022-25	DE	Departmental Elective - 3	3	0	0	30	20	50	100		150	3
5	AHT 011-13	HSC	Open Elective-1	3	0	0	30	20	50	100		150	3
6	EEP 015	DLC	Embedded Systems Lab	0	0	2		25	25		25	50	1
7	EEP 016	DLC	Computer Aided Power System Lab	0	0	2		25	25		25	50	1
8	EEP 017	DLC	Power System Protection Lab	0	0	2		25	25		25	50	1
9	AHT 010/ AHT 009	MC	Essence of Indian Traditional Knowledge / Constitution of India	2	0	0	15	10	25	50	-	-	-
10	AHT 014	NC	Happiness & Well-being	2	0	0	25	25	50	--		-	-
11	GP 06	NC	General Proficiency						50	--	-	-	-
			Total	**17**	**3**	**6**						**900**	**21**
12			**Minor course (Optional)**	3	1	0	30	20	50	100		150	**4**
		DLC	Mini Project-III or Internship-III*	To be completed at the end of sixth semester (during Summer Break) & its									
MOOCs course: *The department may advise the students for any suitable MOOCs course.*													

Department Elective-3
EET 022: Electric Drives
EET 023: 2Modern Control System
EET 024: FACTS Devices
EET 025: Intelligent Systems

Open Elective-1 (HSC)
AHT 011: Total Quality Management
AHT 012: Managing E-commerce & Digital Communication
AHT 013: Industrial Safety and Hazard Management

EFFECTIVE FROM 2025-26

B.Tech. (ELECTRICAL ENGINEERING) (w.e.f. 2025-26)												
SEMESTER-VII												
Sl. No.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT-015/ AHT-016	HSC	HSMC -1 / HSMC-2	3	0	0	30	20	50	100		150	3
2	EET-026-029	DE	Departmental Elective-4	3	0	0	30	20	50	100		150	3
3	EET-030-033	DE	Departmental Elective-5	3	0	0	30	20	50	100		150	3
4	EET-051	OE	Open Elective-2	3	0	0	30	20	50	100		150	3
5	EEP-019	DLC	Project Seminar	0	0	2			50			50	1
6	EEP-020	DLC	Design Project	0	0	4			100			100	2
7	EEP-021	DLC	Mini Project-III or Internship-III*	0	0	2			50			50	1
8	AHT-017	MC	Disaster Management	3	0	0	30	20	50	100		150	3
9	AHT-018	NC	Innovations and Problem Solving (Audit Course)	2	1	0	15	10	25	50		-	-
10	GP-07	NC	General Proficiency						50			-	-
			Total	**17**	**1**	**8**						**950**	**19**
11		**Minor Course (Optional)**		3	1	0	30	20	50	50		150	4
*The Internship-III (4-6 weeks) conducted during summer break after VI semester and will be assessed during VII semester													

	Departmental Elective - 4		**Departmental Elective - 5**
EET-026	Electric Hybrid Vehicle	EET-030	Power System Dynamics, Stability and Control
EET-027	Advance Power Electronics	EET-031	Solar and Wind Energy Systems
EET-028	Power System Transients	EET-032	High Voltage Engineering
EET-029	Bio-medical Instrumentation and Signal Processing	EET-033	Artificial Intelligence and its Applications

HSMC-1	AHT-015	Rural Development, Administration and Planning
HSMC-2	AHT-016	Project Management & Entrepreneurship

Open Elective-2: (This course can be taken only by the students of branches other than EE/EEE in VII Semester. EE/EEE students shall opt open elective offered by other departments)	
EET-051	Non-conventional Energy Resources

Abbreviations: L-No. of Lecture hours per week, T-No. of Tutorial hours per week, P-No. of Practical hours per week, CT- Class Test Marks, TA-Marks of teacher's assessment including student's class performance and attendance, PS-Practical Sessional Marks, ESE-End Semester Examination, TE-Theory Examination Marks, PE- Practical External Examination Marks

1 Hr Lecture	1 Hr Tutorial	2 or 3 Hr Practical
1 Credit	1 Credit	1 Credit

SEMESTER-VIII (effective from session 2025-26)													
Sl.No.	**Subject Codes**	**Category**	**Subject**	**Periods**			**Evaluation Scheme**					**Subject Total**	**Credit**
							Sessional Exam			**ESE**			
				L	**T**	**P**	**CT**	**TA**	**Total**	**TE**	**PE**		
1	AHT 016/ AHT 015	HSC	Project Management & Entrepreneurship/ Rural Development Administration& Planning	3	0	0	30	20	50	100		150	3
2	EET 034-037	DE	Departmental Elective-6	3	0	0	30	20	50	100		150	3
3	EET 052	OE	Open Elective-3	3	0	0	30	20	50	100		150	3
4	EET 053	OE	Open Elective-4	3	0	0	30	20	50	100		150	3
5	EEP 026	DLC	Project	0	0	12			100		200	300	6
6	GP 08	NC	General Proficiency						50				
			Total	**12**	**0**	**12**						**900**	**18**
7			**Minor course (Optional)**	3	1	0	30	20	50	100		150	**4**
MOOCs course: *The department may advise the students for any suitable MOOCs course.*													

Departmental Elective-6
EET 034: Power System Reliability
EET 035: Optimal Control System
EET 036: Electrical Machine Modeling
EET 037: Smart Grid Technology

Open Elective-3 (This course can be taken only by the students of branches other than EE/EEE in VIIIth semester. EE/EEE students shall opt open elective floated by other departments)
EET 052: Electrical Machines

Open Elective-4 (This course can be taken only by the students of branches other than EE/EEE in VIIIth semester. EE/EEE students shall opt open elective floated by other departments)
EET 053: Bio-medical Signal Processing

Annexure - II

List of Minor Courses offered by Electrical Engineering Department (EE/EEE) to B. Tech. Programme

Sl. No.	Award of Degree	Eligible Minor (After successfully passing the subjects worth 20 Credits as available against each Minor)*	Major B. Tech. Degree programmes (Discipline / Branch of Study as Prescribed by the University from time to time)	Offering Department
1	"B. Tech. in branch name with Minor in ***Power Systems/ Power & Energy Systems***"	**Power Systems/ Power & Energy Systems** 1. Energy Conservation and Audit (EET151/EET 013) 2. High Voltage Engineering (EET152/EET 032) 3. FACTS Devices (EET153/ EET024) 4. Power System Transients (EET154EET028) 5. Power System Dynamics, Stability and Control (EET155/EET030) 6. Power System Reliability (EET156/EET034) 7. Smart Grid Technology (EET157/EET037) 8. Solar and Wind Energy Systems (EET158/EET031)	Artificial Intelligence & Machine Learning Computer Science (Artificial Intelligence & Machine Learning) Biotechnology Bio Chemical Engineering Chemical Engineering Civil Engineering Computer Science and Engineering Electrical Engineering Electrical & Electronics Engineering Electronics & Communication Engineering Information Technology Mechanical Engineering Mechanical Engineering (Manufacturing Engineering) Production Engineering Manufacturing Engineering Power Plant Engineering	**EE/EEE**
2	"B. Tech. in branch name with Minor in **Power Electronics, Electrical Machines, and drives**"	**Power Electronics, Electrical Machines, and drives** 1. Energy Conservation and Audit (EET161/ EET 013) 2. Special Electrical Machines (EET162/EET015) 3. Electric Drives(EET163/EET022) 4. Electric Hybrid Vehicles (EET164/EET026) 5. Advance Power Electronics (EET165/EET027) 6. Electrical Machine Modeling (EET166/EET036) 7. FACTS Devices (EET167/EET024) 8. Solar and Wind Energy Systems (EET168/EET031) 9. Microcontroller & Embedded systems (EET169)	Artificial Intelligence & Machine Learning Computer Science (Artificial Intelligence & Machine Learning) Biotechnology Bio Chemical Engineering Chemical Engineering Civil Engineering Computer Science and Engineering Electrical Engineering Electrical & Electronics Engineering Electronics & Communication Engineering Information Technology Mechanical Engineering Mechanical Engineering (Manufacturing Engineering) Production Engineering Manufacturing Engineering Power Plant Engineering	**EE/EEE**
3	"B. Tech. in branch name with Minor in ***Control Systems***"	**Control Systems** 1. Microcontroller & Embedded systems (EET171) 2. Digital Signal Processing (EET172/EET018) 3. Modern Control System	Artificial Intelligence & Machine Learning Computer Science (Artificial Intelligence & Machine Learning) Biotechnology Bio Chemical Engineering Chemical Engineering Civil Engineering Computer Science and Engineering	**EE/EEE**

		(EET173/EET023) 4. Transducers and Signal Conditioning (EET174/EET012) 5. Intelligent Systems (EET175/EET025) 6. Artificial Intelligence and its Applications (EET176/EET033) 7. Optimal Control Systems (EET177/EET035) 8. Robotics and Automation (EET178/EET017)	Electrical Engineering Electrical & Electronics Engineering Electronics & Communication Engineering Information Technology Mechanical Engineering Mechanical Engineering (Manufacturing Engineering) Production Engineering Manufacturing Engineering Power Plant Engineering	
4	"B. Tech. in branch name with Minor in ***Electrical Instrumentation***"	**Electrical Instrumentation** 1. Electrical Engineering Materials (EET181/EET014) 2. Transducers and Signal Conditioning (EET182/EET012) 3. Advanced Instrumentation (EET183/EET016) 4. Digital Signal Processing (EET184/EET018) 5. Artificial Intelligence and its Applications (EET185/EET033) 6. Microcontroller & Embedded systems(EET186/) 7. Energy Conservation and Audit (EET187/EET 013) 8. Bio-medical Instrumentation and Signal Processing (EET188/EET043)	Artificial Intelligence & Machine Learning Computer Science (Artificial Intelligence & Machine Learning) Biotechnology Bio Chemical Engineering Chemical Engineering Civil Engineering Computer Science and Engineering Electrical Engineering Electrical & Electronics Engineering Electronics & Communication Engineering Information Technology Mechanical Engineering Mechanical Engineering (Manufacturing Engineering) Production Engineering Manufacturing Engineering Power Plant Engineering	**EE/EEE**

Data Structures and Algorithms (CST-003)

L:T:P:: 3:1:0
Credits-04

Course Objectives: The objectives of this course is to:

1. Introduce the fundamentals of Data Structures, Abstract concepts and how these concepts are useful in problem-solving.
2. Analyze step by step and develop algorithms to solve real-world problems.
3. Implement various data structures, viz. Stacks, Queues, Linked Lists, Trees and Graphs.
4. Understand various searching & sorting techniques

Course Outcomes: On successful completion of the course, the student will be able to:

1. Compare functions using asymptotic analysis and describe the relative merits of worst-case, average-case, and best-case analysis.
2. Become familiar with a variety of sorting algorithms and their performance characteristics (e.g., running time, stability, space usage) and be able to choose the best one under a variety of requirements.
3. Understand and identify the performance characteristics of fundamental algorithms and data structures and be able to trace their operations for problems such as sorting, searching, selection, operations on numbers, and graphs.
4. Solve real-world problems using arrays, stacks, queues, and linked lists.
5. Become familiar with the major graph algorithms and their analyses. Employ graphs to model engineering problems when appropriate.

Unit 1-Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade-off.

Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Unit 2-Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

Unit 3-Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from the linked list; Linked representation of Stack and

Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and complexity analysis.

Unit 4-Trees and Graphs: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graphs: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Unit 5-Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods,

Hashing: Symbol table, Hashing Functions, Collision-Resolution Techniques

TEXTBOOKS:

1. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
2. Ritika Mehra, Data Structures Using C, Pearson Education.
3. Data Structures using C & C++ -By Ten Baum Publisher – Prentice-Hall International.

REFERENCE BOOKS:

1. Schaum's Outlines Data structure Seymour Lipschutz Tata McGraw Hill 2nd Edition.
2. Fundamentals of Computer Algorithms by Horowitz, Sahni, Galgotia Pub. 2001 ed.
3. Fundamentals of Data Structures in C++-By Sartaj Sahani.
4. Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher-Thomson Learning.

Python Programming (CST-005)

L:T:P:: 2:0:0 **Credits-0**

Course Objectives: The objectives of this course is to:

1. Introduce the basic principles and concepts of python programming, and how python programming concepts are useful in problem-solving.
2. Write clear and effective python code.
3. To perform file operations to read and write data in files.
4. To create applications using Python Programming.

Course Outcomes: On successful completion of the course, the student will be able to:

1. Develop essential programming skills in computer programming concepts like data types.
2. Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
3. Illustrate the process of structuring the data using lists, tuples, and dictionaries.
4. Demonstrate using built-in functions and operations to navigate the file system.
5. Interpret the concepts of modules and user-defined functions in Python.

Syllabus:

UNIT – I: Introduction and Syntax of Python Program: Features of Python, Interactive, Object-oriented, Interpreted, platform-independent, Python building blocks -Identifiers, Keywords, Indention, Variables, Comments, Python environment setup – Installation and working of IDE, Running Simple Python scripts to display a welcome message, Python variables.

Python Data Types: Numbers, String, Tuples, Lists, Dictionary. Declaration and use of datatypes, Built-in Functions.

UNIT – II: Python Operators and Control Flow statements: Basic Operators: Arithmetic, Comparison/ Relational, Assignment, Logical, Bitwise, Membership, Identity operators, Python Operator Precedence. **Control Flow:** Conditional Statements (if, if...else, nested if), Looping in python (while loop, for loop, nested loops), loop manipulation using continue, pass, break, else.

UNIT – III: **Data Structures in Python: String:** Concept, escape characters, String special operations, String formatting operator, Single quotes, Double quotes, Triple quotes, Raw String, Unicode strings, Built-in String methods.

Lists: Defining lists, accessing values in lists, deleting values in lists, updating lists, Basic List Operations, and Built-in List functions.

Tuples: Accessing values in Tuples, deleting values in Tuples, and updating Tuples, Basic Tuple operations, and Built-in Tuple functions.

Sets: Accessing values in Set, deleting values in Set, and updating Sets, Basic Set operations, Built-in Set functions.

Dictionaries: Accessing values in Dictionary, deleting values in Dictionary, and updating Dictionary, Basic Dictionary operations, Built-in Dictionaries functions.

UNIT – IV: Python Functions, modules, and Packages: Use of Python built-in functions (e.g., type/data conversion functions, math functions etc.).

User-defined functions: Function definition, Function call, function arguments and parameter passing, Return statement, **Scope of Variables:** Global variable and Local Variable.

Modules: Writing modules, importing modules, importing objects from modules, Python built-in modules (e.g., Numeric, mathematical module, Functional Programming Module), Packages.

UNIT – V: File Handling: Opening files in different modes, accessing file contents using standard library functions, Reading, and writing files, closing a file, Renaming, and deleting files, File related standard functions.

TEXTBOOKS:

1. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, CreateSpace Independent Publishing Platform, 2016.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015.
3. Ch Satyanarayana, “Python Programming”, 1st Edition, universities press (India) private limited 2018.

REFERENCE BOOKS:

1. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014
2. Mark Lutz, “Programming Python”, 4th Edition, O’Reilly Media, 2011.ISBN-13: 978-9350232873
3. Wesley J Chun, “Core Python Applications Programming”, 3rd edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”,1stEdition, Wiley India Pvt Ltd, 2016. ISBN-13: 978- 8126562176
5. Reema Thareja, “Python Programming using problem-solving approach”, Oxford university press, 2017.

Cyber Security (CST-006)

L:T:P:: 2:0:0 **Credits-0**

Course Objectives: The objectives of this course is to:

1. Familiarize with network security, network security threats, security services, and countermeasures.
2. Be aware of computer security and Internet security.
3. Study the defensive techniques against these attacks.
4. To familiarize with cyber forensics, cybercrimes, and Cyberspace laws.
5. Understand ethical laws of computers for different countries, Offences under cyberspace and the Internet in India.

Course Outcomes: On successful completion of the course, the student will be able to:

1. Understand cyber-attacks and types of cybercrimes, and familiarity with cyber forensics
2. Realize the importance of cyber security and various forms of cyber-attacks and countermeasures.
3. Get familiar with obscenity and pornography in cyberspace and understand the violation of the Right to privacy on the Internet.
4. Appraise cyber laws and how to protect themselves and, ultimately, the entire Internet community from such attacks.
5. Elucidate the various chapters of the IT Act 2008 power of the Central and State Governments to make rules under IT Act 2008

Syllabus:

UNIT – I: Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, the motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., CIA Triad

UNIT – II: Cyber Forensics: Introduction to cyber forensic, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT – III: Cybercrime (Mobile and Wireless Devices): Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service

Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops and desktop.

UNIT – IV: Cyber Security (Organizational Implications): Introduction cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing, and the associated challenges for organizations.

Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes, the psychology, mindset and skills of hackers and other cybercriminals.

UNIT – V: Cyberspace and the Law &Miscellaneous provisions of IT Act.: Introduction to Cyber Security Regulations, International Law. The INDIAN Cyberspace, National Cyber Security Policy. Internet Governance – Challenges and Constraints, Computer Criminals, Assets and Threats. Other offences under the Information Technology Act in India, The role of Electronic Evidence and miscellaneous provisions of the IT Act.2008.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCE BOOKS:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.
3. Debby Russell and Sr. G.T Gangemi, "Computer Security Basics (Paperback)", 2ndEdition, O' Reilly Media, 2006.
4. Wenbo Mao, "Modern Cryptography – Theory and Practice", Pearson Education, New Delhi, 2006.
5. Cyberspace and Cybersecurity, George Kostopoulos, Auerbach Publications, 2012.
6. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, Second Edition, Albert Marcella, Jr., Doug Menendez, Auerbach Publications, 2007.
7. Cyber Laws and IT Protection, Harish Chander, PHI, 2013.

Data Structures and Algorithms Lab (CSP-003)

L:T:P:: 0:0:2 **Credits-1**

Course Objectives: The objectives of this course is to:

1. Analyze step by step development of algorithms to solve real-world problems.
2. Implement various data structures, viz. Stacks, Queues, Linked Lists, Trees and Graphs.
3. Understand various data searching & sorting techniques.

Course Outcomes: On successful completion of the course, the student will be able to:

1. Develop programs using dynamic memory allocation and linked list ADT.
2. Apply Stack and Queue to solve problems.
3. Implement the concept of hashing in real-time dictionaries.
4. Identify and implement suitable data structures for the given problem.
5. Solve real-world problems by finding the minimum spanning tree and the shortest path algorithm.

LIST OF EXPERIMENTS:

1. Write programs to implement the following using an array.
   a) Stack ADT
   b) Queue ADT
2. Write programs to implement the following using a singly linked list.
   a) Stack ADT
   b) Queue ADT
3. Write a program to implement the deque (double-ended queue) ADT using a doubly linked list.
4. Write a program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
5. Write a program to implement circular queue ADT using an array.
6. Write a program to implement all the functions of a dictionary (ADT) using hashing.
7. Write a program to perform the following operations on B-Trees and AVL-trees:
   a) Insertion.
   b) Deletion.
8. Write programs for implementing BFS and DFS for a given graph.
9. Write programs to implement the following to generate a minimum cost-spanning tree:
   a) Prim's algorithm.

b) Kruskal's algorithm.

10. Write a program to solve the single source shortest path problem.

(Note: Use Dijkstra's algorithm).

11. Write a program that uses non-recursive functions to traverse a binary tree in:

a) Pre-order.

b) In-order.

c) Post-order.

12. Write programs for sorting a given list of elements in ascending order using the following sorting methods:

a) Quick sort.

b) Merge sort.

Syllabus
Advanced Applied Mathematics (AHT-006)

L:T:P:: 3:1:0 **Credits-4**

Course Objectives:

The students will learn:
1. The idea of Laplace transform of functions and their applications.
2. The idea of Fourier transform of functions and their applications.
3.To evaluate roots of algebraic and transcendental equations.
4. Interpolation, numerical differentiation& integration and the solution of differential equations.
5.Acquaintance with statistical analysis and techniques.

Course Outcome(s):

At the end of this course, the students will be able to:
1. Remember the concept of Laplace transform and apply in solving real life problems.
2. Apply the concept of Fourier transform to evaluate engineering problems.
3. Understand to evaluate roots of algebraic and transcendental equations.
4. Solve the problem related interpolation, differentiation, integration and the solution of differential equations.
5. Understand the concept of correlation, regression, moments, skewness and kurtosis and curve fitting.

Course Contents:

Module 1: Laplace Transform: **(8 hours)**

Definition of Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve linear differential equations.

Module 2: Fourier Transforms: **(8 hours)**

Fourier integral, Fourier sine and cosine integral, Complex form of Fourier integral, Fourier transform,Inverse Fouriertransforms, Convolution theorem, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations.

Module 3: Solution of Algebraic & Transcendental equations and Interpolation: **(8 hours)**

Number and their accuracy, Solution of algebraic and transcendental equations: Bisection method, Iteration method, Newton-Raphson method and Regula-Falsi method. Rate of convergence of these methods (without proof), Interpolation: Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formula, Interpolation with unequal intervals: Newton's divided difference and Lagrange's formula.

Module 4: Numerical differentiation & Integration and Solution of ODE: **(8 hours)**

Numerical Differentiation, Numerical integration: Trapezoidal rule, Simpson's 1/3rd and 3/8 rule,Runge-Kutta method of fourth order for solving first order linear differential equations, Milne's predicator-corrector method.

Module 5: Statistical Techniques: **(8 hours)**

Introduction: Measures of central tendency, Moments, Skewness, Kurtosis, Curve fitting: Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves. Correlation and rank correlation, Regression analysis: Regression lines of y on x and x on y, Regression coefficients, Properties of regressions coefficients and non-linear regression.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons,10th ed.
2. B.V. Ramana: Higher Engineering Mathematics,McGrawHill.
3. Peter V.O'Neil: Advanced Engineering Mathematics, Cengage Learning,7th ed.
4. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th ed.
5. T.Veerarajan: Engineering Mathematics (for semester III), McGrawHill, 3rd ed.
6. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics,Narosa PublishingHouse,Std. ed.
7. P. Kandasamy, K. Thilagavathy, K. Gunavathi: Numerical Methods, S. Chand.
8. S.S. Sastry: Introductory methods of numerical analysis, Prentice Hall India, 5thed.
9. N.P. Bali and Manish Goyal: Computer Based Numerical and Statistical Techniques,Laxmi Publications, 5th ed.
10. J.N. Kapur: Mathematical Statistics, S. Chand &Company.
11. D.N.Elhance,V. Elhance&B.M. Aggarwal: Fundamentals of Statistics,Kitab Mahal.

Syllabus
Technical Communication (AHT-007)

L:T:P:: 2:1:0 **Credits-3**

COURSE OBJECTIVES:

Students should be able to:

1. To produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. To communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates, and complying with constraints on document format.
3. To clarify the nuances of phonetics, intonation and pronunciation skills.
4. To get familiarized with English vocabulary and language proficiency.

COURSE OUTCOMES:

1. Students will be enabled to **understand** the nature and objective of Technical Communication relevant for the work place as Engineers.
2. Students will **utilize** the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
3. Students would imbibe inputs by presentation skills to **enhance** confidence in face of diverse audience.
4. Technical communication skills will **create** a vast know-how of the application of the learning to promote their technical competence.
5. It would enable them to **evaluate** their efficacy as fluent & efficient communicators by learning the voice-dynamics.

COURSE CONTENTS:

Unit -1 Fundamentals of Technical Communication:
Technical Communication: Introduction, Features; Distinction between General and Technical Communication; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication, Importance of communication

Unit - II Forms of Technical Communication:
Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Unit - III Technical Presentation: Strategies & Techniques

Presentation: Forms; interpersonal Communication; Class Room presentation; style;method, Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of

audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections

Unit - IV Technical Communication Skills
Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances, exposition, narration and description

Unit - V Kinesics & Voice Dynamics:
Kinesics: Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation, pronunciation, articulation, vowel and consonants sounds

Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
6. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S.
7. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi.

Syllabus
UNIVERSAL HUMAN VALUES (AHT-008)

L:T:P:: 3:0:0 **Credits-3**

Course objectives : The objective of the course is four fold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes :

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)

2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

3. They would have better critical ability.

4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Introduction - Value Education

Universal human values; self exploration, natural acceptance an experimental validation; Human aspirations, right understanding, relationship and physical facility, current scenario; Understanding and living in harmony at various levels.

Module 2: Harmony in the Human Being

Understanding human being, needs of self(I) and body; body as an instrument of 'I'; characteristics and activities of 'I' and harmony in 'I'; harmony of I with the Body: Sanyam and Health, Physical needs an prosperity; Programs to ensure Sanyam and Health.

Module 3: Harmony in the Family and Society

Values in human-human relationship; nine universal values in relationships; justice, truth, respect, trust; Difference between intention and competence; Respect and differentiation, Harmony in society: resolution, prosperity, fearlessness and coexistence; Universal harmonious order in society.

Module 4: Harmony in the Nature and Existence

Harmony in the nature. Four orders of nature; existence as co-existence, harmony at all levels of existence.

Module 5: Harmony in the Professional Ethics

Natural acceptance of human values**,** Definitiveness of Ethical Human Conduct**;** Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case studies; transition from the present state to Universal Human Order: at individual level and societal level.

READINGS: Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karam chand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

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Syllabus

EET 002: Signals, Systems and Networks

L T P **Credits-04**
3 1 0

Course Objectives:
The objectives of this course are:

1. To introduce signals and system types and signal operation.
2. To solve first and second order systems.
3. To make student learn Laplace transform technique for solving circuits.
4. To use theorems for solving circuits.
5. To introduce two-port networks, representation and interconnections.

Unit 1: Introduction to Signals and Systems: (8 Hours)
A signal, signal modelling, elementary continuous time and discrete time signals, representation of discrete time signals, basic operation on signals, classification of signals, signals and vectors, system, classification of system, system modelling, invertibility and inverse system, System response.

Unit 2: Solution of First and Second Order Networks (8 Hours)
Solution of first and second order differential equations for Series and parallel R- L, R-C, R-L-C circuits, resonance, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit 3: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)
Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots).

Unit 4: Network Theorems (8 Hours)
Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Maximum power transfer theorem, Substitution theorem, Compensation theorem, and Tellegen's theorem.

Unit 5: Two Port Networks (8 Hours)
Two port networks, characterization of linear time-invariant two-port network, terminal pairs, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interrelationships between the parameters, interconnections of two-port networks, two port symmetry, input impedance in terms of two port parameters, output impedance, image impedance.

References:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.

5. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
6. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.

Course Outcomes:

At the end of this course, the students will able to:

1. Understand the various laws and theorems related to electric networks.
2. Understand the concept of two port networks
3. Able to calculate the response of the network.
4. Able to apply the concept of Laplace in networks
5. Familiarisation with signals and systems

Syllabus

EET 003: TRANSFORMERS AND DC MACHINES

L T P **Credits-04**
3 1 0

Unit 1: Principles of Electro-Mechanical Energy Conversion (8 Hours)
Principles of Energy Conversion, Single-Excited magnetic system, Double-Excited magnetic system. Basic Concept of rotating Electrical Machine: Electromagnetic Torque, Reluctance Torque, Generated EMF in Full pitched and short pitched Coil, Distribution Factor; breadth Factor, Pitch Factor, MMF produced by Distributed windings (MMF of a coil, MMF of distributed windings, MMF waveform of Commutator Machines).

Unit 2: Single Phase Transformers (8 Hours)
Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency, Testing - Open circuit and Short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses. Parallel operation of single-phase transformer. Autotransformers - construction, principle, applications and comparison with two winding transformer,

Unit 3: Three Phase Transformers (8 Hours)
Three-phase transformer - construction, types of connection and phasor groups and their comparative features, Magnetizing current, Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No- load and on-load tap-changing of transformers, Three-winding transformers. Cooling of a transformer.

Unit 4: DC machines (8 Hours)
Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, lap and wave windings, air gap and armature core and winding. Induced EMF in an armature coil, armature MMF wave, armature reaction. Effect of brush shift, linear commutation, Interpoles, and Compensating windings. Derivation of back EMF equation, derivation of torque equation,

Unit 5: DC machine - motoring and generation (8 Hours)
Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. Operating Characteristics of DC generators (separately excited, shunt, series and compound), torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage and field flux control. Losses and efficiency, load testing, and back to back testing of DC machines.

References

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Course Outcomes:

At the end of course, the students will be able to

1. Explain the importance of electromechanical energy conversion
2. Explain, analyse and apply the working principle of DC generator
3. Explain, analyse and apply the working principle of DC motor
4. Explain, analyse and apply the working principle transformer
5. Explain, analyse and apply the importance of three phase transformer

Syllabus

EET 004: Analog and Digital Circuits

L T P **Credits-04**
3 1 0

Unit 1: **Bipolar Junction Transistor (8 Hours)**
Review of BJT biasing circuits, biasing stabilization techniques, thermal runaway, Ebers-Moll model, model and T-model, Early effect, analysis of low frequency BJT amplifiers. BJT AMPLIFIERS: Cascade amplifiers, coupling of amplifiers, RC coupled, direct coupled and transformer coupled amplifiers, differential amplifier, Darlington-amplifier, bootstrapping, tuned amplifiers.

Unit 2: **Feedback amplifiers (8 Hours)**
Classification, feedback concept, transfer gain with feedback, General characteristics of negative feedback amplifiers, analysis of voltage-series, voltage-shunt, current-series and current-shunt feedback amplifiers, stability criterion.

Unit 3: **Oscillators and power amplifiers (8 Hours)**
Classification, criterion for sinusoidal oscillations, Hartley, Colpitts, Clapp, RC phase-shift, Wien-bridge and crystal oscillators, astable, monostable and bistable multivibrators, Classification; class-A, class-B, class-AB and class C amplifiers, push-pull amplifier, complementary-symmetry amplifier, distortion in power amplifiers.

Unit 4: Fundamentals of Digital Systems and logic families (8 Hours)
AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic one's and two's complements arithmetic, codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit 5: Combinational Digital Circuits and Sequential circuits (8 Hours)
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, comparator, parity checker/generator, code converters, priority encoders, A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and types flip flops, applications of shift registers, counters.

References:

1. Boylestad and Nashelsky, Electronic Devices and Circuit Theory, PHI, 2013.
2. Milman, Halkias & Jit, Electronic Devices and Circuits, TMH, 2007.
3. Deshpande, Electronic Devices and circuits, McGraw-Hill, 2007.
4. Kulshrestha, 'Electronic Devices and Circuits' PHI, 2007.
5. Sedra, Microelectronic Circuits, 5e (Intl. Version), Oxford, 2017.
6. Bell,Electronic Devices and Circuits, Oxford, 2009.
7. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
8. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
9. A Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Course Outcomes:

At the end of course, the students will be able

1. to design and analyse single and multistage amplifier circuits for small signal applications.
2. to understand feedback concepts in amplifier and oscillator circuits.
3. to design and analyse power amplifier circuits.
4. Understand the working of logic family and gates.
5. to design the combinational circuit and sequential circuit.

Syllabus

EEP-002: Signals, Systems and Network Lab

LT P **Credits-01**
0 0 2

1. Verification of principle of Maximum power transfer and superposition with dc and ac sources.
2. Verification of Thevenin and Norton theorems in ac circuits.
3. Verification of Tellegen's theorem for two networks.
4. Study the series resonance.
5. Study the parallel resonance.
6. Study the response in RLC series circuit with step voltage input for underdamped, critically damp and overdamped cases.
7. Study the transient response of RC circuit for step input.
8. Study the transient response of RL circuit for step input.
9. Determination of Z and Y parameters for a network
10. Determination of 'h' and ABCD parameters
11. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.
12. Determination of image impedance and characteristic impedance of T and ∏ networks.
13. Verification of parameter properties in inter-connected two port networks: series, parallel and cascade also study loading effect in cascade.
14. To determine attenuation characteristics of a low pass / high pass filters.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

Syllabus

EEP 003: Transformers and DC Machines Lab

LT P **Credits-01**
0 0 2

1. Determination of performance of single phase transformer with & without loading
2. Sumpner's test on single phase transformers
3. Scott connection of single phase transformers
4. Parallel operation of single phase transformers
5. Open Circuit & Load characteristics of DC shunt generator
6. Load characteristics of Cumulative & Differential compound generator
7. Determination of efficiency of DC series generator by Field test and load test
8. Pre-determination of efficiency on identical shunt machines by Hopkinson's test
9. Determination of performance of DC shunt motor with and without loading
10. Determination of efficiency of DC series motor by direct loading
11. Load characteristics of Cumulative and Differential compound motor
12. Perform speed control of DC shunt motor & find the losses by Retardation test

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

Syllabus

EEP 004: Electronic Circuits Lab

L T P **Credits-01**
0 0 2

Analog Circuits

1. To design and verify various biasing techniques for BJTs.
2. To determine voltage-gain output impedance and output power of a Darlington pair compound amplifier.
3. To determine "h" parameters of a PNP transistor in common emitter mode.
4. To study the effect of negative feedback on voltage gain & bandwidth in a two-stage amplifier.
5. To determine frequency of a Hartley Oscillator circuit with change in the capacitor of the tank circuit.
6. To determine frequency and wave shape of a phase shift oscillator circuit.
7. To determine voltage-gain and plot the frequency response of a single stage, two stage RC coupled and direct coupled amplifiers.

Digital Circuits

1. Bread-board implementation of counters & shift registers.
2. Determination of Delay time and NAND, NOR, Ex-OR, AND & OR Gates.
3. Experiments with clocked Flip-Flop.
4. Bread Board implementation of Adder/Subtractor (Half, Full).
5. Transfer characteristics of TTL inverters & TTL Schmitt Trigger inverter.
6. Transfer characteristics of CMOS inverters.
7. Mono-shot multivibrators using IC 74121 and IC 74123.
8. Clock circuit realization using IC 555.
9. Demultiplexer / Decoder operation using IC-74138.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EET 005: AC Rotating Machines

L T P **Credits- 04**
3 1 0

Unit 1: Fundamentals of AC machine windings (8 Hours)
Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, distribution factor.

Unit 2: Pulsating and revolving magnetic fields (8 Hours)
Magnetic field produced by a single winding - fixed current and alternating current. Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field. Calculation of total MMF in a magnetic circuit (MMF for air gap)

Unit 3: Induction Machines (8 Hours)
Construction, Types (squirrel cage and slip-ring), Rotor frequency, rotor (Emf, current and power) Equivalent circuit. Phasor Diagram, Starting and Maximum Torque., Losses and Efficiency. Torque-Slip Characteristics, Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors, Induction-Generator operation, Self-excitation. Doubly-Fed Induction-Machines.

Unit 4: Single-phase induction motors (8 Hours)
Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods: Capacitor start/run single phase induction motor and applications.

Unit 5: Synchronous machines (8 Hours)
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

Course Outcomes:
At the end of course, the students will be able to
1. Understand and design the winding
2. Understand the concepts of rotating magnetic field
3. Understand and apply the working principle of induction machine
4. Understand and apply the working principle of single phase induction machine
5. Understand and apply the working principle of synchronous machines

EET 006: Electrical Measurements and Instrumentation

L T P Credits- 04 3 1 0

UNIT 1: (8 Hours)

Electrical Measurements: Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis, Standards.
Transducers: Definition, Transducer as a function of instrumentation system, Classification of transducers.
Analog Measurements: Measurement of voltage, current, power and energy. Types of Instruments: PMMC, Electro-dynamic, Thermocouple, Electrostatic, and Rectifier.

UNIT 2: (8 Hours)
Instrument Transformers: Introduction, Use of Instrument transformers, Ratios of Instrument transformers, Burden of an instrument transformer, Current Transformers (CT): Construction, Working, Characteristics, Errors, Causes of errors, Error reduction methods, and Effect of secondary open circuit; Potential transformers (PT): Construction, Working, Characteristics, Errors, Causes of errors, Error reduction methods.

UNIT 3: (8 Hours)
Measurement of R, L, C Parameters: Measurement of low, medium and high resistances, Wheatstone bridge, Kelvin's double bridge, Wagner Earthing Device; Measurement of inductance: Maxwell, Hay's, Anderson, Owen, Heaviside, Campbell; Measurement of capacitance: De Sauty's, Schering; Wien bridges; LCR-meter; Q- Meter.

UNIT 4: (8 Hours)
AC Potentiometer: Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement.
Magnetic Measurement: Introduction, Magnetometer methods, Ballistic galvanometer, flux meter, determination of hysteresis loop, measurement of iron losses.

UNIT 5: (8 Hours)
Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram, Study of Digital voltmeter, Frequency meter, Electronic Multimeter.
Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its components, application of CRO in measurement, Lissajous Pattern; Dual Trace & Dual Beam Oscilloscopes.

References:

1. K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India.
2. R.K. Rajput, "Electrical Measurements and Measuring Instruments", S. Chand.
3. E. W. Golding & F.C. Widdis, "Electrical Measurement & Measuring Instrument", A.W. Wheeler& Co. Pvt. Ltd. India.
4. W. D. Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Describe the various Measurements principle.
2. Perform error calculation.
3. Apply the Instruments principles.
4. Explain the concept of CRO.
5. Familiarisation with measuring and testing.

EET 007: Electromagnetic Field Theory

L T P **Credits- 04**
3 1 0

Unit 1: **Review of Vector Calculus (8 hours)**

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit 2: Static Electric Field and Static Magnetic Fields (8 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density. Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Unit 3: Conductors, Dielectrics and Capacitance (8 Hours)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation.

Unit 4: Magnetic Forces, Materials and Inductance (8 Hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit 5: Time Varying Fields, Maxwell's Equations and Electromagnetic Waves (8 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Poynting theorem.

References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electro magnetics", Addison-Wesley Educational Publishers, International Edition, 1971.

Course outcomes:

At the end of the course, students will demonstrate the ability:

1. To explain the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyses time varying electric and magnetic fields.
4. To understand Maxwell's equation in different forms and different media.
5. To understand the propagation of EM waves.

EEP 006 AC Rotating Machines Lab

L T P **Credits-01**
0 0 2

1. Performance of 3-phase squirrel cage induction motor with and without load
2. Performance of 3-phase slip ring induction motor
3. Performance of 1-phase induction motor with and without load
4. Determination of equivalent circuit parameters of 1-phase induction motor load test on 3-phase alternator
5. Pre-determination of regulation of an alternator by EMF method
6. Pre-determination of regulation of an alternator by MMF method
7. Pre-determination of regulation of an alternator by ZPF method
8. Synchronization of 3-phase of alternator with infinite bus bars
9. V and Inverted V-curves of 3-phase synchronous motor
10. Performance of synchronous motor
11. Slip test and regulation of 3-phase alternator
12. Performance test on induction generator

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EEP 007: Electrical Measurements and Instrumentation Lab

L T P **Credits-01**
0 0 2

1. Study of Linear variable differential transducer.
2. Study of Thermistor transducer.
3. Study of RTD transducer.
4. Study of Thermocouple transducer.
5. Study of Strain gauge transducer-based Load measurement.
6. Study of Pressure transducer.
7. Study of Load cell sensor.
8. Study of Wheatstone's bridge.
9. Study of Kelvin's double bridge.
10. Study of Maxwell's bridge.
11. Study of Hay's bridge.
12. Study of Anderson's bridge.
13. Study of De Sauty's bridge.
14. Study of Schering's bridge.
15. Study of Owen's bridge.
16. Study of Wein's bridge.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EEP 008: Simulation Lab

L T P **Credits-01**
0 0 2

1. Introduction to MATLAB software and GUI features (or similar software platform).
2. Perform basic operations on Matrices: Addition, subtraction, Inverse, Divide, Transpose, etc.
3. Find the solution for linear simultaneous equations with 3 and more variables.
4. Solve linear differential equations. Obtain the response of second order system for various standard signals.
5. Obtain the 2D and 3D plots of important test functions.
6. Generate Various Signals and Sequences (Periodic and Aperiodic), such as Unit impulse, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc.
7. Write a program to perform operations like addition, multiplication, scaling, shifting, and folding on signals and sequences and computation of energy and average power.
8. Write a program for finding the even and odd parts of the signal / sequence and real and imaginary parts of the signal.
9. Perform convolution between given signals and sequences
10. Find the Fourier transform of a given signal and plot its magnitude and Phase spectrum
11. Locate the zeros and poles of the given transfer function, and Plot the pole-zero maps in Z-plane
12. Verify the Sampling theorem.

Simulation experiments [MATLAB or any other similar software may be used]

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

Syllabus
CONSTITUTION OF INDIA (AHT-009)

L:T:P:: 2:0:0 **Credits-0**

COURSE OBJECTIVE:

1. To acquaint the students with legacies of constitutional development in India and help to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.

COURSE OUTCOMES

The course should enable the students to:

1. Understand the basic knowledge and salient features of Indian Constitution.
2. Identify and explore the basic features and modalities about Indian constitution.
3. Discusses the essence of Union and its territories, Citizenship, Fundamental Rights, DPSP and Fundamental Duties.
4. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
5. Differentiate different aspects of Indian Legal System and its related bodies.

Unit-1 Constitutional Framework

Meaning of Terms and Phrases frequently used in political system like constitution, constitutionalism, Rule of Law, Federal system, Government and so on. Historical Background of Indian Constitution, Making of Indian Constitution, Salient features of Indian Constitution, Preamble of Indian Constitution.

Unit-2 Different Parts, Articles, and their significance

Part I to IVA (Union and its territories w.r.t. Indian States, Citizenship, Fundamental Rights conferred to citizens and foreigners, Directive Principles of State Policy– Its importance and implementation and Fundamental Duties and its legal status), Article 1 to 51A and their significance.

Unit-3 System of Government

Parliamentary Form of Government in India – The constitution powers and status of the President of India, Federal structure and distribution of legislative and financial powers between the Union and the States, Emergency Provisions: National Emergency, President Rule,

Financial Emergency and Amendment of the Constitutional Powers and Procedure and the significance of basic structure in Indian Judicial system

Unit-4 Working of Central, State & Local Self Government as per constitution

Framework for central government (President, Vice president, Prime Minister, Central council of ministers, Parliament, Supreme court and so on), Framework for state government (Governor, Chief Minister, state legislature, High court and so on) and Framework for local self government (Panchayatiraj, Municipalities) and Union Territories.

Unit-5 Constitutional, Non-Constitutional and other bodies

Discussion on Various constitutional bodies like Election Commission, UPSC, SPSC, Finance commission, NCSC, NCST, NCBC, CAG and AGI. Discussion on Various non-constitutional bodies like NITI Aayog, NHRC, CIC, CVC, CBI, Lokpal and Lokayukta. Discussion on Various other constitutional bodies like Co- operative societies, Official Language, Tribunals etc.

Text/Reference books-

1. M. Laxmikanth, “Indian Polity”, McGraw- Hill, 6th edition, 2020
2. D.D. Basu, “Introduction to the Indian Constitution”, LexisNexis, 21st edition, 2020
3. S.C. Kashyap, “ Constitution of India”, Vitasta publishing Pvt. Ltd., 2019

Syllabus
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (AHT-010)

L:T:P:: 2:0:0 **Credits-0**

COURSE OBJECTIVES:

The course should enable the students to:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life.
3. To make the students know the need and importance of protecting traditional knowledge.
4. To make the students understand the concepts of Intellectual property to protect the traditional knowledge.
5. This course is also concentrating on various acts in protecting the environment and Knowledge management impact on various sectors in the economy development of the country.

COURSE OUTCOMES:

The course should enable the students to:

1. Understand the concept of Traditional knowledge and its importance.
2. Know the need and importance of protecting traditional knowledge.
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge.
5. Know the contribution of scientists of different areas.

Unit – 1 Introduction to Traditional and Culture Knowledge

Define culture, traditional, civilization and heritage knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK). Indigenous traditional knowledge Vs western traditional knowledge vis-à-vis formal knowledge.

Unit-2 Protection of Traditional Knowledge

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of traditional knowledge Protection, value of traditional knowledge in global economy, Role of Government to harness traditional knowledge.

Unit – 3 Traditional Knowledge and Intellectual Property

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and

traditional knowledge, Strategies to increase protection of traditional knowledge, Global legal forums for increasing protection of Indian Traditional Knowledge.

Unit – 4 Traditional Knowledge in Different Sectors

Traditional knowledge in engineering, biotechnology and agriculture, traditional medicine system, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of traditional knowledge.

Unit – 5 Education System in India

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

Text/Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.
3. Traditional Knowledge System in India, by Amit Jha, 2009.
4. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
5. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh Pratibha Prakashan 2012.

EET 008: Electrical Power Generation, Transmission and Distribution

L T P **Credits-04**
3 1 0

Unit 1: (8 hours)

Generation of Electrical Power: Brief introduction, typical layout of Power System Network, block diagram and characteristics of Hydro, Thermal, Nuclear, Wind, Solar, Geothermal, and Tidal generations.

Economics of Power Generation: Power factor, load factor, diversity factor, plant capacity factor, load curve.

Unit 2: (8 hours)

Power System Components: Single line Diagram of Power system, Per unit system, Brief description of power system elements.

Transmission Lines: Configurations, types of conductors, the resistance of line, skin, and proximity effect, Kelvin's law.

Over Head Transmission Lines: Calculating inductance and capacitance of single-phase, three-phase, single-circuit, and double-circuit transmission lines, Representation and performance of short, medium, and long transmission lines, Ferranti effect, Surge impedance loading.

Unit 3: (8 hours)

Corona and Interference: Phenomenon of the corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona, and interference. Electrostatic and electromagnetic interference with communication lines.

Overhead line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency.

Unit 4: (8 hours)

Mechanical Design of transmission line: Catenary curve, calculation of sag and tension, effects of wind and ice loading, sag template, vibration dampers.

Cables: Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, the capacitance of single-phase and three-phase cables, dielectric loss, and heating of cables.

Unit 5: (8 hours)

Distribution Systems: Concept of Neutral grounding, Structure of a distribution system, Distribution feeder configurations and substation layouts, Radial and ring the main systems. Role of DISCOMs and electricity act 2003 and amendments in India. Importance of distribution system reliability indices.

References:

1. W. D. Stevenson, "Element of Power System Analysis," McGraw Hill.
2. I. J. Nagrath and D. P. Kothari, and R.K. Saket "Modern Power System," TMH Publication, 5th edition, 2022.
3. C. L. Wadhwa, "Electrical Power Systems," New age international Ltd. Third Edition.

4. B. R. Gupta, "Power System Analysis and Design," Third Edition, S. Chand & Co.
5. M. V. Deshpande, "Electrical Power System Design," Tata McGraw Hill.
6. R. Billinton, R.N. Allan, "Reliability Evaluation of Power Systems," Plenum Press NY & London, 2nd edition, 1996.

Course Outcomes:

At the end of this course, students will be able to:

1. Understand the basic abstraction of conventional and non-conventional electrical power generation.
2. Analyze the working and draw the transmission and distribution network layout.
3. Understand the working and construction of insulators and cables.
4. Describe the corona and interference-free transmission line.
5. Analyze the electrical distribution systems.

EET 009: Control System Engineering

L T P **Credits-04**
3 1 0

Unit 1: Introduction to control systems (8 hours)
Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit 2: Time Response Analysis (8 hours)
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit 3: Frequency-response analysis (8 hours)
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit 4: Introduction to Controller Design (8 hours)
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Lyapunov Stability for continuous system. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit 5: State variable Analysis (8 hours)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

References:
1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. To Understand the modeling of LTI system.
2. To Analyze the behavior of LTI system.
3. To learn the stability criteria of control systems.
4. To Discriminate time and frequency response.
5. To Design control system.

EET 010: Power Electronics

L T P **Credits-04**
3 1 0

Unit 1: Power switching devices (8 Hours)
Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; drive circuits for MOSFET and IGBT.

Unit 2: Thyristor rectifiers (8 Hours)
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit 3: DC-DC converters (8 Hours)
Elementary chopper, concepts of duty ratio and average voltage, power, Buck converter, duty ratio control. Boost converter, relation between duty ratio and average output voltage. Buck-Boost Converter. Configurations of Cuk Converter, Sepic Converter, Zeta Converter.

Unit 4: Single-phase voltage source inverter (8 Hours)
Single- phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, Modulation techniques, bipolar sinusoidal modulation and unipolar sinusoidal modulation, Harmonics and THD.

Unit 5: Three-phase voltage source inverter (8 Hours)
Three-phase voltage source inverter, 120-degree and 180-degree mode six-step inverters, average output voltages over a sub-cycle, 3-phase PWM inverters, harmonic analysis. Configurations of Multilevel Inverters and Current Source Inverters.

References:
1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
5. P.S. Bimbhra, “Power Electronics” Khanna Publishers, 7th ed., 2022.
6. A.M.S. Jamil Asghar, “Power Electronics” PHI, 1st ed., 2004.

Course Outcomes:
At the end of this course students will be ability to
1. Discuss power level devices, their characteristics and driver circuits.
2. Select and employ controlled rectifier circuits for an application.
3. Analyse the operation of DC-DC Converters.
4. Explain the operation of single-phase voltage source inverters and their analysis.
5. Analyze a three-phase voltage source inverter performance.

EET 011: ELECTRICAL MACHINE DESIGN

L T P
3 0 0

Unit 1: Introduction (8 Hours)

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit 2: Transformers (8 Hours)
Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit 3: Induction Motors (8 Hours)
Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current.

Unit 4: Synchronous Machines (8 Hours)
Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit 5: **Computer aided Design (8 Hours)**
Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, formulation of problem, Introduction to FEM based machine design.

Text / References:

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.
2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.
3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.
4. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.
6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

Course Outcomes:
At the end of this course students will be ability to

1. To design 1-phase transformer.

2. To understand the design of induction machine.

3. To understand the design of synchronous machine.
4. To understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
5. To understand the principles of electrical machine design and carry out a basic design of an ac machine.

EET 012: Transducers and Signal Conditioning

L T P
3 0 0

Unit 1: (8 Hours)
Introduction of Transducer: Definition of Transducers, Sensors and Actuators; Classification of transducers: active and passive, primary and secondary, resistive, inductive and capacitive transducers, inverse transducers.
Characteristics and selection of transducers: Input characteristics-type of input and operating range, transfer characteristics-transfer function, Output characteristics-type of electrical output, output impedance and useful range, selection criteria of transducers, typical specification of a transducer system.

Unit 2: (8 Hours)
Displacement Measurement: resistive-potentiometers, inductive-LVDT and RVDT, capacitive, piezoelectric, ultrasonic, hall effect, optical and proximity sensors.
Speed Measurement: Tachometer, Magnetic pickups, Encoders, Photoelectric pickups, Stroboscopes, Shaft speed measurement.
Vibration Measurement: Piezoelectric, Seismic, Potentiometric, and LVDT.

Unit 3: (8 Hours)
Pressure measurement: manometers and their types, elastic sensors, piezoelectric secondary transducers, differential pressure sensors, high-pressure gauges, vacuum gauges, dead weight tester and vacuum gauge tester.

Unit 4: (8 Hours)
Temperature measurement: Temperature scales, classification of temperature sensors, bimetallic thermometer, Resistance temperature detectors (RTD), types of RTD, lead wire compensation, Thermistors, Thermocouples, cold junction compensation techniques, thermopiles, pyrometers, temperature IC sensor LM35, design of signal conditioning circuits for RTD and Thermocouple.

Unit 5: (8 Hours)
Signal-Conditioning and Op Amp Circuits : Principles of Signal-conditioning; Operational Amplifiers: inverting amplifier, non-inverting amplifier, differential amplifier, instrumentation amplifier, isolation amplifier; Bridge circuits: Wheatstone bridge, bridge amplifier, wiring configurations; Filters: RC filters, active filters; Other Op-Amp Circuits: integrator, differentiator, comparator, logarithmic amplifier, voltage to current converter, current to voltage converter, voltage-controlled oscillator; Noise and noise reduction techniques: Induced noise, grounding, shielding, filtering.

References:

1. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
2. B.C. Nakra & K. Chaudhary, “Instrumentation, measurement and analysis”, Tata Mc Graw Hill 2nd Edition.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Ed.
4. Measurement Systems by E.O. Doebelin, McGraw Hill, 6th Ed.

5. Process Measurement & Analysis by B.G. Liptak, CRC press, 4th Ed.

Course Outcomes:

At the end of this course students will be ability to

1. To measure the linear and rotational speed.
2. To measure the temperature and pressure.
3. Understand the working principle, operation, and characteristics of transducers.
4. Design signal conditioning circuits for measurement of physical parameters.
5. To analyse analog filters.

EET 013: Energy Conservation and Audit

L T P
3 0 0

Unit 1: Energy Scenario (8 Hours)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit 2: Basics of Energy and its various forms (8 Hours)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, Units and conversion.

Unit 3: Energy Management & Audit (8 Hours)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Unit 4: Energy Efficiency in Industrial Systems (8 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities, cooling towers.

Unit 5: Energy Efficient Technologies in Electrical Systems (8 Hours)

Electrical system: Electricity billing, electrical load management. Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

References:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1,2 General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, 4 Electrical Utilities (available online)
3. S. C. Tripathi, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the importance of energy conservation
2. Understand the equipments involved in energy conservation
3. Explain the energy efficient devices.

4. Explain the importance of energy auditing
5. Understand the industrial importance of energy conservation and its auditing.

EET 014: ELECTRICAL ENGINEERING MATERIALS

L T P
3 0 0

Unit 1: (**8 Hours**)
Crystal Structure of Materials: Bonds in solids, crystal structure, co-ordination number, atomic radius representation of plane distance b/w two planed packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth.

Unit 2: (**8 Hours**)
Dielectric Materials: Polarization and Dielectric constant, Dielectric constant of mono-atomic, Poly atomic gases and solids, frequency dependence of electronic and ionic polarizabilities, dipolar relaxation, dielectric loss, piezoelectricity, ferroelectric materials.

Unit 3: (**8 Hours**)
Conductivity: Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, Half effect, Drift and Diffusion currents, continuity equation, thermoelectric effect.

Unit 4: (**8 Hours**)
Conducting and Insulating Materials: Properties and applications of electrical conducting and insulating materials, mechanical properties of metals, Properties of semi-conducting materials, Properties of insulating materials, Superconductivity and super conducting materials, optical properties of solids.

Unit 5: (**8 Hours**)
Magnetic Material: Origin of permanent magnetic dipoles in matters, Classification, Diamagnetism, Para-magnetism, Ferromagnetism, Anti-ferromagnetism and Ferrimagnetism, magnetostriction, Properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials.

References:
1. A. J. Dekker, "Electrical Engineering Materials" Prentice Hall of India.
2. Solymar, "Electrical Properties of Materials" Oxford University Press.
3. Ian P. Hones," Material Science for Electrical and Electronic Engineering," Oxford University Press.

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Understand the crystal structure of materials.
2. Understand dielectric materials and their properties.
3. Explain thermal conductivity of metals.
4. Explain properties of electrical conducting and insulating material.
5. Explain the classification of magnetic material.

EET 015: Special Electrical Machines

L T P
3 0 0

Unit 1: (**8 Hours**)
Poly-phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; E.M.F. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power)

Unit 2: (**8 Hours**)
Single phase AC Motors: Single phase synchronous motor- Hysteresis motor, reluctance motor. Construction, principle of operation, characteristics of universal and repulsion motors.
Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications.

Unit 3: (**8 Hours**)
Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. .

Unit 4: (**8 Hours**)
Permanent Magnet Machines : Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM ac motors, PMBLDC and PMSM and their important features and applications, PCB motors; introduction to permanent magnet generators.

Unit 5: (**8 Hours**)
Linear Induction Motors: Construction, principle of operation, Linear force, and applications.
Switched Reluctance Motors and Synchronous Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits. Synchronous Reluctance Motor.

References:
1. P.S. Bimbhra “Generalized Theory of Electrical Machines” Khanna Publishers.
2. P.C. Sen “Principles of Electrical Machines and Power Electronics” John Wiley & Sons, 2001
3. G.K.Dubey “Fundamentals of Electric Drives”, Narosa Publishing House, 2001
4. Cyril G. Veinott “Fractional and Sub-fractional horse power electric motors” McGraw Hill International, 1987.
5. M.G. Say, “Alternating current Machines” Pitman & Sons.

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Perform analysis for polyphase induction motor dynamics.
2. Analyze 1-phase motors.
3. Explain behavior of different stepper motors.
4. Select PM based motor for a given special application.
5. Apply principles of LIM.

EET 016: Advance Instrumentation

L T P
3 0 0

Unit 1: (**8 Hours**)
Introduction to Instruments and Their Representation: Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Description of the Functional Elements of the Instruments, Microprocessor-Based Instrumentation, Standards and Calibration. Static performance characteristics of instruments. Dynamic characteristics of instruments.

Unit 2: (**8 Hours**)
Flow Measurement Newtonian and non-Newtonian fluids, Reynolds's number, laminar and turbulent flows, velocity profile, Bernoulli's equation for incompressible flow, head type flow meters (orifice, venture meter and pitot tube), variable area type, turbine, electromagnetic, ultrasonic, anemometers, mass flow meter: Coriolis flow meter.

Unit 3: (**8 Hours**)
Miscellaneous Transducers: Digital Transducer- Introduction, types of digital encoding transducers, classification of Encoders-Tachometer, incremental and absolute. Piezoelectric transducer- Principle, operation, equivalent circuit, loading effect, frequency response and uses. Hall Effect Transducer- Construction, Principle and uses. Optoelectronic Transducer- Photovoltaic cell and its application, photoconductive cell and semiconducting photodiode.

Unit 4: (**8 Hours**)
Telemetry: Meaning and basic scheme of telemetry; Sources of error, line or transmission error; DC voltage and current telemetry schemes; Radio telemetry; PWM and digital telemetry schemes.
Data Acquisition System: Analog data acquisition system, digital data acquisition system, Modern digital data acquisition system.

Unit 5: (**8 Hours**)
Display Device and Recorders: Display devices, storage oscilloscope, spectrum analyzer, strip chart and x-y recorders, magnetic tape and digital tape recorders.
Recent Developments: Computer aided measurements, fibre optic transducers, micro sensors, smart sensors, and smart transmitters.

References:

1. A. K. Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. B.C. Nakra & K. Chaudhary, "Instrumentation, measurement and analysis", Tata Mc Graw Hill 2nd Edition
3. Dally. 'Instrumentation for Engineering Measurement 2nd edition, Wiley India.
4. Measurement Systems by E.O. Doebelin, McGraw Hill, 6th Ed.
5. Process Measurement & Analysis by B.G. Liptak, CRC press, 4th Ed.

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Understand the characteristics of instrument systems and their representation.
2. Understand the fluid flow measurement.

3. Understand the various transducers.
4. Explain the basics of telemetry and data acquisition system.
5. Explain display devices, recorders and computer aided measurements.

EET 017: Robotics and Automation

L T P
3 0 0

Unit 1: (**8 Hours**)
Introduction to Robotics: Types and components of a robot, Classification of robots, closed-loop and open loop control systems. Kinematics systems; Basic definitions of Robotics, Descriptions: Positions, Orientations, Frames, Robot Anatomy – Links, Joints and Joint Notation scheme, Degrees of Freedom (DOF), mechanisms and manipulators, Required DOF in a Manipulator.

Unit 2: (**8 Hours**)
Robot Kinematics and Dynamics: Kinematic Modeling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics, Dynamic Modeling: Equations of motion: Euler-Lagrange formulation

Unit 3: (**8 Hours**)
Robotic sensor: Contact and Proximity, Position, Velocity, Force, Tactile, Force-Torque sensors. Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators. Vision System: Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.

Unit 4: (**8 Hours**)
Robotics control: Second order linear system, Feedback control laws: P, PD, PID, Non-linear trajectory tracking control, joint controller, Control Hardware and Interfacing with sensors, actuators, components, Robotic Programming (ROS and VAL II), Applications of Industrial robot (PUMA, KUKA, FANUC, MTAB).

Unit 5: (**8 Hours**)
Artificial Intelligence in Robotics: Applications in unmanned systems, defence, medical, process industries, Motion planning – potential fields, projective path planning, Robotics and Automation for Industry 4.0.

References:
1. Ashitava Ghoshal, Robotics Fundamental Concepts & Analysis, Oxford University Press. (2006).
2. Mittal and Nagrath, Robotics and Control, Tata McGraw-Hill Publishing Company Ltd., New Delhi (2004)
3. Nikku, S.B., Introduction to Robotics, Prentice Hall of India Private Limited (2002).
4. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Perform kinematic and dynamic analyses.
2. Design control laws for a robot.
3. Integrate mechanical and electrical hardware for a real prototype of robotic device.
4. Select a robotic system for given application.
5. Apply knowledge for various applications.

EET 018: Digital Signal Processing

L T P
3 0 0

Unit 1: Discrete-Time Signals and Systems (8 hours)
Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate, Introduction to Z transform.

Unit 2: Fourier Transform (8 hours)
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT).

Unit 3: Discrete Fourier Transform (8 hours)
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform (FFT) Algorithms: DIT and DIF algorithms.

Unit 4: Implementation of Discrete Time System-Filters (8 hours)

Structure realization of discrete time FIR filters: Direct form, Cascade form structure, Linear phase and Lattice structure realization, Structure realization of discrete time IIR filters: Direct Form-I, II, Cascade form structure, Parallel form structure, Transposed direct form realization (Signal Flow Graph), Lattice and Lattice Ladder structure realization.

Unit 5: Design of Digital Filters (8 hours)
Design of digital filters from analog filters, Design of analog low pass Butterworth and Chebyshev Filters, Frequency transformation in analog domain, Design of IIR filters using analog filters, Frequency transformation in Digital domain, Design of FIR filters: Design of FIR Differentiators Design of Linear phase FIR filters using (Fourier series Method, windows Methods, Frequency sampling Method).

References:

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.
5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, “Digital Signal Processing”, John Wiley & Sons, 1988.

Course Outcomes:
At the end of this course students will demonstrate the ability to

1. Analyze the frequency domain analysis of signals.
2. calculate the Fourier coefficients
3. understand the concept of DFT and FFT algorithms.
4. realize the digital filters.
5. design and simulate IIR and FIR digital filters.

EEP 010: Power System Lab

L T P **Credit-01**
0 0 2

Experiments:

1. To study the characteristics of Solar PV.
2. To study the Ferranti effect and voltage distribution using a transmission line model in a long transmission line.
3. Plotting the equipotential lines of single and multilayer cables.
4. To study the performance characteristics of a radial distribution system.
5. To study the performance characteristics of a ring main distribution system.
6. To study and obtain the transmission line's ABCD, h, and image parameters.
7. To study and obtain the string efficiency of insulators with and without guard rings.

Simulation-based Experiments:

8. To study the characteristics of Solar PV.
9. To study the characteristics of Wind Turbine Generation.
10. To determine transmission line parameters of the short, medium, and long transmission lines.
11. To obtain the bus voltages for an IEEE 14 bus distribution system.
12. Study and plot different load curves for power plant generation.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EEP 011: Control System Lab

L T P **Credit-01**
0 0 2

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator Unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD).
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.

Software based experiments (Use MATLAB, LABVIEW software etc.)

6. To determine time domain response of a second order system for step input and obtain performance parameters.
7. To convert transfer function of a system into state space form and vice-versa.
8. To plot root locus diagram of an open loop transfer function and determine range of gain 'K' for stability.
9. To plot a Bode diagram of an open loop transfer function.
10. To draw a Nyquist plot of open loop transfer functions and examine the stability of the closed loop system.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EEP 012: Power Electronics Lab

L T P **Credit-01**
0 0 2

1. Single-pulse (half wave rectifier) controlled converter

2. Single phase fully controlled converter

3. AC to DC single-phase half-controlled converter (Semi converter)

4. Single-phase fully-controlled converter

5. Three-phase fully-controlled (6-pulse) rectifier

6. Step-down DC-DC converter

7. Step-up DC-DC converter

8. 1-phase DC-AC converter (1-phase full-bridge inverter with one pulse per half cycle)

9. 3-phase DC-AC converter (3-phase full-bridge voltage source inverter with one pulse per half cycle)

10. DC motor speed control using single-phase, fully-controlled bridge rectifier

11. Motor speed control using three-phase, voltage source inverter (induction motor/ PMBLDC/PMSM or any other suitable motor)

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EET 019: EMBEDDED SYSTEMS

L T P **Credits-04**
3 1 0

Unit 1: Fundamentals of Microprocessors and Microcontrollers: (8 Hours)
Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit, 16-bit and 32-bit microcontrollers. Overview of the 8051 family. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.

Unit 2: The 8051 Architecture and Instruction (8 Hours)
Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles. Instruction set, Instruction syntax, Data types, Addressing modes, Assembly language programs.

Unit 3: I/O Interfacing (8 Hours)
Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing

Unit 4: Introduction to embedded systems (8 Hours)
Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

Unit 5: Embedded Networking (8 Hours)
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS42 – RS 485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers

References:

1. J. K. Peckol, Embedded Systems: A Contemporary Design Tool, Wiley, 2008
2. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education, 2007.
3. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
4. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
5. R. S. Gaonkar, “Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Explain working of 8-bit microcontrollers

2. Write assembly language programs for 8051 microcontroller
3. Interface peripherals to 8051 like I/O, A/D, D/A, timer, etc.
4. Analyze memory management methods
5. Explain embedded communicating system.

EET 020: Power System Analysis

L T P **Credits-04**
3 1 0

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Unit 1: (8 hours)
Representation of Power System Components.
Symmetrical fault analysis: Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, an internal voltage of loaded machines under transient conditions.
Symmetrical components: Symmetrical Components of the unbalanced phasor, power in terms of symmetrical components, sequence impedances, and sequence networks.
Unsymmetrical faults: Analysis of single line-to-ground fault, line-to-line fault, and Double Line to ground fault on an unloaded generator and power system network with and without fault impedance. Formation of Z-bus using singular transformation and algorithm.

Unit 2: (8 hours)
Load Flow Analysis: Introduction, bus classifications, nodal admittance matrix (Y-bus), development of load flow equations, load flow solution using Gauss-Siedel and Newton-Raphson (N-R) method, the approximation to N-R method, Decoupled load flow, Fast decoupled load flow method.

Unit 3: (8 hours)
Power System Stability: Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement. Concept of series and shunt FACTS Devices.

Unit 4: (8 hours)
Load Frequency Control: Concept of load frequency control, load frequency control of single area system: turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response control area concept, P-I control, Load frequency control of two area system tie line power modeling, block diagram representation of two area system, static and dynamic responses.

Unit 5: (8 hours)
Concept of unit commitment.
Security analysis: Security state diagram, contingency analysis.
State Estimation: Concept, sources of errors in measurement, wide area management, weighted least square method.

References:
1. W. D. Stevenson, Jr., "Elements of Power System Analysis," McGraw Hill.
2. I. J. Nagrath and D. P. Kothari, and R.K. Saket "Modern Power System," TMH Publication, 5th edition, 2022.
3. C. L. Wadhwa, "Electrical Power System," New Age International.
4. T. K. Nagsarkar& M. S. Sukhija, "Power System Analysis," Oxford University Press, 2007.
5. Chakraborthy, Soni, Gupta & Bhatnagar, "Power System Engineering," DhanpatRai & Co.

6. Allen J. Wood and Bruce F. Wollenberg, "Power Generation, Operation, and Control," Wiley–Blackwell, 2nd edition, 1996.

Course Outcomes:

At the end of this course, students will be able to:

1. Draw reactance and impedance diagrams of a power system and evaluate fault currents for different types of faults.
2. Develop numerical methods and algorithms to analyze a power system in a steady state.
3. Synthesize stability constraints in a synchronous grid.
4. Create a load frequency control system for controlling a power system.
5. Understand the concept of economic dispatch, security, and state estimation in a power system.

EET 021: Power System Protection

L T P
3 1 0

Unit 1: (8 hours)

Introduction to power system protection: Philosophy of power system protection, Introduction to the protective system and its elements, the function of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, and basic terminology. **Introduction to protective relaying:** Reliability, dependability, and security; elements of protection system.

Unit 2: (8 hours)

Relays: Relay operating principles, Detection of faults, Different types of relays: Electromechanical-attraction and induction type relays, thermal relay, gas actuated relays, Solid State Relays. Relay Applications and characteristics: Amplitude and phase comparators, over current relays, directional relays, distance relays, and differential relays. Static relays. **Numerical and microprocessor-based relays:** Comparison with electromagnetic relays, classification, and their description, over current relays, directional relays, distance relays, differential relays.

Unit 3: (8 hours)

Protection of transmission line: Transients in lumped parameter & distributed parameter circuits-wave equations, Reflection & Refraction coefficients, Time graded protection, differential and distance protection of feeders, the choice between impedance, reactance, and MHO relays, Elementary idea about carrier current protection of lines, protection of bus, auto reclosing, pilot wire protection.

Unit 4: (8 hours)

Circuit Braking: Arc phenomenon, properties of arc, arc extinction theories, recovery voltage and restriking voltage, current chopping, resistance switching, capacitance current interruption, circuit breaker ratings.

Circuit breakers: Need of circuit breakers, types of circuit breakers, operating modes, principles of construction, details of Air Blast, Bulk Oil, Minimum Oil, SF6, Vacuum Circuit Breakers, DC circuit breakers.

Testing of circuit breakers: Classification, testing station & types of equipment, testing procedure, direct and indirect testing.

Unit 5: (8 hours)

Apparatus Protection: Types of faults on alternator, stator and rotor protection, negative sequence protection, loss of excitation, and overload protection. Types of fault on transformers, percentage differential protection, isolated neutral system, grounded neutral system, and selection of neutral grounding.

References:

1. Badri Ram and D Vishwakarma “Power System Protection and Switchgear,” McGraw Hill Education, 2nd edition, 2017.
2. A.T. Johns, S.K. Salman ‘Digital Protection for Power System’, John Wiley & Sons Ltd. Third Edition
3. Arun G. Phadke and James S. Thorp, “Computer Relaying for Power Systems,” Wiley, 2nd edition, 2012.

4. Soni, Gupta & Bhatnagar, "A Course in Electrical Power," Dhanpat Rai & Sons, India.

Course Outcomes:

At the end of this course, students will be able to:

1. Describe basic protection schemes.
2. Analyze the different components of a protection system
3. Design the protection schemes for different power system components.
4. Analyze the working and construction of different kinds of circuit breakers.
5. Apply the different protection schemes in different power system equipment.

DE-3
EET 022: ELECTRIC DRIVES

L T P
3 0 0

Unit 1: DC motor characteristics (8 hours)
Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, armature voltage control and field control for varying motor speed.
Chopper fed DC drive: Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Unit 2: Multi-quadrant DC drive (8 hours)
Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four- quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Unit 3: Closed-loop control of DC Drive (8 hours)
Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Unit 4: Induction motor characteristics (8 hours)
Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, constant flux operation, flux weakening operation.
Scalar control or constant V/f control of induction motor: Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Unit 5: Control of slip ring induction motor (8 hours)
Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.
References:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.
5. B. K. Bose “Modern Power Electronics and AC Drives”

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the concepts of power electronics to machines.
2. Describe the concepts of Chopper for DC motor Speed Control.
3. Design the Speed control of DC motor

4. Develop the method of Speed control of DC motor
5. Develop the method of Speed control of induction motor

EET 023: Modern Control Systems

L T P
3 0 0

Unit 1: State variable Analysis (8 hours)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Unit 2: Discrete System Analysis (8 hours)
Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Difference Equations, Solution of Discrete time systems. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Unit 3: Nonlinear Control System (8 hours)
Linearization techniques of nonlinear Systems, Phase plane and describing function techniques, Lyapunov's stability analysis, Popov's Stability criteria

Unit 4: Optimal Control System (8 hours)
Formation of optimal control problems, calculus of variation, minimization of functions, constrained optimization, dynamic programming, performance index, optimality principles, Hamilton – Jacobian equation, linear quadratic problem, Ricatti II equation and its solution, solution of two-point boundary value problem

Unit 5: Adaptive Control System (8 hours)
Model reference adaptive control system, Controller structure, Self tuning regulators, Various adaptive control systems

References:
1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the state variable analysis techniques
2. Understand the discrete control system
3. Understand the importance of nonlinear control.
4. Analyzing the optimal control system.
5. Evaluating the performance of adaptive control.

EET 024: FACTS Devices

L T P
3 0 0

UNIT 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)
Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

UNIT 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT 3: Voltage Source Converter based (FACTS) controllers (8 hours)
Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control.

UNIT 4: Application of FACTS (4 hours)
Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.
Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter

UNIT 5: DSTATCOM and other controllers (8 hours)
Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.
Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References
1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Explain the advantage and need of FACTS.
2. State the concepts of Thyristor based controllers
3. Select the devices used for control in transmission line
4. describe the FACTS controller for applications
5. Discuss the controllers in distribution systems.

EET 025: Intelligent Systems

L T P
3 0 0

Unit 1: Neural Networks (Introduction & Architecture) (8 hours)
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory

Unit 2: Neural Networks (Contd.)(Back propagation networks) (8 hours)
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting back propagation training, applications.

Unit 3: Fuzzy Logic (Introduction) (8 hours)
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory versus probability theory, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Unit 4: Fuzzy Logic (Contd.) (Fuzzy Membership, Rules) (8 hours)
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfication & Defuzzification, Fuzzy Controller and its application.

Unit 5: Genetic Algorithm: (8 hours)
Introduction, mutation, population, crossover. Application of Genetic Algorithm,

References:
1. Kumar Satish, “Neural Networks” Tata Mc Graw Hill
2. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications” Prentice Hall of India.
3. Simon Haykin, “Neural Networks” Prentice Hall of India
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the theory of neural network and training algorithms.
2. Understand the importance of fuzzy set theory and its arithmetic operations.
3. Design of fuzzy logic controllers and its applications
4. Creating optimization algorithm problems
5. Applications of Intelligent systems.

EEP 015: Embedded Systems Lab

L T P **Credits-01**
0 0 2

1. Study of microcontroller evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM
4. Interfacing real time clock and serial port
5. Interfacing keyboard and LCD, Flashing of LEDS
6. Interfacing stepper motor and temperature sensor.
7. Intel 8086 Assembly program for Arithmetic and Logical Operations,
8. Intel 8086 Procedures and Macros,
9. Assembly program for Arithmetic and Logical Operations,
10. Assembly program for Multi-byte Operations,
11. Assembly program for Control Manipulation,
12. Assembly program for String Manipulation,
13. Assembly program for Thumb Instructions,
14. Embedded C Programming using Simulator – Simple C Programs,
15. Port Programming.
16. Peripheral Interfacing – Keypad, Motor, LED.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EEP 016: Computer Aided Power System Lab

L T P **Credits-01**
0 0 2

1. (a) Formation of bus admittance matrices by adding one element at a time.
   (b) Write a program for the Z-bus building algorithm using MATLAB.
1. Write a MATLAB program for load flow studies using the Gauss-Seidel Method with and without generator buses.
2. Write a MATLAB program for load flow studies using Newton Raphson and the Fast Decoupled Load Flow method.
3. Write a MATLAB program for load flow studies using Decoupled Load Flow method and compare it with the Fast Decoupled Load Flow method.
4. Analyze the symmetrical and unsymmetrical faults using symmetrical components using MATLAB.
5. Develop a MATLAB program for Transient stability analysis of one machine - infinite bus system and multi-machine system using the point-by-point method.
6. Analyze symmetrical faults and short circuit studies in a given synchronous machine using MATLAB.
7. Using MATLAB, study the simple transmission system and perform short circuit analysis on the IEEE 14 bus system.
8. Development of MATLAB model for stability analysis of single machine - infinite bus with STATCOM.
9. Obtaining parameters of a typical transmission line and modeling it in MATLAB.
10. Obtain the frequency response of single and two-area power systems using MATLAB.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

EEP 017: Power System Protection Lab

L T P **Credits-01**
0 0 2

1. To study the instantaneous over-current relay, determine the time-current characteristics
2. To study the IDMT over-current relay and determine the time-current characteristics
3. To study the earth fault relay and determine the time-current characteristics.
4. To study the thermal relay and determine the time-current characteristics.
5. To study percentage differential relay and plot its operating characteristics.
6. To study Impedance, MHO, and Reactance type distance relays.
7. To study over-voltage relays and determine the time-voltage characteristics.
8. To study under-voltage relays and determine the time-voltage characteristics.
9. To determine fault current for L-G, L-L, L-L-G, and L-L-L faults at the terminals of an alternator at very low excitation

Simulation-Based Experiments:

10. To study the characteristics of an IDMT relay.
11. To study the characteristics of an Overcurrent relay.
12. To study the characteristics of an Overvoltage relay.
13. To study the characteristics of a Distance relay.
14. Write a program for Numerical relay.

****Minimum 10 experiments must be performed. Additional or any other experiment may be added based on contents of syllabi.

Syllabus
Open Elective 1 (HSC)
TOTAL QUALITY MANAGEMENT (AHT-011)

L:T:P:: 3:0:0 **Credits-3**

Course Objective

The course should enable the students to:

1. To understand the concept of Quality in Manufacturing and Service units.
2. To understand the Implication of Quality in Business.
3. To understand the Organization Structure in TQM.
4. To understand how to implement Quality Programs in an Organization.
5. To have exposure to challenges in Quality Improvement Programs.

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. Identify the significance of quality in an organization.
2.Describe how to manage quality improvement teams.
3. Describe how to organize management and quality policies in TQM.
4. Apply the tools of quality improvement programs in an organization.
5. Assess the benefits of implementing TQM Program in an organization.

Unit	Course Content	Lectures
I	**Introduction:** Evolution of Quality, Historical Perspectives, Relationship among Quality, Vision, Mission and Objectives of an Organization, Role of Quality in a Corporate Structure of an Organization, Attributes of Product and Service Quality, Quality Characteristics: Quality of Design, Quality of Performance and Quality of Conformance, Zero Defect and Continuous Improvement.	07
II	**Conceptualization of TQM:** Introduction to Total Quality Management (TQM), Barriers to TQM, Benefits of TQM implementation, Basic Approaches of TQM, TQM Models, Quality Information System and Planning. Importance of TQM in manufacturing and Service Industry.	07
III	**Organization Structure in TQM:** Role of Top Management, Quality Council, Quality Circles, Organization Structure for Quality Circles, Quality Policies, Role of Middle and Lower Management, Problem Solving Techniques.	07
IV	**Tools and Systems for Quality Management:** Basic Tools: Cause & Effect Diagram, Flow Diagrams, Trend Charts, Histogram, Scatter Diagram, Control Chart, Advanced Tools: Affinity Diagram, Inter Relationship Diagram, Tree Diagram, Matrix Diagram, Process Decision Program Chart (PDPC) and Matrix Data Analysis, Fault Tree Analysis, Quality Function Deployment (QFD) Definition and Phases in QFD. Taguchi Approach To Quality System Design, Six - sigma Definition & Implementation Steps, Just In Time Production System, Quality Production through JIT and Kanban, Failure Mode and Effect Analysis (FMEA): Scope, Mode, Illustrative Example and Applications.	10
V	**Quality Assurance:** Causes of Quality Failure, Quality Assurance: Need and Various Elements in Quality Assurance Programme, Quality Control- on Line and off Line, Statistical Concepts in Quality, Chance and Assignable Causes, Bench Making in Quality Management.	09

	Implementation and Need of ISO 9000: ISO 9000 - 2000 Quality System: Elements, Registration, Documentation, Implemental Steps, Quality Audit, Product and Process Audit Scope, Steps and Benefits.	

Books and References

1. Total Quality Management by Dale H Bersterfilled, PHI Publication.
2. Total Quality Management by N.V.R Naidu, G. Rajendra, New Age international Publication.
3. Total Quality Management by L. Sugandhi and Samuel Anand, PHI Publication.
4. Total Quality Management by R.S Naagarazan, New Age International Publication.

Syllabus
Open Elective 1
MANAGING E-COMMERCE AND DIGITAL COMMUNICATION(AHT-012)

L:T:P:: 3:0:0 **Credits-3**

Objective of the Course

The course should enable the students to:

1. To understand of concepts and techniques of internet marketing.
2. To study behaviour and experience of online customer.
3. To study the various techniques of digital promotion.
4. To find out the opportunities for marketers on digital platform.
5. To understand the role of several e commerce models in customer value creation.

Course Outcomes

Upon successful completion of the course, the student will be able to :

1. Understand strategies used in digital marketing.
2. Apply interactive marketing communications to gratify online buyer.
3. Apply digital promotion techniques for marketing of product and services.
4. Evaluate the role of web analytics in social media marketing.
5. Apply and design various e commerce models for e-business.

Unit	Course Content	Lectures
I	**Introduction to digital marketing:** Digital marketing meaning scope and importance, Internet versus traditional marketing. Use of business to consumer and business to internet marketing, internet marketing strategy, Incorporating self-service technologies (SSTs).	08
II	**Online buyer behaviour and models:** marketing mix in online context. Managing online customer experience, planning website design, understanding site user requirement, site design and structure, integrated marketing communications (IIMC), measurement of interactive marketing communication, e-WOM.	08
III	**Digital promotion techniques:** email marketing, strategy to craft email marketing campaign, permission marketing, viral marketing, blogs, search engines marketing (SEM), Search engine optimization, content marketing.	08
IV	**Social media marketing:** designing content for social media marketing, mobile marketing advertising on mobile devices, mobile apps, tracking mobile marketing performance, and introduction to web analytics-meaning types, key metrics and tools.	08
V	**Introduction to e-Commerce and Retailing in Online Space:** advantages of e-Commerce Platforms, Differentiate Show-rooming and Web-rooming, e-tailing, e-Commerce Business Process, Business Models, Interpret e-Commerce Shopping Cart Software & Other Factors of e-Commerce based business, role of aggregators in e-Commerce business.	08

Books and References

1. Kotler, P. and Keller, K.L. (2017) Marketing Management. 15 ° ed . India: Pearson Education .
2. Chaffey, D. and Ellis - Chadwick, F. (2012) . Digital Marketing Strategy. Implementation and Practice. 1st ed. Education
3. Digital Marketing: Cases from India by Rajendra Nargundkar and Romi Sainy, Notion Press, Inc.
4. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation by Damian Rya Publisher.
5. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler, Publisher Wiley.

Syllabus
Open Elective 1
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT (AHT-013)

L:T:P: 3:0:0 **3 Credits**

Course Objective

The course should enable the students to:

1. To impart knowledge about various aspects of industrial safety and occupational health.
2. To impart knowledge aboutOccupational Health and Toxicology.
3. To enable the students to identity hazard and assess risk.
4. To understand Acts and Rules of industrial safety and hazard management.
5. To teach about various safety acts and rules along with safety education and training.

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. Identify the key aspects of industrial safety and mitigating them.
2. Describe various types of solution to problems arising in safety operations and hygiene.
3.Apply principles of OSHA in controlling industrial disasters and losses.
4. Identify various Acts and Rules of industrial safety and hazard management.
5. Assess the overall performance of safety protocols of chemical industries and hazard management.

Unit	Course Content	Lectures
I	**Concepts and Techniques:** History of safety movement -Evolution of modern safety concept - Incident Recall Technique (IRT), disaster control, safety analysis, safety survey,safety inspection, safety sampling. Safety Audits - components of safety audit, types of audit,audit methodology, non - conformity reporting (NCR), audit checklist- identification of unsafe acts of workers and unsafe conditions in the industry.	08
II	**Occupational Health and Toxicology:** Concept and spectrum of health, functional units and activities of occupational health services, occupational related diseases and levels of prevention of diseases. Toxicology- local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.	08
III	**Hazard Identification and Risk Assessment:** The process of risk management, hazard identification, evaluation (risk assessment, risk matrix), risk control implementation, action and recommendation.	08
IV	**Acts and Rules**: Indian boiler Act 1923, static and mobile pressure vessel rules (SMPV). motor vehicle rules, mines act 1952, workman compensation act, rules - electricity act and rules - hazardous wastes (management and handing) rules, 1989, with amendments in 2000 the building and other construction workers act 1996, Petroleum rules, Explosives Act 1963 Pesticides Act. Factories Act 1948 Air Act 1981 and Water Act 1974.	08
V	**Safety Education and Training:** importance of training - identification of training needs training methods - programmes, seminars, conferences, competitions - method of promoting sale practice motivation communication - role of government agencies and private consulting agencies in safety training creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign - domestic Safety and Training.	08

Books and References

1. Industrial Accident Prevention by H.W Heinrich, McGraw - Hi 1980.
2. Safety Management in industry by NV. Krishnan, Jaico Publishing House, Bombay, 1997.
3. Loss Prevention in Process Industries by FP Lees, Butterworth London, 1990.
4. Safety at Work by J.R. Ridey Butterwort London 1983.

Syllabus
Happiness and Well-being (AHT-014)

L:T:P: 2:0:0 **Credits-0**

Course Objectives:

1.To obtain a basic understanding of Positive emotions, strengths and virtues; the concepts and determinants of happiness and well-being.
2.To bring an experience marked by predominance of positive emotions and informing them about emerging paradigm of Positive Psychology
3.Build relevant competencies for experiencing and sharing happiness as lived experience and its implication.
4.To become aware of contextual and cultural influences on health and happiness.

Course Outcomes:

1. This course provides an insight to see the importance of positive emotions, Strength and Virtues in everyday life and society.
2. It helps to use the strength and virtues in improving human behavior and mental health.
3. This course helps to understand the biological, social, psychological and spiritual determinants of Happiness and well-being.
4. This course throws light on research findings related to effects of happiness and well-being on mental illness and stress.
5. Give an insight of the Indian philosophy of happiness and life satisfaction in context of Karma, Moksha and destiny and role of socio-demographic and cultural factors in Happiness and well-being.
6. Helps in establishing work life balance in an individual's life.

UNIT I: Introduction to Positive Psychology

Importance of positive emotions in everyday life and society, Positive Emotions and well being: Hope & Optimism, Love. The Positive Psychology of Emotional Intelligence, Influence of Positive Emotions Strength and Virtues; implications for human behavior and mental health.

UNIT II: Happiness

Determinants of Happiness and well-being – biological, social, psychological and spiritual, Types of happiness- Eudaimonic and Hedonic, Traits associated with Happiness, Setting Goals for Life and Happiness, Research findings on effects of happiness and well-being on mental illness and stress.

UNIT III: Resilience and Well Being

Meaning, Nature and Approaches Theories of Resilience, Positive Response to loss, Post Traumatic Growth, Models of PTG as Outcome, Models of PTG as a Coping Strategy Benefit Finding, Mindfulness and Positive Thinking, Building Resilience and Wellbeing.

UNIT IV: Happiness and Well-being in the Indian context

Indian philosophy of happiness and life satisfaction. – Karma, Moksha and destiny. theory of happiness and wellbeing in Taittiriya Upanishad, Role of socio-demographic and cultural factors in Happiness and well-being. Health and Happiness in contemporary India – rural and urban differences and similarities.

UNIT V: Positive work life

Employee engagement- what causes individuals to join an organization and why they stay or leave, person-centered approach to engagement Understand the concept of work as meaning, Impact of employee well-being on the organization and impact of feelings about work on the individual's well-being. Bringing Positive Psychology to Organizational Psychology

SUGGESTED READINGS:

- Dandekar, R. N. (1963). On dharma. In De Bary (ed.) Sources of Indian Tradition. Delhi, India: Motilal Banarasidass Publishers.
- Dandekar R. N. (1981). Exercises in Indology. Delhi, India: Ajanta Publishers.
- Snyder, C.R., &Lopez,S.J.(2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage. Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.
- Seligman, M. (2011). Flourish: A Visionary New Understanding of Happiness and Well-being, Atria Books.
- Peterson, C. A. (2006). A Primer in Positive Psychology, Oxford University Press.
- Nettle, D.S. (2006). Happiness: The Science Behind Your Smile, Oxford University Press.
- Lyubomirsky, S. (2013). The Myths of Happiness: What Should Make You Happy, but Doesn't, What Shouldn't Make You Happy, but Does, Penguin

Syllabus
HSMC-1
Rural Development: Administration and Planning (AHT-015)

L:T:P:: 3:1:0 **Credits-3**

Course Objectives
This course enables the students to:

1. Gain knowledge on the concepts related to administration, its importance and various approaches of Development Administration.
2. Gain skills on New Public Management, Public Grievances and Redressal Mechanisms, Accountability and Transparency in Administration and e-governance in the rural development sector.
3. Develop their competency on the role of Bureaucracy in Rural Development.

Course Outcomes
After completion of the course student will be able to:

1. Students can understand the definitions, concepts and components of Rural Development.
2. Students will know the importance, structure, significance, resources of Indian rural economy.
4. Students will have a clear idea about the area development programmes and its impact.
5. Students will be able to acquire knowledge about rural entrepreneurship.
6. Students will be able to understand about the using of different methods for human resource planning.

Course Contents

UNIT-I: **(8 hours)**

Rural Planning & Development: Concepts of Rural Development, Basic elements of rural Development, and Importance of Rural Development for creation of Sustainable Livelihoods, An overview of Policies and Programmes for Rural Development- Programmes in the agricultural sector, Programmes in the Social Security, Programmes in area of Social Sector.

UNIT-II: **(8 hours)**

Rural Development Programmes: Sriniketan experiment, Gurgaon experiment, Marthandam experiment, Baroda experiment, Firkha development scheme, Etawapilot project, Nilokheri experiment, approaches to rural community development: Tagore, Gandhi etc.

UNIT-III: **(8 hours)**

Panchayati Raj & Rural Administration: Administrative Structure: bureaucracy, structure of administration; Panchayati Raj Institutions Emergence and Growth of Panchayati Raj Institutions in India; People and Panchayati Raj; Financial Organizations in Panchayati Raj Institutions, Structure of rural finance, Government & Non-Government Organizations / Community Based Organizations, Concept of Self help group.

UNIT-IV: **(8 hours)**

Human Resource Development in Rural Sector: Need for Human Resource Development, Elements of Human Resource Development in Rural Sector Dimensions of HRD for rural

development-Health, Education, Energy, Skill Development, Training, Nutritional Status access to basic amenities – Population composition.

UNIT-V: **(8 hours)**

Rural Industrialization and Entrepreneurship: Concept of Rural Industrialization, Gandhian approach to Rural Industrialization, Appropriate Technology for Rural Industries, Entrepreneurship and Rural Industrialization- Problems and diagnosis of Rural Entrepreneurship in India, with special reference to Women Entrepreneurship; Development of Small Entrepreneurs in India, need for and scope of entrepreneurship in Rural area.

Text Books/References:

1. Corporate Social Responsibility: An Ethical Approach - Mark S. Schwartz.
2. Katar Singh: Rural Development in India – Theory History and Policy.
3. Todaro M.P. Economic Development in III World war.
4. Arora R.C – Integrated Rural Development in India.
5. Dhandekar V.M and Rath N poverty in India.
6. A.N.Agarwal and Kundana Lal: Rural Economy of India.
7. B.K.Prasad: Rural Development-Sarup& Son's Publications.

Syllabus
HSMC-2
PROJECT MANAGEMENT & ENTREPRENEURSHIP (AHT-016)

L:T:P:: 3:1:0 **Credits-3**

Course Objectives:

The course should enable the students to:

1 Understand the concepts of Project Management for planning to execution of projects.
2 Understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3 Be capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.
4 Understand the concepts of Entrepreneurship, role of entrepreneur in economic development, steps for establishing an enterprise.

Course Outcomes:

After completion of the course student will be able to:

1 Understand project characteristics and various stages of a project.
2 Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.
3 Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Describe Entrepreneurship, Examine role of entrepreneur in economic development.
5. Describe the steps to establish an enterprise.

Course Contents

UNIT-I: **(8 hours)**

Entrepreneurship: Entrepreneurship: need, scope , Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship , entrepreneur vs. intrapreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes.

UNIT-II: **(8 hours)**

Entrepreneurial Idea and Innovation: Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & Organizational Effectiveness.

UNIT-III: **(8 hours)**

Project Management: Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal, Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal.

UNIT-IV: **(8 hours)**

Project Financing: Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation , preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance.

UNIT-V: **(8 hours)**

Social Entrepreneurship: Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures.

Case study and presentations: Case study of successful and failed entrepreneurs. Power point presentation on current business opportunities..

Text Book:

1. Innovation and Entrepreneurship by Drucker, P.F.; Harperand Row.
2. Business, Entrepreneurship and Management: Rao, V.S.P.;Vikas
3. Entrepreneurship: Roy Rajeev.
4. Text Book of Project Management:Gopal krishnan,P.andRamamoorthy,V.E.;McMill.
5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.;PHI.
6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.;MGH.

Syllabus

DISASTER MANAGEMENT (AHT-017)

L:T:P:: 3:0:0 **Credits-3**

COURSE OBJECTIVES:

The course should enable the students to:

1. To introduce the students to various types of natural and manmade disasters.
2. To understand causes and impact of disasters.
3. To understand approaches of Disaster Management .
4. To build skills to respond to disaster.

COURSE OUTCOMES:

At the end of the course, Student will be able to:

1. To provide students an exposure to disasters, their significance and types.
2. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. To understand approaches of Disaster Management.
4. To build skills to respond to disaster.

Unit-1 Introduction to Disasters

Concepts, and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks). Disaster Types, Trends, Causes, Consequences and Control of Disasters, Geological Disasters; Hydro-Meteorological, Biological, Technological and Manmade Disasters.

Unit-2 Disasters: Classification, Causes, Impacts

(Including social, economic, political, environmental, health, psychosocial, etc.)

Differential impacts-in terms of caste, class, gender, age, location, disability. Global trends in disasters urban disasters, pandemics, complex emergencies, Climate change.

Unit-3 Approaches to Disaster Risk Reduction:

Disaster cycle- its analysis, Phases, Culture of safety, prevention, mitigation and preparedness, community based DRR, Structural- nonstructural measures, roles and responsibilities of community, Panchayati Raj Institutions/ Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders.

Unit-4 Inter-relationship between Disasters & Development

Factors affecting Vulnerabilities, differential impacts, Impact of Development projects such as dams, embankments, changes in Land-use etc. Climate Change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources

Unit-5 Disaster Risk Management in India:

Hazard and Vulnerability profile of India. Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation)

Text/Reference Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Syllabus
Innovations and Problem Solving (AHT-018)

L:T:P: 2:1:0 **Credits-0**

PREREQUISITE:
Basic Engineering Aptitude

COURSE OBJECTIVES:
This subject aims to inculcate critical thinking abilities and application of knowledge for problem solving. It will expose the students with various simple methods and practices that are essential to development of new systems, problem formulation and problem solving in technical and non-technical fields. This course will stimulate the work environment of the modern day engineers and technologists by familiarizing them with the state-of-the art results, design and analysis tools in various disciplines, the ability to extract relevant information to formulate and solve problems arising in practice.

COURSE OUTCOMES:
The course will enable students to,

1. Identify the market and value proposition
2. Carry out rigorous and accessible formulation to problems
3. Solutions via reducing the search space
4. Eliminating tradeoffs to reduce dimension of optimization problems
5. Execution through developing strategies for experiment, construction and monetization.
6. Simulate the work environment of the modern engineer or knowledge worker in general.

Unit – I 8 Hrs Introduction to Critical Design Thinking

- Understanding critical thinking, creative thinking, and problem solving through examples.
- New ways to solve problems.

Unit – II **8 Hrs**
Theory of Inventive Problem Solving

- Examples of inventive problem solving,
- Era of technical systems,
- Science of inventing,
- Art of inventing,
- Amazing world of tasks

Unit – III **8 Hrs**
Logic and Tools for Creativity and Clarity of Thought

- TRIZ tools for creativity and solutions,
- World's known solutions,
- Fundamentals of Problem solving,
- Thinking in Time and Scale,
- Uncovering and solving contradictions,
- Fast Thinking with ideal outcome.

Unit – IV **8 Hrs**

Modeling for Problem Solving

- Moving from problem to ideal final result,
- Tradeoffs and inherent contradictions,
- Invisible reserves,
- Law of increasing ideality,
- Evaluation of solutions,
- Enriching models for problem solving.

Unit – V **8 Hrs**

Principles for Innovation

- General review,
- Segmentation, Separation,
- Local quality, symmetry change, merging and multi-functionality,
- Nested doll and weight compensation,
- Preliminary counteraction, preliminary action, and beforehand compensation,
- Equipotentiality, the other way around and curvature increase,
- Dynamic parts, partial or excessive actions, dimensionality change, mechanical vibration
- Periodic action, continuity of useful action, and hurrying,
- Blessing in disguise, feedback, and intermediary,
- Self-service, copying, cheap disposables, and mechanical interaction substitution
- Pneumatics and hydraulics, flexible shells and thin films, and porous materials,
- Optical property changes, homogeneous, and discarding and recovering,
- Parameter changes, phase transitions, and thermal expansion,
- Strong oxidants, inert atmosphere, and composite materials,
- How to select most suitable principle out of 40 ways to create good solutions

References

1. ABC-TRIZ Introduction to Creative Design Thinking with Modern TRIZ Modeling by Michael A. Orloff
2. TRIZ And Suddenly the Inventor Appeared TRIZ, the Theory of Inventive Problem Solving by Genrich Altshuller
3. TRIZ for Engineers Enabling Inventive Problem Solving by Karen Gadd
4. Simplified TRIZ New Problem Solving Applications for Engineers and Manufacturing Professionals by Rantanen K., Domb E.

EET 026: ELECTRIC AND HYBRID VECHICLES

L T P
3 0 0

Unit 1: **(8 Hours)**
History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization Transmission characteristics, Mathematical models to describe vehicle performance.

Unit 2: (8 Hours)
Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Unit 3: (8 Hours)
Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Permanent Magnet Motor-drives, Switched Reluctance Motor drives. Special motors.

Unit 4: (8 Hours)
Matching the electric machine and the internal combustion engine (ICE) Sizing the propulsion motor, sizing the power electronics, Battery types, Battery performance parameters. Selecting the energy storage technology, supporting subsystems.

Unit 5: (8 Hours)
Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies.

References:

1. K. T. Chau, “Electric Vehicle Machines and Drives: Design, Analysis and Applications”, John Wiley & Sons, 2015.
2. CRC Press, “Hybrid & Electric Vehicles”, Taylor & Francis Group, 2018.
3. Wei Liu, “Introduction to Hybrid Vehicle System Modeling and Control”, Wiley India, 2015.

Course Outcomes:

At the end of course the students will be able to:

1. Classify the electric hybrid vehicles (EHVs)
2. Demonstrate the knowledge about fundamental concepts, principles and performance parameters
3. Discuss the working of various motors for EHVs
4. Match the electric motor and the internal combustion engine.
5. Select energy storage technology and energy management strategy

EET 027: Advance Power Electronics

L T P
3 0 0

Unit 1: (8 Hours)
Power Supplies: Desirable specification of power supply, drawback of linear power supply. Switch mode power supply (SMPS)-schematic diagram, fly back converters, forward converter, push pull converters, half bridge and full bridge converter; uninterruptible power supply (UPS)-configuration of line and online UPS, switch mode and resonant power supplies, air craft power supply.

Unit 2: (8 Hours)
Industrial Applications: High frequency inverters for induction and dielectric heating, ac voltage controllers for resistance heating and illumination control, high frequency fluorescent lighting, electric welding control.

Unit 3: (8 Hours)
Effect of Harmonics: Parallel and series resonance, Effect of harmonics on static power plant transmission lines, transformers, capacitor banks, rotating machines, harmonic interference with ripple control systems, power system protection, consumer equipments and communication systems, power measurement.

Unit 4: (8 Hours)
Elimination/Suppression of Harmonics: High power factor converter, multi-pulse converters using transformer connections (Delta, polygon) Passive Filters: Types of passive filters, single tuned and high pass filters, filer design criteria, double tuned filters, damped filters and their design.

Unit 5: (8 Hours)
Active Power filters: Compensation principle, classification of active filters by objective, systems configuration, power circuit and control strategy. Shunt Active Filter: Single phase active filter, principle of operation, expression for compensating current, concept of constant capacitor voltage control; Three phase active filter: Operation, analysis and modeling; Instantaneous reactive power theory. Other Techniques: Unified Power Quality Conditioner.

References:
1. Ned Mohan, T. M. Undeland and William P. Robins, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons.
2. M.H. Rashid, “Power Electronics: Circuits, Devices and Applications” Prentice Hall of India.
3. K.R. Padiyar, “HVDC Power Transmission: Technology and System Reactions” New Age International.
4. Roger C. Dugan, Mark F. Mc Granhgan, Surya Santoso, “Electrical Power System Quality” Mc Graw hill, 2nd Edition.
5. Arindam Ghosh and Gerard Ledwich, “Power Quality Enhancement using custom power devices “, Kulwer academic publishers.

Course Outcomes:

After completing this course the student will be able to understand

1. Different types of power supplies and converters

2. Industrial applications
3. Harmonics and its control and Active and Passive filter
4. Industrial applications
5. Apply the electronics devices in real time

EET 028: Power System Transients

L T P
3 0 0

Unit 1: (8 Hours)
Simple Switching Transients: Introduction, Circuit Closing Transient, Recovery Transient, Double Frequency Transients. Resistance and Load Switching. **Abnormal Switching Transients:** Normal and Abnormal Switching Transients, Current Suppression, Capacitance Switching, Re-striking Phenomena, Transformer Magnetizing Inrush Current, Ferro-resonance.

Unit 2: (8 Hours)
Transients in 3-φ Circuits: Introduction, Importance of Neutral Connection, 3-φ Reactor with Isolated Neutral, 3-φ Capacitance Switching, Symmetrical Component Method for Solving 3-φ Switching Transients, Y-Δ Transformer, Circuit Reduction. **Transients in DC Circuits:** Interruption of Direct Currents in Low Voltage Circuits, Transients Associated with HVDC Circuit Breakers.

Unit 3: (8 Hours)
Travelling Waves and Other Transients on Transmission Lines: Circuits with Distributed Constants, Wave Equation, Reflection and Refraction of Travelling Waves, Travelling Waves at Line Terminations, Lattice Diagram, Attenuation and Distortion of Travelling Waves, Multi-conductor Systems and Multi-velocity Waves. **Behaviour of Transformer Windings under Transient Conditions:** Initial Voltage Distribution, Winding Oscillations, Travelling Wave Solution, Voltage Surge through Transformer

Unit 4: (8 Hours)
Transients in the Integrated Power System: Introduction, Short Line or Kilometric Fault, Line Dropping and Load Rejection, Voltage Transients on Closing and Reclosing Lines, Switching HVDC Lines, Switching Surges on an Integrated System

Unit 5: (8 Hours)
Protection of Systems and Equipment against Transient Over-voltages: Protection of Transmission Lines against Lightning, Surge Suppressors and Lightning Arresters, Application of Surge Arresters, Surge Capacitors and Reactors, Surge Protection of Rotating Machines. Transient Voltages and Grounding Practices.

References:
1. Joseph B. Aidala and Leon Katz, “Transients in Electric Circuits”, Prentice Hall.
2. Allan Greenwood, “Power System Transients”.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the importance of transient
2. Understand the transients involved in different equipments
3. Understand the protection against transient
4. Analyze the transient responses.
5. Design the protective arrangement.

EET 029: Bio-medical Instrumentation and Signal Processing

L T P
3 0 0

Unit 1: (8 Hours)
Man-Instrumentation system; Specifications of bio-medical instrumentation system; Problems encountered in measuring a living system; Bioelectric potentials: Resting and action potentials, propagation of action potential; Introduction to ECG, EEG, EMG; Biopotential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes; Biomedical Transducers.

Unit 2: (8 Hours)
Cardiovascular System & Measurement: Heart and cardiovascular system and circulation block diagram; blood pressure and measurement; characteristics of blood flow and heart sounds; Pacemakers and Defibrillators.
Electrocardiography: ECG lead configuration, ECG recording and their types.

Unit 3: (8 Hours)
Nervous System: The anatomy of nervous system; neuronal communication; Organization of brain; Measurement from the nervous system.
Electrocardiogram: Amplifiers, Leads, Recording Principles.

Unit 4: (8 Hours)
Diagnostic techniques: Ultrasonic diagnosis, Eco-cardiography, Eco-encephalography, X-ray, CAT-Scan, MRI; Interfacing computer with medical instrumentation.
Shock hazards from electrical equipments, methods of accident prevention.

Unit 5: (8 Hours)
Filtering for Removal of Artifacts: Random noise, structured noise, and physiological interference; High-frequency noise in the ECG; Motion artifact in the ECG; Power-line interference in ECG signals; Moving-average filters; Derivative-based operators to remove low-frequency artifacts; The adaptive noise canceler.
Event Detection: The P, QRS, and T waves in the ECG; Derivative-based methods for QRS detection; The Pan-Tompkins algorithm for QRS detection.

References:

1. Cromwell, “Biomedical Instrumentation and Measurements”, PHI
2. Willis J. Tompkins, “Biomedical Digital Signal Processing”, EEE, PHI, 2004
3. D C Reddy, “Biomedical Signal Processing: Principles and Techniques”, Tata McGraw-Hill Publishing Co. Ltd, 2005
4. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, McGraw Hill Education.
5. R M Rangayyan, “Biomedical Signal Analysis: A case Based Approach”, IEEE Press, John Wiley & Sons. Inc, 2002

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the basics of bio-medical instrumentation systems.
2. Study the Cardiovascular System and its measurement.
3. Understand the Nervous System and Electrocardiogram.
4. Understand the diagnostic techniques.
5. Learn the Filtering for Removal of Artifacts and Event Detection

EET 030: Power System Dynamics, Stability and Control

L T P
3 0 0

Unit 1: (8 hours)

Introduction to power system stability, operation, dynamics, and control.

Power system stability problems and classification. Role of stability in power system operation and control.

States of Operation and System Security - A Review, System Dynamic Problems - Current Status and Recent Trends, System Model, Some Mathematical Preliminaries, Basics of Steady State Stability.

Unit 2: (8 hours)

Modeling of Synchronous Machine: Introduction, Synchronous Machine, Park's Transformation, Analysis of Steady State Performance, Per Unit Quantities, Equivalent Circuits of Synchronous Machine, Determination of Parameters of Equivalent Circuits, Measurements for Obtaining Data, Transient Analysis of a Synchronous Machine. Dynamics or Synchronization of Synchronous Machine to an Infinite Bus.

Unit 3: (8 hours)

Excitation Systems: Elements and types of excitation system, Power System Stabilizers, Modelling of Excitation System.

Prime-Movers: Transfer function of a Hydraulic Turbine, Governors for Hydraulic Turbine.

Unit 4: (8 hours)

Transmission Lines: Electrical characteristics, performance analysis, the concept of surge impedance, equivalent circuit, parameters, voltage-current profiles, voltage–power characteristics, power transfer, power stability, and loadability characteristics considering thermal limits. Transfer of power between active sources.

Frequency and Voltage Dependence of Loads.

Unit 5: (8 hours)

Small Signal Stability: Stability of a Single-Machine Infinite Bus System.

Transient Stability: Concept of Power-Angle curve, Equal area criterion, Factors affecting stability.

Voltage Stability: Concept of VAr Compensation, Voltage Collapse (with curves) and Prevention.

Difference between Long-Term and Mid-Term Stability. Enumerate the Methods of Stability Improvement.

References:

1. P. Kundur, “Power System Stability and Control,” McGraw Hill, 2006.
2. K.R. Padiyar, “Power System Dynamics: Stability and Control,” BS Publication, 2008.
3. P.M. Anderson and A.A. Fouad, “Power System Control and Stability,” Galgotia Publications, New Delhi, 2003.

4. R. Ramanujam, "Power Systems Dynamics," PHI Publications.
5. I.J. Nagrath, D.P. Kothari, and R.K. Saket "Modern Power System," TMH Publication, 5th edition, 2022.
6. P. Sauer and M. A. Pai, "Power System Dynamics and Stability," Prentice Hall, 1997.

Course Outcomes:

At the end of this course, students will be able to:

1. Understand the fundamental dynamic behavior of power systems to perform basic stability issues.
2. Acquire fundamental knowledge about the modeling of synchronous machines.
3. Recognize the dynamics and control performances of power systems.
4. Familiarize yourself with the power system stability and controls.
5. Realize the impact of dynamics and stability in the power system.

EET 031: Solar & Wind Energy Systems

L T P
3 0 0

Unit 1: The Solar Resource and Solar photovoltaic (8 Hours)
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Unit 2: Solar thermal power generation: (8 Hours)
Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit 3: Physics of Wind Power: (8 Hours)
History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, yaw, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit 4: Wind generator topologies: (8 Hours)
Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 5: Network Integration Issues: (8 Hours)
Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

References:
1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems**”,** John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Remember the energy scenario and the consequent growth of the power generation from renewable energy sources.

2. Understanding the basics of wind and solar power generation.
3. Applying the power electronic interfaces for wind and solar generation.
4. Analyzing the issues related to the grid-integration of solar energy systems.
5. Analyzing the issues related to the grid-integration of wind energy systems.

EET 032: HIGH VOLTAGE ENGINEERING

L T P
3 0 0

UNIT 1: Breakdown in Gases (8 Hours)
Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

UNIT 2: Breakdown in liquid and solid Insulating materials (8 Hours)
Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge.

UNIT 3: Generation of High Voltages (8 Hours)
Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT 4: Measurements of High Voltages and Currents (8 Hours)
Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT 5: Over-voltages and Testing (8 Hours)
Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

References:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
5. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing

Course Outcomes:
At the end of this course students will demonstrate the ability to

1. Describe the breakdown phenomena in gases
2. Explain the breakdown phenomena in solids
3. Analyse the breakdown phenomena in liquids
4. Explain the various high voltage and current testing techniques
5. Design the various measuring techniques

EET 033: Artificial Intelligence and its Applications

L T P
3 0 0

Unit:1: Artificial Intelligence (8 Hours)
Introduction, History and Applications, Intelligence, Communication, Learning, Artificial Intelligence, History, Early Works, Importance, Definitions, Programming Methods, Techniques, Progress of Artificial Intelligence, Growth of AI, AI and Industry, AI and the world, Current Trends in Applied AI, Modeling, Simulation and AI, Intelligent Systems (IS), Role of IS, Comparisons with conventional programs, Fundamentals of various IS

Unit-2 Artificial Neural Network (8 Hours)
difference between human machine and intelligence, biological neural network, artificial neuron model, Concept of Perceptron, ADALINE, Feedback in Neural Network, Neural Network Architectures: Neural Learning, Recurrent Neural Networks

Unit-3 Fuzzy Logic (8 Hours)
Introduction, Foundation of Fuzzy Systems, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic Operations of Fuzzy Numbers, The alpha cut method, The extension method , Linguistic Descriptions and their Analytical Forms, Fuzzy Linguistic Descriptions, Fuzzy Relation Inferences, Fuzzy Implication and Algorithms, Defuzzification Methods, Fuzzy logic controller design.

Unit-4 Genetic Algorithms and Evolutionary Programming (8 Hours)
Introduction, Genetic Algorithms, Procedure of Genetic Algorithms, Genetic Representations, Initilization and Selection, Genetic Operators, Mutation, The Working of Genetic Algorithms, Evolutionary Programming, The Working of Evolutionary Programming.

Unit-5 Application of AI (8 Hours)
Neural Networks in identification and control of D.C Drives, Fuzzy Logic controller design for inverted pendulum and Genetic Algorithms in Schedule Maintenance of Electrical Power Transmission Network problems.

Books:
1. Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005- N. P. Padhy
2. Understanding Neural Networks and Fuzzy Logic: Basic concepts and Applications, Prentice Hall India Private Limited, New Delhi,2002- Stamations V. Kartalopoulos
3. Artificial Intelligence Techniques in Power Systems, IEE Power Engineering Series, UK, 1997-Kevin Warwick, Arthur Ekwue and Raj Aggarwal
4. Intelligent Systems and Signal Processing in Power Engineering, Springer Berlin Heidelberg, New York- Abhisek Ukil

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1 Understanding the basics of Artificial Intelligence and intelligent systems.
2. Analyzing the different neural network architectures and training algorithms.

3. Understand the fuzzy set theory and its arithmetic operations
4. Remembering the different steps for genetic algorithm based optimization algorithm.
5. Applying the AI techniques in different electrical engineering problems.

Power System Reliability (EET 034)

L T P
3 0 0

Unit 1: (8 hours)

The basic concept of reliability, availability, and maintainability. Reliability-related functions. Markov-process. Monte-Carlo method.

Generating Capacity: Unavailability of Generating unit, Capacity outage, recursive algorithm for generating unit removal.

Loss of Load Indices, Forced Outage Rate and Uncertainty, Computation of Loss of Load Expected, and Indices involved with Loss of energy.

Unit 2: (8 hours)

Operating Reserve: Concept, Pennsylvania, New Jersey, and Maryland (PJM) Method, Modified PJM Method, Security Function concept and model, Response Risk and Effect of spinning reserve, and Hydro-Electric Units.

Composite Generation and Transmission Systems: Radial and Network Configurations, State Selection, System and Load Point Indices, Data Requirements for Composite System Reliability.

Unit 3: (8 hours)

Distribution System Reliability: Importance of Failure Rate, Repair Rate, Mean Time to Repair, Mean Time Between Failure. Customer Oriented Indices, Load, and Energy Oriented Indices, System Performance. Effect of Lateral Distributor Protection, Disconnects, Protection Failure, and Transferring Loads.

Parallel and Meshed Distribution Systems: State Space Diagram, Network Reduction Method, Failure Mode and Effect Analysis (FMEA) vs Failure mode effects and criticality analysis (FMECA).

Unit 4: (8 hours)

Plant and Station Availability: Generating Plant Availability, Protection Systems, Typical HVDC Systems and Composite HVDC Links.

Monte-Carlo Simulation: Application to Generation Capacity Reliability Evaluation, Composite Generation and Transmission, and Distribution Systems.

Unit 5: (8 hours)

Evaluation of Reliability Worth: Evaluation of reliability worth, Customer interruption cost evaluation, Cost of interruption surveys, and Customer damage functions.

Analysis of the IEEE Reliability Test System and Roy Billinton Test System. Transient failure overlaps two permanent failures and a permanent and maintenance outage.

References:

1. R. Billinton, R.N. Allan, “Reliability Evaluation of Power Systems,” Plenum Press NY & London, 2nd edition, 1996.

2. Marko Čepin, "Assessment of Power System Reliability: Methods and Applications Paperback – Import, 2011th edition, Springer, 2014
3. Roy Billinton, "Reliability Evaluation of Engineering Systems: Concepts and Techniques," 2nd edition, Springer, 1992.
4. Marvin Rausand and Arnljot Hoyland, "System Reliability Theory: Models, Statistical Methods, and Applications (Wiley Series in Probability and Statistics - Applied Probability and Statistics Section)," 2nd edition, Wiley-Interscience, 2004.
5. Charles Ebeling, "An Introduction to Reliability and Maintainability Engineering," 12th edition, McGraw Hill Education, 2017.

Course Outcomes:

At the end of this course, students will be able to:

1. Understand concepts of reliability to design secure and reliable networks.
2. Carry out planning and reliability for generation, transmission, and distribution systems.
3. Apply the methods of the network, frequency and duration, and Monte Carlo to power systems.
4. Evaluate the reliability of generation, distribution, and composite systems.
5. Evaluate the reliability worth of a system.

Optimal Control System (EET 035)

L T P
3 0 0

UNIT 1: CALCULUS OF VARIATIONS AND OPTIMAL CONTROL (8 Hours)
Introduction – Performance Index- Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variational problem Extrema of functions and functionals with conditions – variational approach to optimal control system

UNIT 2: LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM (8 Hours)
Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case

UNIT 3: DISCRETE TIME OPTIMAL CONTROL SYSTEMS (8 Hours)
Variational calculus for Discrete time systems – Discrete time optimal control systems: -Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system

UNIT 4: PONTRYAGIN MINIMUM PRINCIPLE (8 Hours)
Pontryagin Minimum Principle – Dynamic Programming: - Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton- Jacobi-Bellman Equation – LQR system using H-J-B equation

UNIT 5: CONSTRAINED OPTIMAL CONTROL SYSTEMS (8 Hours)
Time optimal control systems – Fuel Optimal Control Systems- Energy Optimal Control Systems – Optimal Control Systems with State Constraints

TEXT BOOKS:
1 Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2004.
2 Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012.
3. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003.

REFERENCES:
1. B.D.O. Anderson and J.B.Moore, “Optimal Control – Linear Quadratic Methods,” PHI, 1991.
2. S.H.Zak, “Systems and Control,” Oxford University Press, 2006.

Course Outcomes:
At the end of this course, students will demonstrate the ability:
1. To give exposure to optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.
2. To impart knowledge and skills needed to design Linear Quadratic Regulator for Time invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
3. To introduce concepts needed to design optimal controller using Dynamic Programming

Approach and H-J-B equation.
4. To give exposure to various types of fault tolerant control schemes such as Passive and active approaches.
5. To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

EET 036: ELECTRICAL MACHINE MODELING

L T P
3 0 0

UNIT-1: (8 Hours)
Transformations: Electromechanical Energy-Conversion Principles, Kron's Primitive machine, General expression of voltage, force and torque, Basic modeling of electrical machines from coupled circuit point of view. Techniques of transformations, reference frames, operationalized equivalent circuit.

UNIT-2: (8 Hours)
Modeling of D. C. Machines: Analysis of motoring and generating action under steady state, transient and dynamic simulation, Effect of load change under dynamic conditions for different excitations, reversal and braking.

UNIT-3: (8 Hours)
Modeling of Synchronous Machines: dq transformation**,** Concepts of Time varying inductances steady state and dynamic equations, Phasor diagram of Synchronous Machines, Electromagnetic and reluctance torque, Synchronous Machines dynamics, Response under short circuit, sub transient and transient condition. Dynamic simulation of vector controlled synchronous machines.

UNIT-4: (8 Hours)
Modeling of Poly-phase Induction Machines: Equations under stationary, rotating and synchronous reference frames**,** derivation of torque and power expression, Equivalent circuit, Concepts of Time varying inductances, Dynamic under load changes, run up time, Speed reversal and braking. Computer simulation for dynamic response.

UNIT-5: (8 Hours)
Doubly fed induction motor: Principles, operation its control. Induction generator: principles and operations. Doubly fed induction generator: principles and operations.

Books:
1. A. E. Fitzgerald, Charles Kingsley, Jr. and Stephen D. Umans, "Electrical Machinery", McGraw-Hill .
2. P. S. Bimbhra, "Generalized Theory of Machines", Khanna Publications.
3. R. Krishnan "Modeling, Analysis and Control of Electric Drives".
4. B K. Bose "Modern Power Electronics and AC Drives"

Course outcome: After completing this course the student will be able to

1. Understand the importance of modeling
2. Explain the induction machine modeling
3. Explain the DC and synchronous machine modeling
4. Apply the Parks transformation
5. Develop the machine model

EET 037: SMART GRID TECHNOLOGY

L T P
3 0 0

Unit 1: Introduction to Smart Grid: (8 Hours)
Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India. Smart Grid Architecture**:** Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced metering infrastructure. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration

Unit 2-Tools and Techniques for Smart Grid: **(8 Hours)**

Computational Techniques – Static and Dynamic Optimization Techniques for power applications such as Economic load dispatch – Computational Intelligence Techniques – Evolutionary Algorithms in power system – Artificial Intelligence techniques and applications in power system.

Unit 3-Distribution Generation Technologies: **(8 Hours)**

Introduction to Distribution Energy Sources, Renewable Energy Technologies – Microgrids – Storage Technologies –Electric Vehicles and plug – in hybrids – Environmental impact and Climate Change – Economic Issues.

Unit 4-Communication Technologies in Smart Grid: (8 Hours)

Introduction to Communication Technology, Two Way Digital Communications Paradigm, Synchro- Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS)- Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid

Unit 5: Smart-cities (8 Hours)

Smart city pilot projects, essential elements of smart cities, active distribution networks, microgrids, distribution system automation, Reliability and resiliency studies, decentralized operation of power network.

Text Books:
1. Smart Grids, Infrastructure, Technology and Solutions, S. Borlase, CRC Press, 2013, 1st Edition.
2. Renewable and Efficient Electric Power System, G. Masters, Wiley–IEEE Press, 2013, 2nd Edition.

Reference Books:
1. Synchronized Phasor Measurements and their Applications, A.G. Phadke and J.S. Thorp, Springer, 2017, 2nd Edition.
2. Wind Power in Power Systems, T. Ackermann, Hoboken, N J, USA, John Wiley, 2012, 2nd Edition.

Course outcome: After completing this course the student will be able to

1. Understand the importance of Smart Grid
2. Explain the Computational Techniques related to smart grid
3. Explain the Renewable Energy Technologies
4. Apply Communication Technology in smart grids.
5. Discuss essential elements of smart cities

EET 051: Non-conventional Energy Resources (Open Elective-2)

L T P **Credits-03**
3 0 0

Unit 1: (8 hours)

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.
Solar Cells: Theory of solar cells, Solar cell materials, solar cell array, solar cell power plant, limitations.
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Unit 2: (8 hours)

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

Unit 3: (8 hours)

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.
Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.
Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

Unit 4: (8 hours)

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. **Wind Energy**: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

Unit 5: (8 hours)

Bio-mass: Availability of bio-mass and its conversion theory.
Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.
Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants

References:

1. Raja et.al, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Course Outcomes:

At the end of this course, students will be able to:

1. State the need of renewable energy resources, historical and latest development.
2. Describe the use of solar energy and various its various components used in energy production.
3. Explain the concept of Geothermal energy, MHD generator and acquire the knowledge of fuel cells.
4 Analyse the wind energy and the various components used in energy generation.
5. Apply the knowledge of biomass and tidal energy.

EET052: ELECTRICAL MACHINES (Open Elective 3)

L T P **Credits-03**
3 0 0

Unit 1: Fundamentals of AC machine windings (8 Hours)
Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, distribution factor.

Unit 2: Pulsating and revolving magnetic fields (8 Hours)
Magnetic field produced by a single winding - fixed current and alternating current. Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field. Calculation of total MMF in a magnetic circuit (MMF for air gap)

Unit 3: Induction Machines (8 Hours)
Construction, Types (squirrel cage and slip-ring), Rotor frequency, rotor (Emf, current and power) Equivalent circuit. Phasor Diagram, , Starting and Maximum Torque., Losses and Efficiency. Torque-Slip Characteristics, Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors, Induction-Generator operation, Self-excitation. Doubly-Fed Induction-Machines.

Unit 4: Single-phase induction motors (8 Hours)
Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods: Capacitor start/run single phase induction motor and applications.

Unit 5: Synchronous machines (8 Hours)
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

Course Outcome
At the end of course, the students will be able to
1. Understand and design the winding
2. Understand the concepts of rotating magnetic field
3. Understand and apply the working principle of induction machine
4. Understand and apply the working principle of single phase induction machine
5. Understand and apply the working principle of synchronous machines

EET053: BIO-MEDICAL INSTRUMENTATION & SIGNAL PROCESSING

L T P
3 0 0

UNIT -1 (8 hours)
Introduction to Biomedical Instrumentation: Components of the man- instrument system, Specifications of medical instrumentation systems, Problem encountered in measuring living system, Basic transducers principles, Active and passive transducers, transducer for biomedical applications.

UNIT -2 (8 hours)
Bioelectric Potentials: Introduction to bioelectric potentials, Generation, propagation and distribution of bioelectric potential (ECG, EEG and EMG), Bio-potential electrodes, Microelectrodes, skin surface electrodes and needle electrodes, Biochemical transducers (pH electrode, blood gas electrodes and specific ion electrodes).

UNIT -3 (8 hours)
Electrocardiogram (ECG): Anatomy of heart, Block diagram of electrocardiograph, ECG amplifier, ECG lead configuration, ECG recording, Electroencephalogram (EEG): Anatomy of nervous system, Block diagram of Electrocardiograph, Electromyogram (EMG): Block diagram of EMG instrument, Electrodes for EMG.

UNIT -4 (8 hours)
Blood pressure measurement, Blood flow measurement, Systematic skin and body temperature measurement, Elements of intensive care unit, Pacemakers, Defibrillators, Biotelemetry and application of telemeter in patient care.

UNIT -5 (8 hours)
Imaging techniques: Production of x-rays, block diagram of x-ray machine, x-rays Imaging techniques - CAT scan. Ultrasound imaging system, Principle & image reconstruction techniques of NMR and MRI; Application of computer in medical instrumentation; Shock hazards from electrical equipment, methods of accident prevention.

Books:
1. Cromwell– Biomedical Instrumentation and Measurements- PHI
2. Webster, J.G. – Bio- Instrumentation, Wiley (2004)
3. Khandpur R. S – Handbook of Biomedical Instrumentation", Tata McGraw Hill.

Course Outcomes:
1. Explain the transducer for biomedical.
2. Explain the temperature measuring instrument
3. Analyze the ECG, EMG.
4. Explain MMG
5. Diagonize the ECG,EMG

EET 0169: MICRO-CONTROLLER AND EMBEDDED SYSTEMS

L T P
3 0 0

UNIT 1: 8051 MICRO CONTROLLER (8 Hours)

Comparison of microprocessor and microcontroller, microcontroller and embedded processors, overview of various families.

UNIT 2: 8051 ASSEMBLY LANGUAGE PROGRAMMING (8 Hours)

Introduction to 8051 assembly programming, assembling and running an 8051 program, data types and directives. 8051 flag bits and PSW register, register banks and stack, jump loop and call instructions, I/O port programming: addressing modes and accessing memory using various addressing modes, arithmetic instructions and programs, logic instructions and programs, single bit instructions and programming, timer/counter programming in the 8051.

UNIT 3: REAL TIME EMBEDDED SYSTEMS (8 Hours)

8051 connection to RS 232, 8051 serial communication programming, Interrupts, Multiple sources of interrupts, Non maskable sources of interrupts, Interrupt structure in 8051, Timers, Free running counter & Real Time control, classification of real time embedded system, introduction to real time operating system.

UNIT 4: SYSTEM DESIGN (8 Hours)

Serial I/O interface, Parallel I/O ports interface, Digital and Analog interfacing methods, LED array, keyboard, Printer, Flash memory interfacing. Application of Microcontrollers in interfacing, Robotics, MCU based measuring instruments. Real Time
Operating System for System Design, Multitasking System, Task Definition in a Multitasking System, Round Robin Scheduling, Full Pre-emptive Scheduling

UNIT 5: EMBEDDED SYSTEM AND ITS DESIGN (8 Hours)

Introduction to ES& its applications, design parameters of an ES and its significance (With respect to all parameter), present trends in ES, Embedded System design life cycle, product specifications and hardware and software partitioning, Codesign, Introduction to latest micro controllers.

BOOKS:

1. B. B. Brey: The Intel Microprocessors, Architecture, Programming and Interfacing, Pearson Education.
2. Liu Gibson: Microcomputer Systems: The 8086/8088 Family- Architecture, Programming And Design , PHI
3. D. V. Hall: Microprocessors and Interfacing, TMH
4. Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education.
5. Ayala Kenneth:- The 8051 microcontroller, Third Edition, Cengage Learning
6. A V. Deshmukh: Microcontroller (Theory and Application), TMH.
7. Raj Kamal: Embedded Systems- Architecture, Programming and Design, TMH,
8. V. Udayashankara and M. S. Mallikarjuna Swamy: 8051 Microcontroller
9. The 8051 Micro-controller and embedded Systems by: - Ali Mazidi

10. Am embedded software primer, David e Simon, Pearson Education
11. Embedded system design by Frank Vahid and Tony Givargus.

Course Outcomes: -

The students will be able to:

1) Compare microprocessors and microcontrollers
2) Apply microcontroller programming.
3) Explain the real-time embedded systems.
4) Select Operating System for System Design.
5) Describe the present trends in ES.