Curriculum for B.E./B.Tech.
Degree Course in
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Regulation 2024

CHENNAI INSTITUTE OF TECHNOLOGY
(Autonomous)

Document Version

Version Number	Date	Author	Major Updates	Approved by
1.0	10.4.24	Mrs.J.Pooornima	Alignment Issue	Dr. R. SANKAR
1.1	3.5.24	Mrs.J.Pooornima	As mentioned	Dr. R. SANKAR
1.2	8.6.24	Mrs.J.Pooornima	As Per BoS Meeting Suggestion	Dr. R. SANKAR
1.3	1.8.24	Mrs.J.Pooornima	As per latest guidelines	Dr. R. SANKAR

Section 1: General Course Structure

A. Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit

B. Structure of Program

S. No.	Category	Credits
1	Humanities & Social Science Courses(HSMC)	13
2	Basic Science Courses (BSC)	20
3	Engineering Science Courses (ESC)	15
4	Program Core Courses (PCC)	77
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Employability Enhancement Skills (EES)	17
8	Mandatory Course (MC)	-
	TOTAL	166

C. Course code and definition

Code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits

- **Course level coding scheme:** Four-digit number is used as a suffix with the Course Code for identifying the level of the course. Thousand's place denotes the regulation number (we use "3" for 2022-23 Regulation) Digit at hundred's place signifies the semester in which the course is offered. The last two digits represent the serial order of course within the semester. For example, 3101, 3102, … are courses offered during the first semester.

D. Category-wise Courses

Humanities and Social Science & Management Courses (HSMC)

S. No.	Course Title	Semester	L	T	P	C
1.	தமிழரமரபு / Heritage of Tamils	I	1	0	0	1
2.	Communicative English - I	I	3	0	2	4
3.	தமிழரும்ததொழில்நுட்பமும் / Tamils and Technology	II	1	0	0	1
4.	Communicative English - II	II	3	0	2	4
5.	Principles of Management	VII	3	0	0	3
Total Credits						**13**

Basic Science Courses (BSC)

S. No.	Course Title	Semester	L	T	P	C
1.	Mathematics-I -Calculus and Linear Algebra	I	3	1	0	4
2.	Engineering Physics	I	3	0	2	4
3.	Mathematics – II-Probability and Statistics	II	3	1	0	4
4.	Mathematics-III - Mathematical Methods for Engineering	III	3	1	0	4
5.	Numerical Methods	IV	3	1	0	4
Total Credits						**20**

Engineering Science Courses (ESC)

S. No.	Course Title	Semester	L	T	P	C
1.	Problem Solving using C Programming	I	3	0	2	4
2.	Data Structures using C Programming	II	3	0	2	4
3.	Object Oriented Programming in JAVA	III	3	0	2	4
4.	Advanced Database Management System	IV	3	0	0	3
Total Credits						**15**

Program Core Courses (PCC)

S. No.	Course Title	Semester	L	T	P	C
1.	Electric Circuit Analysis	I	3	0	2	4
2.	Sensors and Instrumentation System	I	3	0	2	4
3	Electro Magnetic Field Theory	II	3	0	0	3
4.	Electronic Devices and Circuits	II	3	0	2	4
5.	Digital Logic Circuits	II	3	0	2	4
6.	Signals and Systems	III	3	0	0	3
7.	DC Machines and Transformers	III	3	0	2	4
8.	Microprocessor and Microcontroller	III	3	0	2	4
9.	Core Course Project-I	III	0	0	2	1
10.	Analog Integrated Circuits	III	3	0	2	4
11.	Transmission and Distribution	IV	3	0	0	3
12.	Synchronous and Induction Machines	IV	3	0	2	4
13.	Control Systems Engineering	IV	3	0	2	4
14.	Power Electronics	IV	3	0	2	4
15.	Core Course Project-II	IV	0	0	2	1
16.	Power System Analysis	V	3	0	2	4
17.	Special Electrical Machines	V	3	0	2	4
18.	Embedded System Design	V	3	0	2	3
19.	Core Course Project-III	V	0	0	2	1
20.	Protection and Switchgear	VI	3	0	0	3
21.	High Voltage Engineering	VI	3	0	0	3
22.	Power System Operation and Control	VI	3	0	2	4
23.	Core Course Project-IV	VI	0	0	2	1
24.	Electric Energy Generation, Utilization and Conservation	VII	3	0	0	3
Total Credits						**77**

Professional Elective courses (PEC)

S. No.	Course Title	Semester	L	T	P	C
1.	Professional Elective – I	V	3	0	0	3
2.	Professional Elective – II	V	3	0	0	3
3.	Professional Elective – III	VI	3	0	0	3
4.	Professional Elective – IV	VI	3	0	0	3
5.	Professional Elective – V	VII	3	0	0	3
6.	Professional Elective – VI	VII	3	0	0	3
Total Credits						**18**

Employability Enhancement courses (EES)

S. No.	Course Title	Semester	L	T	P	C
1	Employability Enhancement Skills - I	I	0	0	2	1
2	Employability Enhancement Skills - II	II	0	0	2	1
3	Employability Enhancement Skills - III	III	0	0	2	1
4	Employability Enhancement Skills - IV	IV	0	0	2	1
5	Employability Enhancement Skills - V	V	0	0	2	1
6	Project Work (Phase 1)	VIII	0	0	4	2
7	Project Work (Phase 2)	VIII	0	0	20	10
Total Credits						**17**

Open Elective Courses (OEC)

S. No.	Course Title	Semester	L	T	P	C
1.	Open Elective – I	VI	3	0	0	3
2.	Open Elective – II	VII	3	0	0	3
Total Credits						**6**

Mandatory Courses (MC)

S. No.	Course Title	Semester	L	T	P	C
1.	**Mandatory Course – I**	III	2	0	0	0
2.	**Mandatory Course – II**	IV	2	0	0	0
Total Credits						**0**

E. Induction Program

- ***Catapult*** is a dynamic week-long event designed for our incoming first-year students, offering an immersive introduction to the diverse array of clubs and activities across the college campus. In addition to familiarizing them with our labs and Centers of Excellence (COEs), Catapult aims to acclimate first-year students to college life, ensuring they feel at ease with the forthcoming experiences of their four-year journey.

- This initiative fosters meaningful connections between seniors and juniors, providing a platform for them to explore departmental projects and engage in collaborative activities, thereby enhancing camaraderie and knowledge sharing within the college community.

Evaluation Scheme

1. **For Theory Courses:**
   The weightage of Internal assessment is 40% and for End Semester Exam is 60% The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

2. **For Practical Courses:**
   The weightage of Internal assessment is 60% and for End Semester Exam is 40% For Theory cum Lab. The student has to obtain at least 50% marks individually both in internalassessment and end semester exams to pass.

3. **For Theory Cum Practical Courses:**
   The weightage of Internal assessment is 50% and for End Semester Exam is 50% The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

Note: The internal assessment is based on the student's performance in 3 Internal Assessment (IA) exams, quizzes, assignments, class performance, attendance, etc.

For Project works:

Assessment of project works comprises three internal reviews and an end-of-semester evaluation. Internal reviews, worth 40 marks in total, encompass assessment criteria such as Project Synopsis/Proposal Evaluation, Methodology and Design of Existing System, Feasibility of Project Proposal, Planning of Project Work, and Team Work. At the conclusion of the semester, 20 marks are designated for assessing the quality of the report, while the remaining 40 marks are reserved for evaluating performance in viva-voce, demonstration of the work, and other relevant factors.

F. Learning Beyond Class Room

1. Students should be encouraged to visit Centers of Excellence (COEs) in the campus and learn additional technical skills
2. Students should be encouraged to participate in internal / external competitions, hackathons, etc. on a regular basis.

Semester I							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	HS4101	தமிழரமரபு / Heritage of Tamils	1	0	0	1
2.	Theory	MA4101	Mathematics-I Calculus and Linear Algebra	3	1	0	4
3.	T&P	HS4102	Communicative English - I	3	0	2	4
4.	T&P	PH4101	Engineering Physics	3	0	2	4
5.	T&P	EE4101	Electric Circuit Analysis	3	0	2	4
6.	T&P	EE4102	Sensors and Instrumentation Systems	3	0	2	4
7.	T&P	CS4111	Problem Solving using C Programming	3	0	2	4
8.	Practical	ES4101	Employability Enhancement Skills - I	0	0	2	1
						Total	**26**

Semester II							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	MA4201	Mathematics-II Probability and Statistics	3	1	0	4
2.	Theory	HS4201	தமிழரும்ததொழில்நுட்பமும் / Tamils and Technology	1	0	0	1
3.	Theory	EE4201	Electro Magnetic Field Theory	3	0	0	3
4.	T&P	HS4202	Communicative English - II	3	0	2	4
5.	T&P	EE4202	Electronic Devices and Circuits	3	0	2	4
6.	T&P	EE4203	Digital Logic Circuits	3	0	2	4
7.	T&P	CS4202	Data Structures using C Programming	3	0	2	4
8.	Practical	ES4202	Employability Enhancement Skills-II	0	0	2	1
9.	-	-	NCC Credit Course Level1#	2	0	0	2
						Total	**25**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Semester III							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	MA4301	Mathematics-III Mathematical Methods for Engineering	3	1	0	4
2.	Theory	EE4301	Signals and Systems	3	0	0	3
3.	T&P	EE4302	DC Machines and Transformers	3	0	2	4
4.	T&P	EE4303	Analog Integrated Circuits	3	0	2	4
5.	T&P	EE4304	Microprocessor and Microcontroller	3	0	2	4
6.	T&P	CS4311	Object Oriented Programming in JAVA	3	0	2	4
7.	Practical	ES4303	Employability Enhancement Skills-III	0	0	2	1
8.	Practical	EE4305	Core Course Project-I	0	0	2	1
9.	Practical	EE43MX	Mandatory Course-I	2	0	0	0
						Total	**25**

Semester IV							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	MA4401	Numerical Methods	3	1	0	4
2.	Theory	EE4401	Transmission and Distribution	3	0	0	3
3.	T&P	CS4411	Advanced Database Management System	3	0	0	3
4.	T&P	EE4403	Synchronous and Induction Machines	3	0	2	4
5.	T&P	EE4404	Control Systems Engineering	3	0	2	4
6.	T&P	EE4405	Power Electronics	3	0	2	4
7.	Practical	EE4406	Core Course Project-II	0	0	2	1
8.	Practical	ES4401	Employability Enhancement Skills-IV	0	0	2	1
9.	Practical	EE44MX	Mandatory Course-II	2	0	0	0
10.			NCC Credit Course Level2#	2	0	0	2
						Total	**24**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Semester V							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4VXX	Professional Elective-I	3	0	0	3
2.	Theory	EE4VXX	Professional Elective-II	3	0	0	3
3.	Theory	EE4501	Embedded System Design	3	0	0	3
4.	T&P	EE4502	Special Electrical Machines	3	0	2	4
5.	T&P	EE4503	Power System Analysis	3	0	2	4
6.	Practical	EE4504	Core Course Project-III	0	0	2	1
7.	Practical	ES4505	Employability Enhancement Skills-V	0	0	2	1
						Total	**19**

Semester VI							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4601	High Voltage Engineering	3	0	0	3
2.	Theory	EE4VXX	Professional Elective-III	3	0	0	3
3.	Theory	EE4VXX	Professional Elective-IV	3	0	0	3
4.	Theory	EE46OX	Open Elective – I	3	0	0	3
5.	Theory	EE4602	Protection and switch Gear	3	0	0	3
6.	T&P	EE4603	Power System Operation and Control	3	0	2	4
7.	Practical	EE4604	Core Course Project-IV	0	0	2	1
8.		-	NCC Credit Course Level3#	2	0	0	2
						Total	**20**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Semester VII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4701	Electric Energy Generation, Utilization and Conservation	3	0	0	3
2.	Theory	GE4701	Principles of Management	3	0	0	3
3.	Theory	EE4VXX	Professional Elective V	3	0	0	3
4.	Theory	EE4VXX	Professional Elective VI	3	0	0	3
5.	Theory	EE47OX	Open Elective - II	3	0	0	3
6.	Practical	EE4702	Project Work (Phase 1)	0	0	4	2
						Total	**17**

Semester VIII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Practical	EE4801	Project Work (Phase 2)	0	0	20	10
						Total	**10**

SEMESTER I

Course Code	Heritage of Tamils	L	T	P	C
HS4101		1	0	0	1

UNIT I Language and Literature **3**

Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice inSangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

UNIT II Heritage Rock Art Paintings to Modern Art Sculpture **3**

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making –Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

UNIT III Folk and Martial Arts **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

UNIT IV Thinai Concept of Tamils **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.

UNIT V Contribution of Tamils To Indian National Movement and Indian Culture **3**

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self – Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by International Institute of Tamil Studies.)

5. Keeladi – Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL).

TOTAL: 15 PERIODS

Course Code	Mathematics-I -Calculus and Linear Algebra	L	T	P	C
MA4101		3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Develop a thorough understanding of fundamental concepts in calculus, linear algebra, and differential equations.
- Enhance problem-solving skills by employing techniques such as differentiation, integration, matrix operations, and differential equations to analyze and solve complex problems.
- Explore advanced topics including Fourier series, multiple integration, differential equations, and linear algebra concepts such as vector spaces and transformations.

Course Description

Calculus covers limits, derivatives, and integrals, emphasizing applications in optimization and area/volume calculations. Linear Algebra explores vectors, matrices, and systems of equations, focusing on concepts like linear transformations, eigenvalues, and eigenvectors. Both courses provide fundamental tools for understanding and solving problems across various disciplines, including physics, engineering, and economics.

Prerequisites

The prerequisites for Calculus and Linear Algebra typically include a strong foundation in algebra, trigonometry, and precalculus. Students should be comfortable with functions, graphs, algebraic manipulations, and trigonometric identities. Additionally, a solid understanding of basic concepts in geometry, such as lines, angles, and geometric shapes, is often beneficial

UNIT I: Foundations of Calculus **12**

Functions of a Single Variable – Limits, Continuity, and Differentiability – Mean Value Theorem – Local Maxima and Minima – Integration – Theorems of Integral Calculus – Evaluation of Definite and Improper Integrals – Applications of Definite Integrals.

UNIT II: Advanced Calculus **12**

Partial Derivatives – Maxima and Minima (Multivariable), Multiple Integrals: Line, Surface, and Volume Integrals.

UNIT III: Linear Algebra **12**

Vector Space – Basis – Subspaces – Linear Dependence and Independence – Matrix Algebra – Matrices: Properties and Operations – Projection Matrix – Orthogonal Matrix – Idempotent Matrix – Partition Matrix – Quadratic Forms.

UNIT IV: Systems of Linear Equations **12**

Systems of Linear Equations and Solutions – Gaussian Elimination, Eigenvalues and Eigenvectors, Determinants, Rank, LU Decomposition, Singular Value Decomposition

UNIT V: Vector Calculus **12**

Vector Identities – Total Derivative – Gradient, Divergence, and Curl – Directional Derivatives – Taylor Series – Optimization involving a Single Variable – Stokes' Theorem – Green's Theorem – Gauss Divergence Theorem.

Assessments & Grading

Exercises / Assignments, Quizzes, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

- CO1: Apply differentiation techniques to analyze functions, identify extrema, and understand the properties of functions using differentiation theorems such as Rolle's theorem, mean value theorems, Taylor's and Maclaurin's theorems, and L'Hospital's rule.
- CO2: Apply integration techniques to solve problems involving multiple integrals, change of variables, and understand the theorems of Green, Gauss, and Stokes, enabling them to calculate volumes, areas, and solve various physical problems.
- CO3: Solve a variety of first-order and higher-order differential equations, includinginitial value problems and boundary value problems, using appropriate techniques such asseparation of variables and understand the application of Cauchy's and Euler's equations
- CO4: Understand and manipulate matrices, solve systems of linear equations usingmatrix methods, and comprehend the properties of determinants and inverse matrices, enabling them to analyze linear systems and transformations effectively.
- CO5: Grasp the fundamental concepts of vector spaces, linear transformations, eigenvalues, and eigenvectors, enabling them to analyze linear maps, understand the structure of vector spaces, and apply these concepts in various mathematical contexts.

TEXT BOOKS:

1. Grewal, B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2023.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2023.
3. Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill, 2017.

REFERENCES:

1. Hass, J., Heil, C., and Weir, M.D., "Thomas' Calculus", 14th Edition, Pearson Education, 2018.
2. Poole, D., "Linear Algebra: A Modern Introduction", 4th Edition, Cengage Learning India, 2014.

YouTube Resources:

1. https://youtu.be/riXcZT2ICjA?feature=shared
2. https://youtu.be/xyAuNHPsq-g?feature=shared
3. https://youtu.be/LHsPJ2bQX1U?feature=shared
4. https://youtube.com/playlist?list=PLF797E961509B4EB5&feature=shared
5. https://youtube.com/playlist?list=PLDesaqWTN6ESPaHy2QUKVaXNZuQNxkYQ_&feature=shared

TOTAL: 60 PERIODS

Course Code	Communicative English –I	L	T	P	C
HS4102	(Common to all Program)	3	0	2	4

COURSE OBJECTIVES:

1. To improve the communication competency.
2. To learn basic grammatical structures in suitable contexts.
3. To build students English language skills through LSRW exercises.
4. To enable the students to write in English precisely and effectively.
5. To develop language proficiency in expressing their opinions.

Course Description

This course aims to enhance communication competency by teaching basic grammatical structures in relevant contexts. It focuses on developing English language skills through listening, speaking, reading, and writing (LSRW). Students will learn to write precisely and effectively, while also building proficiency in expressing their opinions.

Prerequisites

- Basic understanding of the English language, including fundamental vocabulary and grammar concepts

INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? Why is communication critical for excellence during study. research, and work? What are the seven C's of effective communication?

UNIT I – INTEGRALS OF COMMUNICATION (GREETINGS & INTRODUCTION) 8

Listening – Listening comprehensions, listening to news.
Speaking- Just A Minute, Introducing a friend
Reading- Reading Comprehension /Newspaper / Articles/ Magazines
Writing –Letter of Introduction, Developing the Hints
Vocabulary – Synonyms/Antonyms, Acquaintance with Prefixes/ suffixes from foreign languages in
English to form derivatives &Word formation
Grammar – Parts of Speech, Mixed Tenses, Active/Passive Voice

UNIT II – GIVING AND RECEIVING INSTRUCTIONS 9

Listening – Listening to short stories, Narrations & Persuasive Speech
Speaking- Giving Instructions to use the Product/ Presenting or summarizing about a product
Reading – Reading Advertisements /Biographies
Writing – Instructions, Paragraph Writing
Vocabulary – Abbreviation, Acronyms, One-word Substitutes
Grammar – WH Questions/Yes or No Questions, Imperatives

UNIT III – DESCRIBING PEOPLE AND PLACES **9**

Listening- Listen to the description of a product
Speaking –Picture Description, Narrating personal experiences and events
Reading- Gadget Reviews, User Manuals
Writing–Recommendations, Product/ Process Description.
Vocabulary – Homonyms, Homophones, Compound Words
Grammar – Adjectives, Adverbs, Articles.

UNIT IV –VISUALIZATION AND CLASSIFICATION **9**

Listening – TED talks
Speaking- Interviewing a celebrity/Famous Personality
Reading – Company profiles, Business Letters
Writing – Interpretation of Charts and Graphs
Vocabulary – Discourse markers, Linking words and Phrases, Collocations.
Grammar – Pronouns, Conjunction, Preposition

UNIT V – EXPOSITION **9**

Listening- Watching Movies& Listening Dialogue &Conversations
Speaking- Role play, Panel Discussion, Debate
Reading- Blogs, Novels, Short Stories
Writing – Descriptive Essay, Dialogue Writing
Vocabulary – Phrasal verbs
Grammar–Simple/Compound/Complex Sentences, Error Spotting, Punctuation.

THEORY – 45 PERIODS

List of Exercises:

1. Extempore (oral)
2. Conversation on asking directions
3. Picture Description, about purchasing a product
4. Summarizing a TED talk
5. Role play
6. Academic Journals in online through OER (Open Educational Resources)

PRACTICAL: 30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able
CO1. To use appropriate words in a professional context
CO2. To gain an understanding of basic grammatical structures and use them in the right context.
CO3. To write definitions, descriptions, narrations and essays on various topics
CO4. To speak fluently and accurately in formal and informal communicative contexts
CO5. To express their opinions effectively in both oral and written medium of communication.

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr.Lourdes Joevani, Department of English, Anna University.
3. Professional English-II, V.K. Publications, Dr.S.N. Mahalakshmi.

REFERENCES:

1. Technical Communication – Principles and Practices By Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. Learning to Communicate–Dr.V. Chellammal. Allied Publishers, NewDelhi,2003

YouTube Resources:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. http://engineeringvideolectures.com/course/696
3. https://www.pearson.com/english/catalogue/business-english/technical-english.html
4. https://www.cambridgeenglish.org/learning-english/free-resources/
5. https://www.youtube.com/watch?v=eLV6qv0CiHY

Course Code	Engineering Physics	L	T	P	C
PH4101	(Common to all Program)	3	0	2	4

COURSE OBJECTIVES:

- To enable students to understand the mechanics and properties of matter.
- To provide an overview of sound and ultrasonic production, detection and applications.
- To introduce the basics of lasers.
- To enrich the basic knowledge of optical fiber
- To understand quantum mechanical phenomena and apply them in computing fields.

UNIT I MECHANICS AND PROPERTIES OF MATTER **9**

Center of mass (CM) – motion of the CM – moment of inertia – theorems of M. I – moment of inertia of continuous bodies (Ring, Disc) – gyroscope. Elasticity –Type of modulus: Young's Modulus, Bulk Modulus, Rigidity Modulus –Poisson ratio - Hooke's law – stress- strain diagram – Factors affecting elasticity – bending of Beams – Young's modulus by uniform bending and non–uniform bending – Torsional Pendulum – I – shaped girders.

UNIT II ACOUSTICS AND ULTRASONICS **9**

Acoustics: Classification and characteristics of sound – decibel – Weber – Fechner law – Factors affecting acoustics of buildings and their remedies – Absorption Coefficient. - Doppler effect. Ultrasonic – Production of Ultrasonic by Magnetostriction and piezoelectric methods – acoustic grating – Non-destructive testing – Pulse-echo system through transmission and reflection modes – A, B and C – scan displays.

UNIT III LASER **9**

Laser: Characteristics – Spontaneous and stimulated emission – Pumping methods – Optical Resonator – Active medium and Active center – Einstein's coefficient – Principles of Laser – population inversion- Components Laser systems - Types of laser – Nd – YAG laser, CO_2 laser, Semiconductor lasers: homojunction and heterojunction - Industrial and medical application

UNIT IV FIBRE OPTICS **9**

Fiber optics – Principle, Numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – Attenuation, Dispersion – Fiber Optical Communication system (Block diagram) – Displacement sensors- Temperature/Pressure sensors –Optical fibers in computers - Medical Applications: Endoscope.

UNIT V QUANTUM MECHANICS **9**

Blackbody Radiation - Planck's quantum theory – Compton effect – Particle properties of wave: Matter waves, wave function – The Schrodinger equation (Time-dependent and time-independent forms) – Particle in an infinite potential well: One Dimensional Box –Qubit-Quantum computing – the role of Quantum computing in advancing Artificial intelligence.

THEORY: 45 PERIODS

PRACTICAL EXERCISES (FIVE ONLY)

1. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
2. Non-Uniform bending – Determination of Young's modulus.
3. Uniform bending – Determination of Young's modulus.
4. Laser – Determination of the wavelength of the laser using grating.
5. Optical fiber – Determination of Numerical Aperture and acceptance angle.
6. Acoustic grating – Determination of velocity of ultrasonic waves in liquids.
7. Michelson Interferometer.

PRACTICAL: 30 PERIOD

TOTAL: 75 PERIODS

COURSE OUTCOME

After the completion of the course, students will be able to

CO1. Understand the importance of mechanics and express their knowledge in properties of matter

CO2. Analyze the applications of acoustics and ultrasonic in engineering field.

CO3. Acquire knowledge in laser and its applications

CO4. Demonstrate a strong foundational knowledge in fiber optics.

CO5. Comprehend and apply quantum mechanical principles.

TEXT BOOKS

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw – Hill (Indian Edition), 2017.
3. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009.
4. Kasap, Safa, Capper, "Handbook of Electronic and Photonic Materials"2nd edition, Springer,2017.
5. Eleanor Rleffel and Wolfgang Polak, "Quantum computing a gentle introduction", 1st edition, The MIT press,2012.

REFERENCES

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition),2009.
2. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
3. D. Halliday, R. Resnick, and J. Walker. Principles of Physics, Wiley (Indian Edition), 2015.
4. Hugh D. Young, Roger A. Freedman, A. Lewis Ford, Searls and Zemansky University Physics, 2009.
5. David J. Griffiths, "Introduction to Quantum Mechanics", 2nd edition, Cambridge University Press, 2017.

WEB REFERENCES

1. Advanced Quantum Mechanics with Applications – https://nptel.ac.in/courses/115103104
2. Quantum Mechanics and Molecular Spectroscopy – https://nptel.ac.in/courses/104101126
3. Fiber Optic Communication Technology – https://nptel.ac.in/courses/108106167
4. Introduction to Photonics – https://nptel.ac.in/courses/108106135
5. Introduction to Laser – https://nptel.ac.in/courses/115102124
6. Biomedical Ultrasound - https://nptel.ac.in/courses/121108458

Course Code	Electric Circuit Analysis	L	T	P	C
EE4101		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To provide key concepts to analyse and understand electrical circuits
- To impart knowledge on solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce phasor diagrams and analysis of single &three phase circuits

Course Description

This course covers key concepts for analyzing electrical circuits, solving circuit equations using network theorems, obtaining transient responses, understanding resonance in coupled circuits, and introducing phasor diagrams for single and three-phase circuits analysis.

Prerequisites

- Basic understanding of electrical engineering fundamentals, including Ohm's Law, Kirchhoff's Laws, and basic circuit analysis techniques.

UNIT I Basic Circuits Analysis **9**

Circuit Elements, Ohm's Law -Kirchhoff 's Laws – Resistors in series and parallel circuits -Network reduction: voltage and current division, Source transformation – Star Delta conversion -Fundamentals concepts of R, L and C elements- A.C Circuits – Average and RMS Value -Mesh current and node voltage methods of analysis.

UNIT II Theorems for Dc and Ac Circuits **9**

Superposition Theorem - Thevenin's and Norton's Theorems – Maximum power transfer theorem– Reciprocity Theorem

UNIT III Transient Response Analysis **9**

Standard test signals -Transient response of RL, RC and RLC circuits using Laplace transform for Source free, Step input and Sinusoidal input.

UNIT IV Resonance and Coupled Circuits **9**

Series and parallel resonance– their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Dot rule - Coefficient of coupling.

UNIT V Three Phase Circuits **9**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced – phasor diagram of voltages and currents – power and power factor measurement using two-watt meter method

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

- CO1: Apply Kirchhoff's laws, star-delta conversion, mesh and nodal techniques for analysis of DC and AC Circuits.

- CO2: Apply Superposition, Thevenin's, Norton's, Reciprocity and Maximum power transfer theorems for
- network reduction of DC and AC circuits.
- CO3: Derive the transient response of RL, RC & RLC circuits using Laplace transforms for DC and AC inputs.
- CO4: Characterize the frequency response of series and parallel resonance circuits and single tuned circuits.
- CO5: Illustrate the performance parameters of three phase three wire and four wire circuits for various conditions.

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Mc Graw Hill publishers, 9thedition, New Delhi, 2020.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2019.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCES:

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.
2. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGrawHill, First Edition, 2019.
3. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
4. Sudhakar A and Shyam Mohan SP, "Circuits and Networks Analysis and Synthesis", McGraHill, 2015.
5. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley Sons, Inc. 2018.

YouTube Resources:

1. https://swayam.gov.in/course/218-networks-and-systems
2. https://onlinecourses.nptel.ac.in/noc17_ee13/preview
3. https://www.coursera.org/learn/linear-circuits-dcanalysis
4. https://onlinecourses.nptel.ac.in/noc17_ee15/preview
5. https://www.youtube.com/watch?v=OGa_b26eK2c

45 PERIODS

LIST OF EXPERIMENTS

1. Verification of series and parallel electrical circuit.
2. Verification of ohm's law and Kirchhoff's laws.
3. Verification of Thevenin's theorem.
4. Verification of Norton's theorem.
5. Verification of Superposition theorem.
6. Verification of Maximum Power transfer theorem
7. Simulation of R-C, R-L and RLC electric circuit transients
8. Design and implementation of series and parallel resonance circuit.
9. Single phase power and power factor measurement using resistive and inductive load
10. Three phase power and power factor measurement using two-watt meter method

30 PERIODS

TOTAL: 75 PERIODS

Course Code	Sensors and Instrumentation System	L	T	P	C
EE4102		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To educate the fundamental concepts and characteristics of measurement and errors.
- To impart the knowledge on the functional aspects of measuring instruments.
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications.
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

Course Description

This course provides a concise overview of measurement fundamentals, covering error analysis, functional aspects of measuring instruments, and the significance of bridge circuits. It explores sensors and transducers, their principles, applications, and concludes with digital instrumentation principles, equipping students with essential knowledge for diverse industrial applications.

Prerequisites

- Basic knowledge of physics.
- Familiarity with an electrical circuit is required.

UNIT I Concepts of Measurements **9**

Instruments: classification, applications– Elements of a generalized measurement system - Staticanddynamiccharacteristics-Errorsinmeasurement-Statisticalevaluationofmeasurementdata

UNIT II Measurement of Parameters in Electrical Systems **9**

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT &PT).

UNIT III AC/DC Bridges and Instrumentation Amplifiers **9**

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT IV Transducers for Measurement of Non-Electrical Parameters **9**

Classification of transducers – Measurement of voltage, current, power, Energy, Power factor, pressure, temperature, displacement, flow, angular velocity–Digital transducers–Smart-Sensors

UNIT V Digital Instrumentation **9**

A/D converters: types and characteristics – Sampling, Errors and Analysis- Measurement of voltage, Current, frequency and phase-Digital Voltmeters, Multimeters - D/A converters: types and characteristics- Phase, Time and frequency measurement-Oscilloscope (CRO, DSO)- Data Loggers – Instrument standards- Basics of LabVIEW - Difference between local and global variables-Features of LabVIEW.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Ability to understand the fundamental art of measurement in engineering.
CO2: Ability to understand the structural elements of various instruments.
CO3: Ability to understand the importance of bridge circuits.
CO4: Ability to understand about various transducers and their characteristics by experiments.
CO5: Ability to understand the concept of digital instrumentation and virtual instrumentation by experiments.

TEXTBOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

REFERENCES:

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009
2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011
3. W.Bolton, Programmable Logic Controllers, 6th Edition, Elseiver, 2015.
4. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3 rd Edition 2014.
5. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.
6. R. K. Raput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016

45 PERIODS

YouTube Resources:

1. https://nptel.ac.in/courses/108105153
2. https://swayam.gov.in/nd1_noc19_ee44/preview
3. https://electrical4u.in/electrical-measurements/
4. https://www.electrical4u.com/electrical-measuring-instruments-typesaccuracy-precision-resolution-speed/
5. https://www.electricaleasy.com/2014/06/instrument-transformers-ctand-pt.html
6. https://www.youtube.com/watch?v=GwVQYe7hbdc&list=PLTv19Zbw92D_iieBo38nd3fCjMIHHLfrK

List of Experiments:

1. Bridge Networks
   a) Wheatstone Bridge
   b) Schering Bridge
2. Dynamics of Sensors/Transducers
   (a) Temperature
   (b) Pressure
   (c) Displacement
3. Power and Energy Measurement
4. Instrumentation Amplifier
5. Analog – Digital converters (ADC)
6. Digital – Analog converters (DAC)

30 PERIODS

TOTAL: 75 PERIODS

Course Code	Problem Solving Using C Programming	L	T	P	C
CS4111		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the basic programing constructs of C Language
- To develop C programming using arrays and strings
- To develop modular applications in C using functions and pointers
- To develop applications in C using structs and unions
- To do input/output and file handling in C

Course Description

This course covers the fundamental programming constructs of C language, including arrays, strings, functions, and pointers. It emphasizes modular application development using structs, unions, and file handling techniques. Students will gain proficiency in input/output operations and practical application development in C.

Prerequisites

- Basic knowledge of computer programming concepts, familiarity with fundamental principles of algorithmic problem-solving

UNIT I Basics of C Programming **15**

Introduction to programming paradigms – Structure of C program – Creating C programs – Variables, Keywords, Data types, Constants, Operators, input / output statements – Decision making statements – Looping with while, do-while, and for loops – Nested loops and loop control statements.

Coding Exercises:
1. Write a C program to find the sum of two integers entered by the user
2. Write a C program to check if a given number is even or odd
3. Write a C program to find the largest among three numbers using if-else statements

Problems-solving Assignments:
1. Write a C program to calculate the factorial of a given positive integer using a loop
2. Write a C program to check if a given number is a prime number
3. Write a C program to find the GCD (Greatest Common Divisor) of two numbers using a function

UNIT II Arrays and Strings **15**

Working with arrays: One dimensional array: declaration, initialization, and accessing elements – Two dimensional arrays: Declaration -Initialization – Accessing elements – Operations: Read – Print – Sum – Transpose, Strings in C: string functions and manipulation – linear and binary Search, Selection sort

Coding Exercises:

1. Implement a program that finds the largest element in an array of integers
2. Write a C program to count the number of vowels and consonants in a given string
3. Write a program to reverse a string without using the standard string library functions

Problems-solving Assignments:

1. Write a C program to merge two sorted arrays into a single sorted array
2. Write a C program to find the second largest element in an array
3. Write a program that finds the intersection of two arrays and stores the result in a third array

UNITIII Functions and Pointers 15

Modular programming – Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion– Parameter passing: Pass by value, Pass by reference– Introduction to pointers and memory management – Pointer operators – Pointer arithmetic - Pointers and arrays

Coding Exercises:
1. Write a C program to exchange the values of variables
2. Implement a recursive function to calculate the factorial of a given number

Problems-solving Assignments:
1. Write a C program to sort an array of strings in alphabetical order using function
2. Create a program to implement a binary search algorithm to search for an element in a sorted array using recursion.

UNIT IV Structure and Union 15

Structure – Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Singly linked list – Typedef – Union – Storage classes and Visibility

Coding Exercises:
1. Write a C program to find the average and total marks of students using a structure

Problems-solving Assignments:
1. Write a C program to create a structure representing a book with title, author, and publication year. Implement functions to add, display, and search for books in a library
2. Implement a program to manage a student database using structs, including functions to add, delete, and display student records

UNIT V File Processing 15

Files – Types of file processing: Sequential access, Random access – Sequential access file – Random access file – Command line arguments – Code optimization and best practices

Coding Exercises:
1. Create a program that reads data from a file and calculates the average of a set of numbers
2. Write a program to copy the contents of one file into another file

Problems-solving Assignments:
1. Write a C program to read student records from a file and calculate their total and percentage
2. Develop a program to read employee details from a file, sort them based on salary, and write the sorted data back to the file.

Final Project (sample): Design a simple inventory management system for a small store using structs and file handling. The program should allow users to add, update, and delete items in the inventory and display the current stock.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Demonstrate knowledge on C Programming constructs
CO2: Design and implement applications using arrays and strings
CO3: Develop and implement modular applications in C using functions and pointers
CO4: Develop applications in C using structures and unions
CO5: Develop applications using sequential and random-access file processing

TEXT BOOKS:

1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education,2015.
2. Paul Deitel and Harvey Deitel, "C How to Program", 9th edition, Pearson, 2021
3. E Balagurusamy, "Programming in ANSI C", Eighth Edition, McGraw Hill Education, 2019.

REFERENCE BOOKS:

1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-HillEducation, 1996.
3. Peter van der Linden, "Expert C Programming", Pearson, 1994. 4. Reema Thareja, "Programming inC", Second Edition, Oxford University Press India, 2016.

YouTube Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs02/preview
3. https://www.mathworks.com/academia/books.html
4. https://in.mathworks.com/support/learn-with-matlab-tutorials.html
5. https://www.youtube.com/watch?v=4gkfw0GEi3g

TOTAL: 75 PERIODS

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – I	L	T	P	C
ES4101	**Foundations of Mathematics and Reasoning**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles

Course Description

This course categorizes and applies quantitative methods to enhance problem-solving skills. It covers fundamentals of numeric ability, probabilities, and quantitative aptitude. Additionally, it involves critical evaluation of various possibilities through puzzles to strengthen analytical thinking and reasoning abilities.

Prerequisites

- Basic understanding of mathematics, particularly in areas such as arithmetic, algebra, and basic probability theory

UNIT I Numbers 6

Introduction – Classification of numbers – Formation of Numbers (Small & Large) –Place Value – Face Value – Divisibility Rule – Prime, Composite Numbers – Prime Factorization – Number of factors – Number of factors (Odd & Even) – Sum of factors – Successors and Predecessors – Greatest Integer Value – Vedic Mathematics – Trailing Zeroes – Unit Digits–Remainder Theorem – Real Number – Rational Numbers: Integers, Fractions – Comparison of Numbers – Operations on fractions – Scientific Notation

UNIT II Problems on Letters, Numbers and Symbols 6

Factors and Multiples, LCM and HCF – Relationship between LCM and HCF – Factorial – Simplification – VBODMAS – Square, Square Root – Cube, Cube Root – Exponents & Powers (Surds and Indices) – Sequence & Series: Arithmetic Progression – Geometric Progression – Special Progression, Letter Series, Number Series, Alpha – Numeric Series, Continuous Pattern Series

UNIT III Verbal and Non – Verbal Reasoning 6

Verbal Reasoning – Analogy: Completing the Analogous pair, Direct Analogy, Choosing the Analogous pair, Double Analogy, choosing a Similar Word, Detecting Analogies, Multiple word Analogy, Number Analogy, Alphabet Analogy – Classification: Odd Words and Numerals – Coding and Decoding: Letter, Number, Symbol, Matrix, Substitution, Deciphering Message Word, Number and Symbols. Non – Verbal Reasoning Figure Series – Missing figure, Incorrect figure – Analogy: Similarity Related Pair, Similarity Related figures, unrelated figures, Group of figures.

UNIT IV Ratio and Proportion **6**

Introduction – Ratio – Proportion: Direct and Indirect – Unitary Method – Problems on Ages – Chain Rule – Partnership – Mixture or Allegation – Time and Work: Individual, Group, Efficiency, Wages – Pipes and Cistern: Inlet, Outlet, and Leakage

UNIT V Percentage **6**

Introduction – Percentages in real life – Profit and Loss – Discount– Simple Interest – Compound Interest – Relationship between Simple Interest and Compound Interest – Overhead Expenses and GST.

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COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Develop the arithmetic ability and properties of numbers that we use in day to day life
CO2: Demonstrate the logic behind the formation of numbers, alphabets series.
CO3: Apply the reasoning methods logically and evaluate complex relationships between the variables and numbers.
CO4: Use the concept of ratios and proportion in ages and partnership problems.
CO5: Apply the short cuts of the mathematical tricks to reduce the time duration in problem solving

TEXT BOOKS:

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES:

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

YouTube Resources:

1. https://www.youtube.com/playlist?list=PLpyc33gOcbVA4qXMoQ5vmhefTruk5t9lt
2. https://www.youtube.com/watch?v=_cW7_BUDYcw
3. https://www.youtube.com/watch?v=AFh1-fqdaf4
4. https://www.youtube.com/c/Aptitudesoftware
5. https://www.youtube.com/playlist?list=PL8p2I9GklV454LdGfDOw0KkNazKuA-6B2

TOTAL: 30 PERIODS

SEMESTER – II

Course Code	Mathematics -II - Probability and Statistics	L	T	P	C
MA4201	(COMMON TO ALL PROGRAMS)	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the basic concepts of probability and distributions.
- To learn the basic concepts of two -dimensional random variables.
- To acquire the knowledge in random processes, stationary, Markov and Poisson process.
- To acquire the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
- To summarise the design of experiments in the field of agriculture.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability: Axioms – Sample space – Events - Conditional Probability – Baye's Theorem - Discrete and continuous random variables - Moments - Moment generating functions - Standard distributions: Binomial - Poisson - Geometric - Uniform - Exponential and Normal distributions.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions - Marginal and conditional distributions - Covariance - Correlation - linear regression - Transformation of random variables - Central limit theorem (excluding proof).

UNIT III RANDOM PROCESSES AND MARKOV CHAINS 12

Random Processes: Introduction and Classification -Stationary Processes -Markov Processes - Poisson Processes -Discrete Parameter Markov Chains -Chapman-Kolmogorov Equations (Statement only) - Limiting Distributions.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters **-**Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, F and Chi-square distributions for mean, variance **-** Contingency table (test for independent) - Goodness of fit.

UNIT V DESIGN OF EXPERIMENTS 12

One way and two-way classifications - Completely randomized design - Randomized block design - Latin square design.

TOTAL: 60 PERIODS

Assessments & Grading

Exercises / Assignments, Quizzes, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge ofStandard distributions which can describe real life phenomenon.
- CO2: Recognize the basic concepts of two - dimensional random variables and apply in engineeringapplications.
- CO3: Develop the basic concepts of random processes which are widely used in engineering fields.
- CO4: Apply the concept of testing of hypothesis for small and large samples in real life problems.
- CO5: Investigate of design of experiments in the field of agriculture.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers",
2. Pearson Education, Asia, 8th Edition, 2015.
3. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
4. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New
2. Delhi, 8th Edition, 2014.
3. Papoulis, A. and Unnikrishna pillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability
6. and Statistics", Tata McGraw Hill Edition, 2004.
7. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

YouTube Resources:

1. https://youtube.com/playlist?list=PLC58778F28211FA19&feature=shared
2. https://youtu.be/obZzOq_wSCg?feature=shared
3. https://youtu.be/oI3hZJqXJuc?feature=shared
4. https://youtu.be/rzFX5NWojp0?feature=shared
5. https://youtube.com/playlist?list=PLblh5JKOoLUJjeXUvUE0maghNuY2_5fY6&feature=shared

Course Code	Tamils and Technology	L	T	P	C
HS4201		1	0	0	1

UNIT I Weaving and Ceramic Technology **3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II Design and Construction Technolog3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT III Manufacturing Technology **3**

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV Agriculture and Irrigation Technology **3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry– Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries– Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT V Scientific Tamil & Tamil Computing **3**

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries –Sorkuvai Project.

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (inprint)
2. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBook and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

TOTAL: 15 PERIODS

Course Code	Electro Magnetic Field Theory	L	T	P	C
EE4201		3	0	0	3

COURSE OBJECTIVES:

To introduce the basic mathematical concepts related to electromagnetic vector fields

- To impart knowledge on the concepts of Electrostatic fields, electric potential, energy density and their applications.
- Magneto static fields, magnetic flux density, vector potential and its applications.
- Different methods of emf generation and Maxwell's equations
- Electromagnetic waves and characterizing parameters

Course Description

This course covers electrostatic fields, electric potential, energy density, and applications. Additionally, it includes magneto static fields, magnetic flux density, vector potential, and applications. Furthermore, it covers methods of EMF generation, Maxwell's equations, and electromagnetic waves along with their characterizing parameters. Students gain a comprehensive understanding of electromagnetism and its applications.

Prerequisites

- Solid foundation in calculus, particularly vector calculus, and differential equations.
- Familiarity with basic concepts of electromagnetism, such as electric charge, electric fields, and magnetic fields

UNIT I Electrostatics – I **9**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II Electrostatics – II **9**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, – Electric field in free space, conductors, dielectrics - Dielectric polarization –Dielectric strength – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS **9**

Lorentz force, Magnetic field intensity (H)-Magnetomotive force-Reluctance – Biot–Savart's Law - Ampere's Circuital Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Boundary conditions, Inductance(self and mutual),Coefficient of coupling, Energy density, Applications.

UNIT IV Electrodynamic Fields **9**

Faradays Law-Transformer and motional EMF – Displacement current -Maxwell's equations (differential and integral form) – Applications.

UNIT V Electromagnetic Waves **9**

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors - Poynting vector and theorem.

COURSE OUTCOMES:

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

CO1: Explain Gradient, Divergence, and Curl operations on electromagnetic vector fields.
CO2: Explain electrostatic fields, electric potential, energy density and their applications.
CO3: Calculate magneto static fields, magnetic flux density, vector potential
CO4: Explain different methods of emf generation and Maxwell's equations
CO5: Explain the concept of electromagnetic waves and characterizing parameters

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES

1. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, Newage Publishers, 2018.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers 2013.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Fifth Edition (Schaum's Outline Series), McGraw Hill, 2018.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education (India) Private Limited, 2017.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Sixteenth Edition Eighth Reprint :2015

YouTube Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2. https://www.britannica.com/science/electrostatics
3. https://www.britannica.com/science/magnetostatics
4. https://www.youtube.com/watch?v=DWiZTLtQc3w&pp=ygUWRWxlY3Ryb21hZ25ldGljIFdhdmVzIA%3D%3D
5. https://www.youtube.com/watch?v=LAQa7gJZCIY&list=PLwyFA5ZBghfBccWoy0brW4Qmoo0XxTYih

TOTAL:45 PERIODS

Course Code	Communicative English –II	L	T	P	C
HS4202		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To engage learners in meaningful language activities to improve their LSRW skills
- To enhance learner's awareness of general rules of writing for specific audiences
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To cultivate the learners to understand job applications and interviews for internship and placements.

Course Description

This course focuses on improving learners' language skills (LSRW), emphasizing meaningful language activities. It enhances awareness of writing rules for specific audiences and purposes. Learners develop analytical thinking for problem-solving in communication contexts and gain understanding of job applications and interviews for internships and placements.

Prerequisites

- Basic proficiency in the language of instruction, whether it's English or another language.
- Familiarity with fundamental writing and communication skills

UNIT I –MAKING COMPARISONS **9**

Listening – Evaluative Listening: Advertisements, Product Descriptions, –Audio/ video
Speaking –Marketing a product, Persuasive Speech Techniques.
Reading – Reading advertisements, user manuals, brochures
Writing – Letter to the editor; Compare and Contrast Essay
Grammar – Impersonal passive voice; Prepositional phrases
Vocabulary –Contextual meaning of words

UNIT II –EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING **9**

Listening – Listening to longer technical talks and completing–gap filling exercises. Listening technical information from podcasts
Speaking –Describing and discussing the reasons of accidents or disasters based on news reports
Reading – Reading longer technical texts/Novels
Writing – Writing responses to complaints; Problem solution Essay
Grammar –Subject – Verb Agreement, Infinitive and Gerunds
Vocabulary – Adverbs.

UNIT III –PROBLEM SOLVING **9**

Listening– Watching movie scenes/documentaries depicting a technical problem and suggesting solutions.
Speaking – Group Discussion (based on case studies), – techniques and Strategies.

Reading – Case Studies, excerpts from literary texts, news reports etc.
Writing – Checklists, Argumentative Essay
Grammar –Error correction, If conditional sentences
Vocabulary – Compound Words, Sentence Completion.

UNIT IV- REPORTING OF EVENTS AND RESEARCH **9**

Listening – Listening Comprehension based on news reports and documentaries.
Speaking –Interviewing, Presenting an oral report, Mini presentations on select topics
Reading –Newspaper articles
Writing –Industrial visit Report, Accident Report, Survey Report
Grammar–Reported Speech, Modals
Vocabulary–Conjunctions, use of prepositions.

UNIT V –THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY **9**

Listening – Listening to TED Talks, Presentations, Formal job interviews
Speaking – Mock Interview, Making presentations with visual aids
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals
Writing –Job / Internship application – Cover letter with Resume
Grammar – Numerical adjectives, Relative Clauses
Vocabulary–Idioms.

THEORY – 45 PERIODS

List of Exercises:
1. Listening /Reading Comprehension
2. Introducing Oneself
3. Summary of a Podcast
4. Mini Presentation on General topic (ICT tools)
5. Autobiography of a famous Personality
6. Narrating an unforgettable event
7. Drafting an Email (printed format)
8. Developing a story using given Vocabulary
9. Group Discussion
10. Mock Interview

PRACTICAL: 30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOME:

At the end of the course, learners will be able to
CO1. Compare and contrast products and ideas in technical texts.
CO2. Identify cause and effects in events, industrial processes through technical texts
CO3. Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO4. Report events and the processes of technical and industrial nature.

CO5. Present their opinions in a planned and logical manner, and draft effective resumes incontext of job search.

TEXTBOOKS:

1. English for Engineers & Technologists (2020edition) Orient Blacks wan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba,and Dr. Lourdes Joevani, Department of English, Anna University.
3. Professional English-II, V.K. Publications, Dr.S.N. Mahalakshmi.

REFERENCES:

1. Raman. Meenakshi, Sharma. Sangeeta (2019), Professional English, Oxford universitypress. New Delhi.
2. Improve Your Writing V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate–Dr. V. Chellammal. Allied Publishers, NewDelhi,2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & KrishnaMohan, Tata McGraw Hill & amp; Co. Ltd., 2001, New Delhi.

YouTube Resources:

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pf
3. https://freevideolectures.com/course/3250/introduction-to-filmstudies/10
4. https://www.ef.com/wwen/english-resources/
5. https://www.smilesforlearning.org/gclid=EAIaIQobChMI49DF9bnd6AIVSY6PCh1d_gV9EAAYASAAEgIBPvD_BwE.

Course Code	Electronic Devices and Circuits	L	T	P	C
EE4202		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the structure of basic electronic devices.
- To impart knowledge on the working of Transistors family.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier-gain and frequency response.
- To learn the required functionality of feedback amplifiers and oscillators.

Course Description

This course covers the structure of basic electronic devices and working principles of transistor families. It includes operational and application aspects of transistors like BJT and FET, characteristics of amplifier gain and frequency response, and functionality of feedback amplifiers and oscillators. Practical applications are emphasized.

Prerequisites

- Foundational understanding of basic electronics concepts, including voltage, current, resistance, and basic circuit analysis.
- Familiarity with semiconductor physics, particularly the behavior of diodes.

UNIT I Semiconductor Physics and Diodes **9**

Energy band structure of insulators, conductors and semiconductors – conductivity of an intrinsic semiconductor – Fermi Dirac distribution and energy band diagram – Fermi levels in extrinsic semiconductor – Hall effect-PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance – Clipping & Clamping circuits - Zener diode characteristics- Zener diode Reverse characteristics – Zener diode as regulator-Schottky diode.

UNIT II Semiconductor Devices 9

Transistor operation – Current components – Early effect – Eber-Moll model of transistor – Transistor as an amplifier-Transistor as a switch Construction and characteristics of JFET – Relation between pinch off voltage and drain current – JFET as voltage variable resistor-UJT–, CMOS – Its construction and characteristics.

UNIT III Amplifiers **9**

CB, CE, CC configuration, Biasing and characteristics-FET Biasing-BJT small signal model – Analysis of CE, CB, CC amplifiers– Gain and frequency response of BJT

UNIT IV Multistage Amplifiers and Differential Amplifier **9**

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – Single tuned amplifiers – Gain and frequency response –Power amplifiers-SMPS

UNIT V Feedback Amplifiers and Oscillators **9**

Introduction to Feedback amplifier – voltage / current, series, Shunt feedback –positive feedback –

Condition for oscillations, phase shift – Wien Bridge, Hartley oscillators.

COURSE OUTCOMES:

OUTCOMES**:** Upon successful completion of the course, the students will be able to:

CO1: Explain the structure and operation of PN junction devices (diode, Zener diode, LED and Laser diode)
CO2: Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PNjunction diodes
CO3: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT
CO4: Analyze the performance of various configurations of BJT and MOSFET based amplifier CO5: Explain the characteristics of MOS based cascade and differential amplifier

TEXT BOOKS:

1. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2009.
2. Robert L.Boylestad, "Electronic devices and circuit theory", 13th edition, Pearson prentice Hall 2022.
3. Sedra and smith, "Microelectronic circuits",7th Edition., Oxford University Press, 2017
4. R. S. Sedha, "Basic Electronics: Semiconductor Physics and Devices",5th Edition ,2021
5. Stephen W. Farnsworth,"Electronic Devices and Circuits: A Systems Approach", 4th Edition 2020

REFERENCES:

1. Balbir Kumar, Shai.B.Jain, "Electronic devices and circuits" PHI learning private limited 2nd edition 2014.
2. Thomas L.Floyd, " Fundamentals of Electronic devices" Pearson prentice hall, 9th Edition, 2021
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 4th Edition, 2010
4. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, Second edition, 2012.

YouTube Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee80/preview
2. https://archive.nptel.ac.in/courses/108/108/108108112/
3. https://archive.nptel.ac.in/courses/108/102/108102097/
4. https://www.youtube.com/watch?v=Rx43l-QpeWQ
5. https://onlinecourses.nptel.ac.in/noc21_ee86/preview

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Characteristics of Semiconductor diode, Zener diode, photo diode, and photo transistor
2. Characteristics of Single-Phase half-wave and full wave rectifiers with inductive andcapacitive filters
3. Characteristics of NPN Transistor under Common Emitter, Common Collector and Common base configurations.
4. Characteristics of JFET and draw the equivalent circuit

5. Characteristics of UJT and generation of saw tooth waveforms
6. Design and frequency response characteristics of a Common Emitter amplifier
7. Characteristics of light activated relay circuit.
8. Design and testing of RC phase shift oscillator
9. Design of Differential amplifiers using FET
10. Realization of passive filters.

PRACTICAL: 30 PERIODS
TOTAL: 75 PERIODS

Course Code	Digital Logic Circuits	L	T	P	C
EE4203		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study various number systems and to simplify the mathematical expressions using Boolean functions word-problems.
- To introduce the fundamentals and implementation of combinational circuit using logic Gates.
- To study the fundamentals and implementation of sequential digital circuits.
- To study the design of various asynchronous-circuits.
- To introduce digital simulation techniques for development of application- oriented logic circuit.

Course Description

This course explores number systems, Boolean functions, and simplification of mathematical expressions. It covers fundamentals and implementation of combinational and sequential digital circuits, including asynchronous circuits. Additionally, it introduces digital simulation techniques for developing application-oriented logic circuits. Practical problem-solving skills are emphasized.

Prerequisites

- Foundational understanding of basic mathematics, including algebra and Boolean algebra.
- Familiarity with logic gates and basic digital electronics concepts

UNITI Number Systems and Digital Logic Families **9**

Number system, error detection, corrections & codes conversions, Boolean algebra: DeMorgan's theorem, switching functions and minimization using K-maps – representation of logic functions-SOP and POS forms, K-map representations- minimization using K maps.

UNIT II Combinational Circuits **9**

Combinational logic – simplification and implementation of combinational logic – multiplexers and de multiplexers – code converters, adders, subtractors, encoders, decode.

UNIT III Synchronous Sequential Circuits **9**

Sequential logic- SR, JK, D and T flip flops – Modulo counters – Shift registers – design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT IV A Synchronous Sequential Circuits **9**

Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits.

UNIT V VHDL **9**

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

COURSE OUTCOMES:

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

CO1: Explain various number systems and characteristics of digital logic families and apply K maps to simplify the given Boolean expressions.
CO2: Explain the implementation of combinational circuit such as multiplexers and demultiplexers – code converters, adders, subtractors, Encoders and Decoders
CO3: Explain the implementation of synchronous sequential circuits and Design various synchronous circuits using Flip Flops
CO4: Design various asynchronous circuits using Flip Flops and Explain asynchronous Sequential circuits and programmable logic devices
CO5: Use VHDL for simulating and testing RTL, combinatorial and sequential circuits

TEXTBOOKS:

1. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, Edition 2017.
2. Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill,2017.
3. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018.

REFERENCES:

1. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 2th Edition, 2017.
2. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

YouTube Resources:

3. https://nptel.ac.in/courses/108/105/108105132/
4. https://nptel.ac.in/courses/108/105/108105113/
5. https://www.coursera.org/learn/digital-systems
6. https://www.udemy.com/course/digital-electronics-logic-design/
7. https://www.youtube.com/c/vhdllanguage

45 PERIODS

LIST OF EXPERIMENTS:

1. Implementation of Boolean Functions, Adder
2. Implementation of Boolean Functions, Subtractor
3. Code converters: Excess-3 to BCD
4. Code converters: Binary to Gray code converter
5. Parity generator and parity checking
6. Encoder
7. Decoders
8. Study of multiplexer and de multiplexer
9. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
10. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.

30 PERIODS
TOTAL: 75 PERIODS

Course Code	Data Structures using C Programming	L	T	P	C
CS4202		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

- To learn the features of C
- To learn the basics of array, strings, structure and union
- To explore the applications of linear and non-linear data structures
- To represent data using stack and queue data structure
- To learn the basics of sorting and searching algorithms

Course Description

Master data structures and algorithms in C. Covering arrays, linked lists, trees, graphs, sorting, searching, and hashing. Focus on theoretical concepts and practical implementation. Develop proficiency in problem-solving and algorithmic thinking.

Prerequisites

Prerequisites: Proficiency in C programming language, understanding of basic programming concepts including variables, control structures, functions, and pointers.

Unit 1: Introduction to C **9**

Structure of a C program – Constants, Variables – Data Types –Operators- Expressions using operators in C – Decision Making and Branching – Looping statements. Functions- Need of Functions – Function declaration and definition -Pass by value – Pass by reference – Recursion – Storage classes. Pointers – Application of Pointers - Pointers arithmetic – Pointer to pointer. Dynamic memory allocation – Malloc - Calloc – Realloc.

UNIT II: Arrays, Strings, Structure and Union **9**

Array- Need of Array – Array Declaration and initialization- Two-dimensional Array- Passing array and 2D array to function. String- string declaration and initialization – string manipulation – passing string to function- Array of string- String operation. Structures and unions – Declaration and initialization of structure – Structure within a structure – Array of structures- Passing structure to function- Union – Passing union to function. Simple Programs.

Unit III: Introduction to Data Structures **9**

Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT) Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays. Linked Lists -Representation and Operations of Linked Lists- Singly Linked List- Doubly Linked List- Circular Linked List- Circular Doubly Linked List. Applications of linked list.

Unit IV: Stacks, Queue and Tree **9**

Introduction to Stack-Stack Implementation-Operations of Stack- Applications of Stack. Introduction to Queue-Queue Implementation- Operations of Queue- Circular Queue and Priority Queue. Trees: Binary

Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees.

Unit V: Graphs, Searching, Sorting and Hashing **9**

Introduction-Graph representation- Graph Traversals. Searching and Sorting: Searching - Types of Searching- Linear search – Binary Search- Sorting - Types of sorting –insertion sort - bubble sort - merge sort - selection sort- quick sort. Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing- Collision, Collision Resolution Technique (CRT)-Perfect Hashing.

TEXTBOOKS:

1. Pradip Dey and Manas Ghosh, —Programming in C, Second Edition, Oxford University Press, 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

REFERENCES:

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education,1996
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, 1983.
3. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla, — Data Structures and Program Design in C, Second Edition, Pearson Education, 2007
4. Jean-Paul Tremblay and Paul G. Sorenson, —An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:
CO1: Implement linear and non-linear data structure operations using C program
CO2: Suggest appropriate linear / non-linear data structure for any given scenario.
CO3: Apply hashing concepts for a given problem
CO4: Modify or suggest new data structure for existing applications
CO5: Appropriately choose the sorting algorithm for the specified application

You tube Resources:

1. https://youtu.be/AT14lCXuMKI?si=G5qpf4ZQ33ISvzi-
2. https://youtu.be/AT14lCXuMKI?si=0UIRGS75QJqwuHAS
3. https://youtu.be/4Rll-_e9-0M?si=AiQ6pqbBHEiOhGLw
4. https://youtu.be/tw-qWGG8y5g?si=pU3xKL4bhj-Bp6gn
5. https://youtu.be/tw-qWGG8y5g?si=J-w9-6x_MrFRlHmM

THEORY: 45 PERIODS

LIST OF EXPERIMENTS:

1. Simple C Programs
2. Using if and Switch Constructs Programs
3. Looping Statements Problems
4. Functions and Recursive Programs
5. Arrays, Strings and Matrices Programs
6. Pointers and Arrays Programs
7. Stacks, Queues, Expression Evaluation Programs
8. Infix to Postfix Conversion
9. Linked List Programs: List, Merging Lists, Linked List, Single Linked List, Double Linked List, Header Linked List, Insertion and Deletion of Linked List, Traversing a Linked List.
10. Traversing Binary Trees, Binary Search Tree, Insertion and Deletion Operations

PRACTICAL: 30 PERIODS
TOTAL: 75 PERIODS

Course Code	Employability Enhancement Skills – II	L	T	P	C
ES4202	**Exploring Mathematical Concepts and Reasoning**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles.

Course Description

This course explores quantitative methods to enhance problem-solving skills. It covers fundamentals of numeric abilities, probabilities, and quantitative aptitude. Additionally, it delves into critical evaluation of puzzles, fostering analytical thinking and logical reasoning. Practical application of quantitative techniques is emphasized for real-world problem-solving scenarios.

Prerequisites

- Basic understanding of mathematics, including arithmetic, algebra, and geometry.

UNIT I Time and Distance **6**

Introduction – Speed: Late / Early / Usual Time – Average Speed – Chasing – Problems on Train: Crossing Pole, Crossing Platform, Train moving in same and different direction – Boats and Streams: Upstream, Downstream – Clock – Calendar.

UNIT II Probability and Statistics **6**

Introduction – Algebra of Events – Addition theorem of Probability – Permutation and Combinations – Problems based on choosing the objects – Statistics: Range – frequency, Arithmetic Mean – Median – Mode – Variance – Standard Deviation – Measures of Dispersion – Coefficient of Variation.

UNIT III Arithmetic and Logical Reasoning **6**

Introduction – Mathematical Operations – Blood Relations: Direct, Indirect, coded – Problems on Cubes and Dices: Face identification – Folding and cutting Images – Counting technique of figures – Distance & Direction.

UNIT IV Applied Mathematics **6**

Mensuration (2D&3D): Square, Rectangle, Triangle, Circle, Parallelogram, Rhombus, Trapezoid, Quadrilateral, Cube, Cuboid, Cylinder, Cone, Sphere, Miscellaneous – Trigonometry: Ratio, Identities, Heights and Distances – Algebra – Logarithm – Geometry.

UNIT V Verbal and Logical Reasoning **6**

Introduction – Venn diagram – Syllogism – Data Sufficiency – Decision Making – Puzzle: Number Puzzle, Letter Puzzle – Ranking Test – Data Arrangement: Linear, Circular, Miscellaneous – Critical Reasoning.

COURSE OUTCOMES:

OUTCOMES: After the completion of the course, students will be able to:

- CO1: Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests.
- CO2: Solve questions related to Time etc. from company specific and other competitive tests.CO3: Illustrate and solve puzzle related questions from specific and other competitive tests

TEXT BOOKS:

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES:

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic-maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

YouTube Resources:

1. https://www.youtube.com/watch?v=ufbDCFUn6PY
2. https://www.youtube.com/watch?v=sbbYntt5CJk
3. https://testbook.com/reasoning/arithmetic-reasoning
4. https://unacademy.com/content/clat/study-material/logical-reasoning/arithmetic-reasoning/
5. https://www.youtube.com/watch?v=i-KdbT-TKH0

TOTAL: 30 PERIODS

Course Code	NCC Credit Course Level 1-ARMY WING	L	T	P	C
-		2	0	0	2

UNIT I NCC General 6

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness 4

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development 7

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership 5

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development 8

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 PERIODS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs a) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) b) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs a) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) b) Appeared for C Certificate Exam

SEMESTER - III

Course Code	MATHEMATICS-III -Mathematical Methods for Engineering (Common to B.E - CIVIL, MECH, MCT, EEE, ECE, EC(ACT) and EE(VLSI))	L	T	P	C
MA4301		3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To apply the concept of Laplace transforms in engineering problems.
- To introduce the concepts of Z transforms.
- To learn the basic concepts of Fourier series and Fourier transforms.
- To use the numerical techniques of differentiation and integration in engineering and technology disciplines.

Course Description

Transforms involve Fourier, Laplace, and Z-Transforms for signal analysis. Complex Variables cover complex arithmetic, functions, and residue theory. Differential Equations include ODEs and PDEs solution methods. Numerical Methods encompass root finding, interpolation, integration, differentiation, and ODE/PDE solving algorithms.

Prerequisites

Prerequisites typically include calculus, algebra, and basic differential equations. For advanced topics, understanding complex numbers, linear algebra, and familiarity with programming languages for numerical methods is beneficial.

UNIT I ANALYTIC FUNCTION & COMPLEX INTEGRATION **12**

Analytic functions - Cauchy-Riemann equations (statement only) - Complex integration - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Zeros - Singular points - Residues - Cauchy's residue theorem (statement only) - Evaluation of contour integrals on simple closed curves.

UNIT II LAPLACE TRANSFORMS **12**

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorem - Transforms of derivatives and integrals - Initial and final value theorem - Inverse transforms - Convolution theorem - Transform of periodic functions - Application - solution of linear second order ordinary differential equations with constant coefficients.

UNIT III Z-TRANSFORMS **12**

Elementary properties - Inverse Z-transform (using partial fraction and residues) - Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.

UNIT IV FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Change of interval - Half range Sine series –Half range Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT V FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
CO2: Apply Laplace transform and inverse transform of simple functions, properties, various related problems.
CO3: Understand the characteristics and properties of Z – transform.
CO4: Recognize the concepts of Fourier series and Fourier Transform and applying engineering problems.
CO5: Develop the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration in Engineering problems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John WileyandSons,10th Edition, New Delhi, 2016.
3. Sankara Rao. K, "Numerical Methods for Scientists and Engineers", PHI Learning Pvt Ltd., New Delhi, 2007.

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REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics||, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics ||, Narosa Publications, New Delhi, 3rd Edition, 2007.
5. O'Neil, P.V. Advanced Engineering Mathematics||, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
6. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
7. S. Ponnusamy, "Foundations of Complex Analysis" 2nd Edition, Narosa Publishing House, 2014.

You tube Resourses:

1. https://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/2.
2. https://ocw.mit.edu/courses/mathematics/18-336-numerical-methods-for-partial-differential-equations-spring-2009/
3. https://www.youtube.com/user/patrickJMT
4. https://www.youtube.com/user/DrChrisTisdel
5. https://www.youtube.com/user/ilectureonline

TOTAL: 60 PERIODS

Course Code	Signals and Systems	L	T	P	C
EE4301		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain
- To analyze Linear time invariant system in Discrete time signals

Course Description

This course provides an understanding of signal and system properties, characterization of LTI systems in the time domain, analysis of continuous-time signals/systems using Fourier and Laplace transforms, analysis of discrete-time signals/systems using Fourier and Z transforms, and examination of linear time-invariant systems in discrete-time signals.

Prerequisites

- Solid foundation in calculus, familiarity with basic concepts of linear algebra, understanding of differential equations

UNIT I Classification of Signals and Systems **9**

Classification of signals and systems-Representation of Discrete time signals-Mathematical Representation of CT and DT signals –Shifting and scaling properties-Linear, Time invariant and causal systems-Sampling Theorem

UNIT II Analysis of Continuous Time Signals **9**

Fourier series for periodic signals - Fourier Transform -Application of Fourier transform- Laplace Transforms and Properties-RMS Value, Average value Calculation for any general periodic waveform.

UNIT III Linear Time Invariant Continuous Time Systems **9**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV Analysis of Discrete Time Signals **9**

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)–Properties of DTFT - Z Transform & Properties

UNIT V Linear Time Invariant-Discrete Time Systems **9**

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Determine if a given system is linear/causal/stable
CO2: Determine the frequency components present in a deterministic signal
CO3: Characterize continuous LTI systems in the time domain and frequency domain
CO4: Characterize discrete LTI systems in the time domain and frequency domain
CO5: Compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015. (Units I - V)
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

YouTube Resources:

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/117/104/117104070/
3. https://www.youtube.com/playlist?list=PL9567DFCA3A66F299
4. https://www.youtube.com/watch?v=XMCp2UMNmik
5. https://www.youtube.com/watch?v=EcvHobHeOks

TOTAL:45 PERIODS

Course Code	DC Machines and Transformers	L	T	P	C
EE4302		3	0	2	4

COURSE OBJECTIVES:

To understand the concept of D.C. Generator

- To identify the appropriate D.C Motor for a given application based on its characteristics.
- To identify the appropriate test to determine the performance parameters of a given machine.
- To familiarize operational characteristics of single-phase transformers
- To deliberate the testing of transformer and three phase transformer connections

Course Description

This course provides insights into selecting DC motors for specific applications, testing methods for machine performance parameters, operational characteristics of single-phase transformers, and testing procedures for transformers and three-phase transformer connections. Students gain practical knowledge essential for electrical machine selection, testing, and operation.

Prerequisites

- Basic knowledge of mathematics, including calculus and algebra

UNIT I D.C. Generators **9**

Electromechanical Energy conversion principles-Principle of operation of D.C. Machine – lap and wave windings – use of laminated armature – E.M.F Equation - Armature reaction – Cross magnetizing and de-magnetizing AT/pole – compensating winding – commutation and methods of improving commutation Methods of Excitation – build-up of E.M.F - Load characteristics of shunt, series and compound generators

UNIT II D.C. Motors **9**

Principle of operation – Back E.M.F. - Torque equation – separately excited, series and shunt motors-motoring and generating mode of operation and characteristics- application of shunt, series and compound motors – Speed control of D.C. Motors - Armature voltage and field flux control methods. Motor starters (3-point and 4-point starters) Testing of D.C. machines - Losses – calculation of efficiency – condition for maximum efficiency.

UNIT III Testing of Dc Machines **9**

Methods of Testing – direct, indirect, and regenerative testing – Brake test – Swinburne's test – Hopkinson's test – Field's test - separation of stray losses in a d.c. motor test.

UNIT IV Single Phase Transformer **9**

Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no load and on load - phasor diagrams Equivalent circuit - losses and efficiency – regulation - All day efficiency.

UNIT V Testing Of Transformer & Polyphase Transformer **9**

OC and SC tests - Efficiency and Regulation- Vector groups, parallel operation - Auto transformers-comparison with two winding transformers- control transformer – audio frequency transformer – Poly-phase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ - Scott and open Δ Connection.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the concept and working of D.C. Generators and their characteristics.
CO2: Explain the construction and working principle of DC motors.
CO3: Various testing methods of DC machines.
CO4: Compute various performance characteristics of Single-phase transformer.
CO5: Understand the testing of Transformer and concept of Three phase transformers.

TEXT BOOKS:

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013(7th Edition).
2. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. Electrical Technology (Vol-II)- by B.L. Theraja and A.K. Theraja, S. Chand Publishing, 2022 (23rd Edition).

REFERENCE BOOKS:

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 5th Edition, 2020.
3. J.Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2017(5th Edition)

YouTube Resources:

1. https://nptel.ac.in/courses/108/102/108102146/
2. https://nptel.ac.in/courses/108/105/108105155/
3. https://nptel.ac.in/courses/108/105/108105017/
4. https://nptel.ac.in/courses/108/106/108106071/
5. https://www.youtube.com/watch?v=9hBmgdGjt1Y&pp=ygUuVGVzdGluZyBPZiBUcmFuc2Zvcm1lc iAmIFBvbHlwaGFzZSBUcmFuc2Zvcm1lcg%3D%3D

45 PERIODS

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator- calculation of critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test on DC motor – generator set.
8. Load test on single-phase transformer
9. Load test on three-phase transformer.
10. Open circuit and short circuit tests on single phase transformer.

30 PERIODS

TOTAL: 75 PERIODS

Course Code	Analog Integrated Circuits	L	T	P	C
EE4303		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To impart knowledge on the following topics
- Fabrication techniques of IC's
- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits
- Basic operations of regulator Circuits.

Course Description

This course covers fabrication techniques of ICs, signal analysis using Op-amp circuits, Op-amp applications, functional blocks, and applications of special ICs like timers and PLL circuits. Additionally, it includes basic operations of regulator circuits, providing essential knowledge in integrated circuit design and applications.

Prerequisites

- Familiarity with operational amplifiers (Op-amps) and their basic properties
- Basic knowledge of analog and digital electronics fundamentals.

UNIT I IC Fabrication **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, Diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II Characteristics of Op-amp **9**

Ideal OP-AMP characteristics, Basic applications of op-amp–Inverting, Non-inverting amplifier, summer, Subtractor, differentiator and Integrator-V/I & I/V converters. DC characteristics, AC characteristics, frequency response of OP-AMP.

UNIT III Applications of Op-amp **9**

Instrumentation amplifier and its applications for transducer Bridge, Analog multiplier & Divider, single stage active filters, sallen key, Butterworth filter-comparators, multi vibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converters using OP-AMPs.

UNIT IV Special ICs **9**

Functional block, characteristics of 555 Timer and its PWM application-IC-566 voltage-controlled oscillator IC; 565–phase locked loop IC, AD633 Analog multiplier ICs.

UNIT V Application ICs **9**

AD623 Instrumentation Amplifier and its application as load cell weight measurement- IC voltage regulators –LM78XX; Fixed voltage regulators its application as Linear power supply -LM317, 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038

COURSE OUTCOMES:

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

- CO1: Explain monolithic IC fabrication process, fabrication of diodes, capacitance, resistance, FETs and PV Cell.
- CO2: Analyze the characteristics and basic applications (inverting/non-inverting amplifier, summer, differentiator, integrator, V/I and I/V converter) of Op-Amp.
- CO3: Explain circuit and applications of op-amp based instrumentation amplifier, log/antilog amplifier,analog multiplier /divider, active filters, comparators, waveform generators, A/D and D/A converters
- CO4: Explain Functional blocks, characteristics and applications of Timer, PLL, analog multiplier ICs.
- CO5: Explain the applications of ICs in Instrumentation amplifier, fixed and variable voltage regulator, SMPS and function generator.

TEXT BOOKS:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, Third Edition, 2011
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', , New Age, Fourth Edition, 2018.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, PHI 2021.

REFERENCES:

1. Fiore, "Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.
2. Floyd, Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2nd Edition, 2017.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill, 86 2016 – Fourth Edition.
6. Muhammad H. Rashid,' Microelectronic Circuits Analysis and Design' Cengage Learning, 2nd Edition, 2012.

YouTube Resources:

1. https://nptel.ac.in/courses/108/108/108108111/
2. https://nptel.ac.in/courses/117107094/
3. https://nptel.ac.in/courses/117103063/
4. https://www.coursera.org/specializations/semiconductor-devices
5. http://www.nptelvideos.in/2012/11/digital-integrated-circuits.html

45 PERIODS

LIST OF EXPERIMENTS

1. Timer IC application: Study of NE/SE 555 timer in A stability, Mono stability operation.
2. Application of Op-Amp: inverting and non-inverting amplifier, Adder, Comparator, Integrator and…Differentiator.
3. Voltage to frequency characteristics of NE/SE566IC.
4. Variability Voltage Regulator using ICLM317.

30 PERIODS

TOTAL: 75 PERIODS

Course Code	Microprocessor and Microcontroller	L	T	P	C
EE4304		3	0	2	4

COURSEOBJECTIVES:

The main objectives of this course are to:

- Tostudytheaddressingmodes&instructionsetof8085&8051
- To develop skills in simple program writing in assembly languages
- To introduce commonly used peripheral/interfacing ICs.
- To study and understand typical applications of micro-processors.
- To study and understand the typical applications of micro-controllers

Course Description

This course covers the addressing modes and instruction sets of 8085 and 8051 microprocessors, assembly language programming skills development, introduction to peripheral and interfacing ICs, and typical applications of both microprocessors and microcontrollers. Students gain practical knowledge essential for embedded systems development and applications.

Prerequisites

- Foundational understanding of digital electronics, including basic logic gates, flip-flops, and registers.

UNIT I Introduction to 8085 Architecture **9**

Functional block diagram – Memory interfacing–I/O ports and data transfer concepts – Timing Diagram–Interrupt structure.

UNIT II 8085 Instruction Set and Programming **9**

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing –Lookup table-Subroutine instructions, stack.

UNIT III Interfacing Basics and ICs **9**

Study of Architecture and programming of ICs: 8255- PPI, 8259-PIC, 8251-USART, 8279 -Keyboard display controller and 8254- Timer/Counter – Interfacing with 8085 -A/D and D/A converter interfacing.

UNIT IV Introduction To 8051 Microcontroller **9**

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer –I/O ports – Serial communication, Simple programming –keyboard and display interface –Temperature control system –stepper motor control - Usage of IDE for assembly language programming.

UNIT V Architecture Review of Arduino Uno Board **9**

Introduction-Interfacing of Digital Input (LED) and Output devices (Switch)-Interfacing of Current sensor and LCD, real time digital clock using arduino, Room Temperature Monitor & Visitor Counter, design of traffic light controller.

COURSEOUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

- CO1: Ability to write assembly language program for microprocessor and microcontroller
- CO2: Ability to design and implement interfacing of peripheral with microprocessor andmicrocontroller
- CO3: Ability to analyze, comprehend, design and simulate microprocessor- based systems used for control and monitoring.
- CO4: Ability to analyze, comprehend, design and simulate microcontroller- based systems used for control and monitoring.
- CO5: Ability to understand and appreciate advanced architecture evolving microprocessor field

TEXTBOOKS:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P)ltd., Mumbai, 6th Education, 2013.
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, Second Edition 2011.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The PIC Micro Controller and Embedded systems,2010.

REFERENCES:

1. Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.
2. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.
3. Mike Predko, "8051 Micro-controllers", McGraw Hill, 2009
4. Kenneth Ayala, 'The 8051 Microcontroller', Thomson, 3rd Edition 2004.

YouTube Resources:

1. https://nptel.ac.in/courses/108/105/108105102/
2. https://8085-simulator.en.softonic.com/
3. https://www.youtube.com/watch?v=VGNVFWheeI4&pp=ygUoQXJjaGl0ZWN0dXJlIFJldmlldyBPZiBBcmR1aW5vIFVubyBCb2FyZA%3D%3D
4. https://www.youtube.com/watch?v=RP2sWt_oAWo&list=PLgwJf8NK-2e5vHwmowy_kGtjq9Ih0FzwN
5. https://mcu-8051-ide.soft112.com/

45 PERIODS

LIST OF EXPERIMENTS

1. Simple arithmetic operations using 8085: Multi precision addition / subtraction /multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions using 8085.
3. Simple arithmetic operations with 8051: Multi precision addition / subtraction / multiplication/ division.
4. Programming with control instructions: Increment / Decrement, Ascending / Descending Order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions using 8051.

30 PERIODS
TOTAL:75 PERIODS

Course Code	OBJECT ORIENTED PROGRAMMING USING JAVA	L	T	P	C
CS4311		3	0	2	4

COURSEOBJECTIVES:

The main objectives of this course are to:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of inheritance and interfaces
- To know the principles and uses of packages
- To develop a java application with threads and Exceptions
- To design and builds simple Graphical User Interfaces

Course Description

This course covers object-oriented programming concepts and Java basics, principles of inheritance and interfaces, package principles and usage, developing Java applications with threads and exceptions, and designing simple graphical user interfaces. Students gain practical skills in Java programming for software development.

Prerequisites

- Basic understanding of programming concepts such as variables, data types, loops, and conditional statements.

UNIT I Introduction to OOP and Java Fundamentals **9**

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File- Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java– access specifiers - static members Data Types, Variables, Operators, Control Flow, Arrays

UNIT II Inheritance and Interfaces **9**

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces

UNIT III Methods and Packages **9**

Methods in Java – Predefined and User Defined Methods – Types of Defining Methods - Constructors – Types of Constructors – Constructor Over Loading - Introduction to Packages – Creating Packages – Importing Packages

UNIT IV Exception Handling and Multithreading **9**

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions– Multithreading – Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication,

UNIT V Event Driven Programming **9**

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images- Basics of event handling - event handlers -actions- mouse events - AWT event hierarchy- Introduction

to Swing – layout management - Swing Components – Text Fields, Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

COURSE OUTCOME:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: UnderstandObjectOrientedProgrammingconceptsandbasiccharacteristicsofJava

CO2: Know the principles of inheritance and interfaces

CO3: Know the principle sand uses of packages

CO4: Develop a java application with threads and Exceptions

CO5: Design and build simple Graphical User Interfaces

TEXTBOOKS

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES

1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.
3. Timothy Budd, "Understanding Object-oriented programming with Java", Updated edition, Pearson Education, 2000.

YouTube Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2. https://www.youtube.com/watch?v=SiBw7os_zI&pp=ygUpSW50cm9kdWN0aW9uIHRvIE9PUCBhbmQgSmF2YSBGdW5kYW1lbnRhbHM%3D
3. https://www.geeksforgeeks.org/java-program-to-use-exceptions-with-thread/
4. https://www.youtube.com/watch?v=3FkWddODLno&list=PLcAXS40ayh2dLLB5zEb7_n5K-zfdMUgMQ
5. https://www.geeksforgeeks.org/java-program-to-use-exceptions-with-thread/

45 PERIODS

LIST OF EXPERIMENTS

1. Class and object creation.
2. Method Overloading
3. Constructors
4. Overloading Constructors
5. Inheritance.
6. Exception handling.
7. Packages
8. Event-driven programming.
9. Mini project using java concepts.

30 PERIODS
TOTAL: 75 PERIODS

Course Code	Employability Enhancement Skills – III	L	T	P	C
ES4303	**Professional Communication and Teamwork Skills**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize students with various forms of communication.
- To develop effective team communication skills.
- To enhance stakeholder communication skills.
- To cultivate ethical communication practices.
- To explore digital communication tools and trends.

UNIT I **9**

Introduction to Communication - Verbal Communication Skills: - Written Communication Skills - Nonverbal Communication - Interpersonal Communication.

UNIT II **9**

Characteristics of Effective Teams - Team Building and Group Cohesion - Conflict Resolution - Decision Making in Teams - Cross-Cultural Communication.

UNIT III **9**

Stakeholder Communication - Presentation Skills - Effective Meetings - Feedback and Evaluation.

UNIT IV **9**

Professional Codes of Conduct - Integrity in Communication - Addressing Ethical Challenges - Analyzing real-world ethical communication dilemmas.

UNIT V **9**

Digital Communication Tools - Social Media and Networking - Emerging Trends in Communication.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Demonstrate proficiency in various forms of communication.
CO2: Exhibit strong team communication skills.
CO3: Display competence in stakeholder communication.
CO4: Apply ethical communication principles.
CO5: Utilize digital communication tools effectively.

TEXT BOOKS:

1. Sharon J. Gerson and Steven M. Gerson. "Technical Communication: Process and Product", Pearson, 2014
2. Karl A. Smith. “Teamwork and Project Management”, McGraw-Hill Education, 2013
3. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins. "Engineering Ethics: Concepts and Cases", Cengage Learning, 2012
4. Christoph Meinel and Harald Sack. "Digital Communication: Communication, Multimedia, Security", Springer, 2014.

REFERENCES:

1. Katherine L. Adams and Gloria J. Galanes. "Communicating in Groups: Applications and Skills", McGraw Hill Education, 2018
2. Lawrence Holpp. "Managing Teams: Strategies for Success", McGraw Hill, 1998.
3. Caroline Whitbeck (ed) "Ethics in Engineering Practice and Research", Cambridge University Press, 2011.

TOTAL: 30 PERIODS

Semester – IV

Course Code	Numerical Methods	L	T	P	C
MA4401	(Common to B.E - CIVIL, MECH, MCT, EEE, ECE, EC(ACT) and EE(VLSI))	3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

- CO1: Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- CO2: Appreciate the numerical techniques of interpolation and error approximations invarious intervals in real life situations.
- CO3: Apply the numerical techniques of differentiation and integration for engineeringproblems.
- CO4: Understand the knowledge of various techniques and methods for solving first andsecond order ordinary differential equations.
- CO5: Solve the partial and ordinary differential equations with initial and boundaryconditions by using certain techniques with engineering applications.

TEXTBOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014 47.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6 th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

Course Code	Transmission and Distribution	L	T	P	C
EE4401		3	0	0	3

CORSE OBJECTIVES:

The main objectives of this course are to:

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the types, construction of underground cables and methods to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC and HVDC

Course Description

This course examines the structure of electric power systems, computation of transmission line parameters, equivalent circuits, and voltage regulation. It covers mechanical design, voltage distribution in insulator strings, underground cable construction, and distribution systems including substations, grounding methods, and EHVAC/HVDC systems.

Prerequisites

- Basic electrical engineering principles, including circuit analysis, electromagnetic theory, and power systems fundamentals

UNIT I Transmission Line Parameters **9**

Basic concepts of Electrical power generation-AC and DC transmission concepts-Models and performance of transmission lines and cables-Economic load dispatch(with and without considering transmission losses)-Structure of Power System –Series and shunt compensation- Resistance, Inductance and Capacitance of single and three phase transmission lines with symmetrical, unsymmetrical spacing and transposition for single and double circuits -Stranded and bundled conductors – Skin and proximity effects.

UNIT II Modelling and Performance of Transmission Lines **9**

Classification of Transmission Lines – Equivalent Circuits, Phasor Diagram, Voltage Regulation and Transmission Efficiency of Short, Medium and Long Transmission Lines - End Condenser Method - Nominal T Method and Nominal π Method – Formation of Corona – Critical Voltages.

UNIT III Mechanical Design of oh Lines and Insulators **9**

Mechanical design of overhead transmission lines – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, Voltage distribution in insulator string and string efficiency, Electric field distribution- Methods of improvement of string efficiency.

UNIT IV Under Ground Cables **9**

Underground cables- Comparison between overhead line and underground cables - Types of Cables – Construction of single core and 3 core Cable - Insulation Resistance – Potential Gradient - Capacitance of Single core and 3 core cables- Grading of cables.

UNITV DISTRIBUTION SYSTEMS AND HV TRANSMISSION **9**

Distribution Systems – Types of distribution system - Voltage Control and Power factor improvement methods – Types of Substations - Methods of Grounding – HVDC transmission system and types – Comparison between HVDC and EHVAC Transmission system.

COURSE OUTCOMES:

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

CO1: Understand the importance and the functioning of transmission line parameters.
CO2: Acquire knowledge on the modelling and performance of Transmission lines.
CO3: Understand the concepts mechanical design of Lines and Insulators.
CO4: Acquire knowledge on Underground Cables
CO5: Understand the importance of distribution of the electric power in power system.

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.
3. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.

REFERENCES

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
2. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. Arun Ingole, "power transmission and distribution" Pearson Education, 2017
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
6. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013

YouTube Resources:

2. https://archive.nptel.ac.in/courses/108/102/108102047/
3. https://www.coursera.org/lecture/electric-powersystems/transmission-subtransmission-imo4x
4. https://www.electrical4u.com/transmission-line-in-power-system
5. https://www.electricaleasy.com/2017/03/underground-powercables.html
6. https://www.eeeguide.com/insulating-materials-for-undergroundcables

TOTAL:45 PERIODS

Course Code	Advanced Data Base Management Systems	L	T	P	C
CS4411		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To learn the fundamentals of data models, relational algebra and SQL
- To represent a database system using ER diagrams and to learn normalization techniques
- To understand the fundamental concepts of transaction, concurrency and recovery Processing
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
- To have an introductory knowledge about the Distributed databases, NOSQL and database security.

Course Description

This course provides a comprehensive overview of database management systems (DBMS), covering fundamental concepts, relational databases, database design, transactions, implementation techniques, and advanced topics. Students will gain a deep understanding of database systems architecture, relational model, SQL fundamentals, database design principles, transaction management, implementation techniques such as indexing and hashing, and advanced topics including distributed databases, NoSQL databases, and database security.

Prerequisites

- Basic understanding of computer science fundamentals
- Familiarity with data structures and algorithms
- Knowledge of programming concepts, preferably in a language like Python or Java

UNIT I Relational Databases **9**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II Database Design **9**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III Transactions **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multi version – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm

UNIT IV Implementation Techniques **9**

RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics – Cost Estimation.

UNIT V Advanced Topics **9**

Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues –Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Construct SQL Queries using relational algebra
CO2: Design database using ER model and normalize the database
CO3: Construct queries to handle transaction processing and maintain consistency of the Database
CO4: Compare and contrast various indexing strategies and apply the knowledge to tune the performance of the database
CO5: Appraise how advanced databases differ from Relational Databases and find a suitable database for the given requirement.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

YouTube Resources:

1. https://youtu.be/OqjJjpjDRLc?si=3qJgPs5XUoKbqjCi
2. https://youtu.be/s57648-bbOs?si=AURtbrEgknFNHXKg
3. https://youtu.be/lJvkIgFT3dY?si=FicSqdSc6FZ9jaUn
4. https://youtu.be/_RbsFXWRZ10?si=RNu19XWxFonaeZbo
5. https://youtu.be/NNjUhvvwOrk?si=XixN-_fzPwU7t_j-

TOTAL: 45 PERIODS

Course Code	Synchronous and Induction Machines	L	T	P	C
EE4403		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the concept of Synchronous Generator and their characteristics
- To understand the concepts of Synchronous motor.
- To understand and study the performance of Three Phase Induction motor
- To understand and study the speed control of Three phase induction motor
- To understand the performance characteristics of Single-phase motors and Special machines.

Course Description

This course provides an overview of synchronous generators and motors, including their characteristics and performance analysis. Additionally, it covers the principles of three-phase induction motors, including performance evaluation and speed control methods. Furthermore, it includes the study of single-phase motors and special machines' performance characteristics.

Prerequisites

- Basic understanding of electrical engineering principles, including circuit theory and electromagnetism

UNIT I Synchronous Generator **9**

Constructional Features of Alternators-Cylindrical and salient pole machines-Performance Characteristics–Different types of winding– E.M.F Equation. –Synchronization of alternators–synchronizing power, torque – Regulation by EMF, M.M.F methods –Parallel operation of Geneartors-Experimental determination of Xd and Xq (Slip test) – Regulation of salient pole alternators

UNIT II SYNCHRONOUS MOTORS **9**

Theory of operation – Starting of synchronous motor-Types of losses and efficiency calculation of electrical machines-Synchronous motor with different excitations – synchronous condenser – power developed by a Synchronous Motor– Torque- hunting and its suppression – Methods of starting – V and Inverted V curves.

UNIT III Three Phase induction motor **9**

Principle of operation – Types of rotors-Performance – Slip –cogging and crawling- Equivalent circuit – Torque-Slip and Torque speed characteristics – No load and blocked rotor Test-Equivalent circuit-Condition for maximum torque – Losses and efficiency – Circle diagram – Separation of losses. starting – Types of starters.

UNIT IV Speed Control of Three Phase Induction Motor **9**

Starting and Speed control – Voltage control, Frequency control and pole changing –V/f control – Slip power recovery scheme: scherbius system, Kramer system - Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking-

UNIT V Single Phase Motors & Special Machines **9**

Single phase Motors: Single phase induction motor – split-phase motors - Capacitor start-run motors. Principles of A.C. Series motor - Universal motor, shaded pole motor, (Qualitative Treatment only)- Linear Induction Motor- Concept of Magnetic Levitation.

COURSE OUTCOME

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Construction, Operation of Synchronous Generator and their characteristics, regulation parallel operation.
CO2: Construction and working of Synchronous motor and their characteristics
CO3: Construction and working of Three phase induction motor and their characteristics
CO4: Speed control methods of Three Phase induction motor.
CO5: Characteristics of single-phase motors and special machines

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 5th Edition, 2020.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2017. (5th Edition)
3. Electrical Technology (Vol-II)- by B.L. Theraja and A.K. Theraja, S. Chand.Publishing 2022 (23rd Edition).

REFERENCE BOOKS:

1. Electromachanics - III (Synchronous and Single-Phase machines), S. Kamakashiah, Right Publishers.
2. Performance and Design of AC Machines, MG. Say, 2002, BPB Publishers.
3. Theory of Alternating Current Machinery, Langsdorf, Tata McGraw-Hill Companies, 1984.
4. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013(7th Edition)

YouTube Resources:

1. https://nptel.ac.in/courses/108/105/108105131/
2. https://nptel.ac.in/courses/108/106/108106072/
3. https://www.youtube.com/watch?v=Hn3FkCOPuos&list=PLPpCFgQP7QKHog5-n3DFqSxLI_LP-BvXP
4. https://www.youtube.com/watch?v=cuwSCutTHEI&pp=ygUbVGhyZWUgUGhhc2UgaW5kdWN0aW9uIG1vdG9y
5. https://www.youtube.com/watch?v=awrUxv7B-a8&pp=ygUmU2luZ2xlIFBoYXNlIE1vdG9ycyAmIFNwZWNpYWwgTWFjaGluZXM%3D

45 PERIODS

LIST OF EXPERIMENTS:

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase salient pole alternator by slip test.
3. V and Inverted V curves of Three Phase Synchronous Motor.
4. Load test on three-phase induction motor.

5. Load test on single-phase induction motor.
6. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
7. No load and blocked rotor test on single-phase induction motor.

30 PERIODS

TOTAL: 75 PERIODS

Course Code	Control Systems Engineering	L	T	P	C
EE4404		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To make the students to familiarize with various representations of systems.
- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To make the students to design compensator based on the time and frequency domain specifications.
- To develop linear models: mainly state variable model and Transfer function model.

Course Description

This course familiarizes students with system representations, stability analysis in both time and frequency domains, and compensator design based on domain specifications. It emphasizes developing state variable and transfer function models for linear systems, providing a comprehensive understanding of system dynamics and control design principles.

Prerequisites

- Solid foundation in mathematics, particularly in calculus, linear algebra, and differential equations

UNIT I Modelling of Linear Time Invariant system (LTIV) 9

Control system: Open loop and Closed loop – Feedback control system characteristics –Mathematical modelling and Representation of systems-Feedback principles: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph-Transient and steady state analysis of linear time invariant systems.

UNITII Time domain analysis 9

Standard test inputs – Time response – Time domain specifications – Stability analysis: Concept of stability –Stability analysis using Routh Hurwitz stability criterion.

UNIT III Stability Analysis of Frequency Domain and Time Domain 9

Frequency domain specifications Introduction to closed loop Frequency Response Bode plot, Polar plot and Nyquist plot, Root locus Bode plot, Polar plot and Nyquist plot, Root locus

UNIT IV Design of Feed Back Control System 9

Design specifications – Lead, Lag and Lag-lead compensators using Bode plot -Effect of adding lag and lead compensators–P, PI and PID controllers - Design using reaction curve and Ziegler-Nichols technique, Introduction of Adaptive Schemes – The adaptive Control Problem – Applications

UNIT V State Variable Analysis 9

State variable formulation – Non-uniqueness of state space model –solution of state equations of LTI Systems- State transition matrix –Eigen values – Eigen vectors - Free and forced responses for Time Invariant and Time Varying Systems – Controllability – Observability. Linear versus nonlinear systems

- Describing function analysis: Fundamentals, common nonlinearities (saturation, dead - zone, on - off non - linearity, backlash, hysteresis) and their describing functions.

COURSE OUTCOMES:

OUTCOMES: Upon the successful completion of the course, students will be able to:
CO1: Represent Simple Systems in Transfer Function and State Variable Forms.
CO2: Analyze Simple Systems in Time Domain.
CO3: Analyze Simple Systems in Frequency Domain.
CO4: Infer the Stability of Systems in Time and Frequency Domain.
CO5: Interpret Characteristics of The System and Find Out Solution for Simple Control problems.

TEXT BOOKS:

1. Benjamin C. Kuo, "Automatic Control Systems", 7th edition PHI Learning Private Ltd, 2010.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Educaon Pearson, 3 Impression 2009.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System analysis andDesign with MATLAB", CRC Taylor& Francis Reprint 2009.
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5thEdition, 2010

YouTube Resources:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/107106081/
3. https://www.tutorialspoint.com/control_systems/index.htm.
4. https://freevideolectures.com/course/5301/dynamics-and-control
5. https://www.youtube.com/watch?v=PGW2laCpvJ0&list=PLgwJf8NK-2e6zb5ztH0FEnYHKj1HqQxQC

45 PERIODS

LIST OF EXPERIMENTS:

1. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform.
2. Root Locus based analysis in simulation platform.
3. Determination of transfer function of a physical system using frequency response and Bode's asymptotes.
4. Design of Lag, lead compensators and evaluation of closed loop performance.
5. Design of PID controllers and evaluation of closed loop performance.
6. Discretization of continuous system and effect of sampling.
7. Test of controllability and observability in continuous and discrete domain in simulation platform.
8. State feedback and state observer design and evaluation of closed loop performance.

30 PERI0DS
TOTAL:75 PERIODS

Course Code	Power Electronics	L	T	P	C
EE4405		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To learn different types of power semiconductor devices, operation, and characteristics
- To impart knowledge on performance parameters of controlled rectifiers
- To know the operation, switching techniques and basic topologies of chopper switching regulators
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study various AC- AC converters such as AC Voltage controller, Cyclo-converter and Matrix converter.

Course Description

This course covers power semiconductor devices, their characteristics, and operation. It includes performance parameters of controlled rectifiers, chopper switching regulator operation, and modulation techniques for pulse width modulated inverters. Additionally, it examines harmonic reduction methods and various AC-AC converters like AC voltage controllers, cyclo-converters, and matrix converters.

Prerequisites

- Strong foundation in electrical engineering principles, particularly in circuit analysis, power electronics, and semiconductor devices

UNIT I Power Semiconductor Devices **9**

Study of switching devices - SCR, TRIAC, GTO, IGBT and MOSFET – Static VI Characteristics and firing circuits of thyristor – SCR, MOSFET and IGBT - Triggering, commutation and snubber circuits for SCR - Introduction to driver circuits.

UNIT II Phase-Controlled Converters **9**

2-pulse, 3-pulse and 6-pulse converters – Performance parameters - Effect of source inductance - Dual converters - Applications- Light dimmer system.

UNIT III DC TO DC Converters **9**

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulators - Applications-Battery operated vehicles-Single and three phase configuration of Uncontrolled Rectifiers-Voltage and current commutated thyristor based converters-Bidirectional AC –DC Voltage source converters- Magnitude and phase of Line current Harmonics for Uncontrolled and Thyristor based converters-Power factor and distortion factor of AC-DC Converters.

UNIT IV Inverters **9**

Single phase and three phase voltage and current source inverters (both 120-degree mode and 180-degree mode) –Voltage & harmonic control - PWM techniques: Multiple PWM, Sinusoidal PWM, Modified Sinusoidal PWM – Current source inverter, Applications - Induction heating, UPS.

UNIT V AC TO AC Converters **9**

Single phase and Three phase AC voltage controllers – Control strategy – Multistage sequence control - single phase and three phase cyclo-converters – Introduction to Matrix converters, Applications – welding.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to outline the operation of 2, 3, and 6 pulse converters with performance parameters.
CO2: To be able to illustrate the operation of Buck, Boost, Buck-Boost Regulators, and Battery-Operated vehicles.
CO3: To be able to interpret the single and three phase voltage source inverter and current source inverters
CO4: To be able to outline the construction and operating principle of AC voltage controllers, Cyclo-converter and Matrix converter

TEXT BOOKS:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, New Delhi, 4th Edition, 2017.
2. P. S. Bimbhra, 'Power Electronics', Khanna Publishers, New Delhi, 6thEdition,2018.

REFERENCES:

1. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint,2003.
2. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. Ned Mohan, Tore M. Undel, William P. Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and sons Publication, 3rd Edition, 2010.
5. M. D. Singh and K. B. Khachandani, "Power Electronics", McGraw-Hill Education, 2nd Edition, 2017.

YouTube Resources:

1. https://nptel.ac.in/courses/108/105/108105066/#
2. https://www.sciencedirect.com/topics/materials-science/powerelectronics
3. https://www.coursera.org/specializations/power-electronics
4. https://www.youtube.com/watch?v=bjhtYVGFhH4&list=PL-6f7zOCOoBVaKowRn0ADwQPsba8s8I9n
5. https://www.youtube.com/watch?v=yZU3dX7aj2I&pp=ygUTREMgVE8gREMgQ29udmVydGVycw%3D%3D

45 PERIODS

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC
2. Characteristics of MOSFET and IGBT.
3. AC to DC half and fully controlled converter
4. Step down and Step up MOSFET based choppers
5. Simulation of 1Φ converters with R load.
6. Simulation of 3Φ converters with R load.

30 PERIODS

TOTAL:75 PERIODS

Course Code	Employability Enhancement Skills – IV	L	T	P	C
ES4404	**Leadership and Project Management Skills**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand leadership within the context of project management.
- To differentiate between leadership and management roles.
- To learn project initiation processes and setting SMART objectives.
- To build high-performing teams through motivation, empowerment, and effective communication.
- To develop skills in project planning, estimation, resource allocation, risk management, and scheduling.

UNIT I Introduction to Project Management 9

Understanding Leadership - Introduction to Project Management - Leadership vs. Management - Project Initiation - Setting SMART Objectives.

UNIT II Empowering Team Members 9

Building High-Performing Teams - Motivation Theories - Empowering Team Members - Leadership Communication - Handling Team Conflicts.

UNIT III Estimation Techniques 9

Work Breakdown Structure (WBS) - Estimation Techniques - Gantt Charts and Network Diagrams - Resource Allocation - Risk Management.

UNIT IV Quality Management 9

Leading Project Teams - Monitoring and Controlling Progress - Change Management - Quality Management - Stakeholder Communication.

UNIT V Transition Planning. 9

Project Closure Activities - Lessons Learned - Celebrating Success - Transition Planning.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Apply leadership principles to project management scenarios.
CO2: Distinguish between leadership and management functions in project environments.
CO3: Initiate projects effectively by setting SMART objectives.
CO4: Foster high-performing teams through motivation, empowerment, and conflict resolution.
CO5: Proficiently plan, schedule, and manage project activities, resources, risks, and stakeholder communications.

TEXT BOOKS:

1. Peter G. Northouse. "Leadership: Theory and Practice", SAGE Publications, 2021
2. Patrick Lencioni. "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 2011
3. Robert K. Wysocki. "Effective Project Management: Traditional, Agile, Extreme", Wiley, 2019
4. Clifford F. Gray and Erik W. Larson. "Project Management: The Managerial Process", McGraw-Hill Education, 2017
5. Harold Kerzner. "Project Management Case Studies", Wiley, 2008.

REFERENCES:

1. Harold Kerzner. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 10th edition, Wiley, 2009
2. Gregory P. Shea and Cassie A. Solomon. "Leading Successful Change: 8 Keys to Making Change Work", Gildan Media, LLC, 2013.

TOTAL: 30 PERIODS

Course Code	NCC Credit Course Level 2 NAVAL WING	L	T	P	C
		2	0	0	2

UNIT I NCC General **6**

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness **4**

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development **7**

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership **5**

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development **8**

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 PERIODS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs c) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) d) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs c) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) d) Appeared for C Certificate Exam

SEMESTER V

Course Code	Embedded System Design	L	T	P	C
EE4501		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the Building Blocks of an embedded System and Software Tools
- To emphasize the role of Input/output interfacing with Bus Communication protocol
- To illustrate the ISR and scheduling for the multitasking process
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches.

Course Description

This course provides a comprehensive introduction to embedded systems, focusing on both hardware and software aspects. It covers fundamental concepts such as structural units in embedded processors, selection of processors and memory devices, memory management methods, timer and counting devices, real-time clock, and debugging techniques. Additionally, the course delves into embedded networking, including I/O device ports, buses, and serial communication protocols such as RS232, RS485, CAN Bus, Serial Peripheral Interface (SPI), and Inter-Integrated Circuits (I2C).

Prerequisites

- Basic Understanding of computer architecture and digital systems.
- Some knowledge of microprocessors and embedded systems would be beneficial.

UNITI introduction to Embedded systems **9**

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT II Embedded Networking **9**

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS485– CAN Bus- Serial Peripheral Interface (SPI) –Inter Integrated Circuits (I2C).

UNIT III Interrupts the Service Mechanism and Device driver **9**

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.

UNIT IV RTOS-Based Embedded System Design **9**

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing- Inter process Communication- Introduction to process synchronization using semaphores.

UNIT V Embedded System Application Development **9**

Embedded Product Development Life Cycle – Case Study: Precision Agriculture –Autonomous car.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: The hardware functionals and software strategies required to develop various Embedded systems
CO2: The basic differences between various Bus communication standards
CO3: The incorporation of the interface as Interrupt services
CO4: The various scheduling algorithms through a Real-time operating system.
CO5: The various embedded concepts for developing automation applications.

TEXT BOOKS:

1. Rajkamal, 'Embedded System-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017
2. Peckol, "Embedded system Design", JohnWiley&Sons,2010.

REFERENCES:

1. Robert L. Silberschatz, Galvin, Gagne" Operating System Concepts,6th ed, John Wiley,2003
2. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill,1997
3. RajKamal, "Embedded Systems-Architecture, Programming and Design" Tata McGraw Hill,2006.
4. Karim Yaghmour, Building Embedded Linux System", O'reillyPub,2003
5. Mukesh Sighal and NGShi "Advanced Conceptsin Operating System", McGraw Hill,2000.

YouTube Resources:

1. https://youtu.be/0fSqoVwBj60?si=NwNo6KwrQ-19FR27
2. https://youtu.be/0xgvINDxXJI?si=V6dlUgG91kURGsEK
3. https://youtu.be/y9RAhEfLfJs?si=zP_N7ANg6IDwJumx
4. https://youtu.be/uFhDGagZzjs?si=-dM0uOdi_Uw7x6l1
5. https://youtu.be/TP1_F3IVjBc?si=2St-Wc73Aog6saRc

TOTAL: 45 PERIODS

Course Code	Special Electrical Machines	L	T	P	C
EE4502		3	0	2	4

COURSE OBJECTIVES:

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor

Course Description

"Special Electrical Machines" explores advanced designs and applications beyond conventional motors and generators, including synchronous reluctance, switched reluctance, and permanent magnet machines. Topics include design principles, control strategies, and integration into modern power systems for specialized industrial and automotive applications.

Prerequisites

Prerequisites encompass fundamentals of electrical engineering, including knowledge of electromagnetic theory, machine design, power electronics, and control systems, as well as proficiency in mathematical modeling and analysis techniques.

UNIT I STEPPER MOTORS 9

Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control –Applications

UNIT II SWITCHED RELUCTANCE MOTORS 9

Principle of operation- Torque prediction–Characteristics- Control of SRM drive- Sensor less operation of SRM – Current sensing-rotor position measurement and estimation methods- sensor less rotor position estimation-inductance based estimation –applications.

UNIT III PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics- Controller design -Transfer function –Machine, Load and Inverter-Current and Speed Controller.

UNIT IV PERMANENT MAGNET SYNCHROUNOUS MOTORS 9

Permanent Magnet ac Machines, PMSM - Principle of operation – EMF and Torque equations - Phasor diagram - Torque speed characteristics –constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES 9

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.

45 PERIODS

Using MATLAB software
LAB COMPONENT:

1) Simulation of BLDC motor
2) Simulation of SRM motor
3) Simulation of stepper motor
4) Simulation of PMSM motor
5) Simulation of any other special machines

30 PERIODS

COURSE OUTCOMES:

CO1 Ability to model and analyze power electronic systems and equipment using computational software.
CO2 Ability to optimally design magnetics required in special machines -based drive systemsusing MATLAB software tools.
CO3 Ability to analyse the dynamic performance of special electrical machines
CO4 Ability to understand the operation and characteristics of other special electrical machines.
CO5 Ability to design and conduct experiments towards research.

TEXT BOOKS:

1. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi,
2. 2000 Dekker 2009
3. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London, 1989Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.

REFERENCES:

1. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives:fundamentals to applications-CRC 2019.
2. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, MarcelApplications -CRC Press 2009
3. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, andApplications -CRC Press 2017.

YouTube Resources:

1. https://youtu.be/Nn1V9KLrtX4?si=ECY5z9ltATr87Ctq
2. https://youtu.be/zvbUJdPuapY?si=riOqgQGubO-Um4lN
3. https://youtu.be/Nn1V9KLrtX4?si=66Rjes5oSyLtJ1Eg
4. https://youtu.be/lBoyZI7E2Qc?si=W4Vj6D0qWxB6Q7aJ
5. https://youtu.be/lBoyZI7E2Qc?si=-Eu-oZgKTjhp3r71

TOTAL: 45+30 = 75 PERIODS

Course Code	Power System Analysis	L	T	P	C
EE4503		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

1. Impact knowledge on need for operational studies, and to model the power system under steady state operating condition.
2. To understand and apply iterative techniques for power flow analysis.
3. To model of carry out short circuit studies for power system during symmetrical fault.
4. To model of carry out short circuit – studies during
5. To study about the various methods for analyzing power system stability

Course Description

This course introduces the necessity of operational studies and modeling of power systems under steady-state conditions. It covers iterative techniques for power flow analysis, short-circuit studies for symmetrical faults, and methods for analyzing power system stability, providing a comprehensive understanding of power system modeling and analysis.

Prerequisites

- Strong foundation in electrical engineering fundamentals, knowledge of power system analysis techniques, proficiency in mathematical modeling, and understanding of circuit theory.

UNIT I Power System **9**

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix.

UNIT II Power Flow Analysis **9**

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage and frequency-controlled buses-Power factor correction-Power Flow Solution by Newton Raphson method **–** Flow charts – Comparison of methods.

UNIT III Symmetrical Fault Analysis **9**

Symmetrical components-Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix.

UNIT IV Unsymmetrical Fault Analysis **9**

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

UNIT V Stability Analysis **9**

Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Solution of swing equation by step by step method - Swing curve, Equal area criterion - Critical clearing angle.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Ability to model the power system under steady state operating condition.
CO2: Ability to carry out power flow analysis using.
CO3: Ability to infer the significance of short circuit studies in designing circuit breakers.
CO4: Ability to analyze the state of the power system for various unsymmetrical faults.
CO5: Ability to analyze the stability of power system using different methods.

TEXTBOOKS:

1. Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 2nd edition, 2017.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 3rd edition, 2013.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Fourth Edition, 2018.

REFERENCE BOOKS:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw– Hill Education Second Edition, Reprint 2018.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint, 2015.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi,12th reprint, 2015.

YouTube Resources:

1. https://nptel.ac.in/courses/111/106/111106135/
2. https://nptel.ac.in/courses/111/103/111103021/
3. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring2011/lecture-notes/
4. https://www.khanacademy.org/math/linear-algebra
5. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebraspring-2010/video-lectures/

45 PERIODS

LIST OF EXPERIMENTS:

1. Formation of Bus Admittance and Impedance Matrices.
2. Power Flow Analysis Using Gauss-Seidel Method.
3. Power Flow Analysis Using Newton Raphson Method.
4. Symmetric and Unsymmetrical Fault Analysis.
5. Transient Stability Analysis of SMIB System.
6. Computation and modelling of transmission Lines.

30 PERIODS
TOTAL: 75 PERIODS

Course Code	Employability Enhancement Skills – V	L	T	P	C
ES4505	**Innovation and Entrepreneurship**	0	0	2	1

Course Objectives:

- To understand the fundamentals of entrepreneurship and innovation.
- To explore the components of an innovation ecosystem.
- To learn the principles of the Lean Startup methodology and its application.
- To develop skills in identifying entrepreneurial opportunities.
- To cultivate creativity and ideation techniques for innovation

Unit 1: Understanding Innovation - Entrepreneurship Fundamentals - Innovation Ecosystem - The Lean Startup Methodology - Identifying Opportunities

Unit 2: Creativity and Ideation Techniques - Market Research and Validation - Customer Discovery - Prototype Development

Unit 3: Business Model Canvas - Revenue Models - Customer Acquisition and Retention - Pricing Strategies - Scalability and Growth

Unit 4: Financial Planning - Funding Options - Pitching Investors - Valuation Method - Financial Management

Unit 5: Go-to-Market Strategy - Building a Team - Scaling Operations - Managing Growth - Exit Strategies

Course Outcomes:

At the end of the course, students will be able to
CO1: Demonstrate an understanding of entrepreneurship fundamentals and innovation principles.
CO2: Analyze and navigate innovation ecosystems.
CO3: Apply Lean Startup methodology to validate and iterate business ideas.
CO4: Identify and evaluate entrepreneurial opportunities effectively.
CO5: Generate creative ideas, conduct market research, validate concepts, and develop prototypes for entrepreneurial ventures.

Textbooks

1. Eric Ries. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Random Housey, 2011
2. Alexander Osterwalder and Yves Pigneur. "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley, 2010
3. Karen Berman and Joe Knight. "Financial Intelligence for Entrepreneurs: What You Really Need to Know About the Numbers" Harvard Business Review Press, 2008

References

1. Clayton M. Christensen. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail", Harvard Business Review Press, 2013
2. Steve Blank and Bob Dorf. "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company" Wiley, 2020
3. Peter Thiel and Blake Masters. "Zero to One: Notes on Startups, or How to Build the Future" Virgin Digital, 2014

Semester VI

Course Code	High Voltage Engineering	L	T	P	C
EE4601		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

Course Description:

This course provides a comprehensive understanding of high voltage phenomena, their generation, measurement, and testing in electrical power systems. Topics covered include over voltages, dielectric breakdown, generation of high voltages and currents, measurement techniques, and insulation coordination. Practical aspects of protection against over voltages and testing of electrical apparatus are emphasized.

Prerequisites:

- Basic knowledge of electrical circuits and principles
- Familiarity with electromagnetism
- Understanding of electric power systems
- Knowledge of circuit theory and analysis

UNITI Over Voltages in Electrical Power System **9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects –- Protection against over voltages.

UNITII Dielectric Breakdown **9**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

UNITIII Generation of High Voltages and High Currents **9**

Generation of High DC voltage: Rectifiers, voltage multipliers, vandi graff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil-generation of switching surges – generation of impulse currents - Triggering and control of impulse generators.

UNITIV Measurement of High Voltages and High Currents **9**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNITV High Voltage Testing & Insulation Coordination 9

High voltage testing of electrical power apparatus as per International and Indian standards- Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination & testing of cables.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Ability to understand Transients in power system.
CO2: Ability to understand Generation and measurement of high voltage.
CO3: Ability to understand High voltage testing.
CO4: Ability to understand various types of over voltages in power system.
CO5: Ability to measure over voltages.

TEXTBOOKS:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

REFERENCES

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

YOUTUBE RESOURCES:

1. https://youtu.be/XlT6HIxPCbk?si=vtcSsi9fTWQ5x4tE
2. https://youtu.be/2O6aPrO5Iw4?si=f0XPi9AZv7_1ePsG
3. https://youtu.be/_4QM4bVSjfk?si=P5GYsQNR1iHYRdP4
4. https://youtu.be/cjzqDX2oWXY?si=sXJHPfLi28e369Dz
5. https://youtu.be/cjzqDX2oWXY?si=zgROnemsIcJtx7Xg

TOTAL: 45 PERIODS

Course Code	Protection and Switchgear	L	T	P	C
EE4602		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To impart knowledge on causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system
- To impart knowledge on characteristics and operations of different types of relays
- To learn the different apparatus protection, static and numerical relays
- To impact knowledge on operation of circuit breaker and different types of circuit breaker

Course Description

This course covers the causes of abnormal operating conditions (faults, lightning, and switching surges) in electrical systems, characteristics and operations of various relays, including static and numerical types, apparatus protection techniques, and the operation of different types of circuit breakers.

Prerequisites

- Basic understanding of electrical engineering principles, familiarity with circuit analysis, and knowledge of electrical components

UNIT I Protection Schemes **9**

Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme

UNIT II Electromagnetic Relays **9**

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays –Principle of overcurrent- Overcurrent, Directional, Distance protection, Differential, Negative sequence and Under frequency relays

UNIT III Apparatus Protection **9**

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line

UNIT IV Static Relays and Numerical Protection **9**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines

UNIT V High Performance Computing For Smart Grid **9**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers –System stability concepts, Equal area criterion- comparison of different circuit breakers – Rating and selection of Circuit breakers

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

- CO1: To be able to understand the nature and causes of faults, the need for power system protectionand essential qualities of protection
- CO2: To be able to outline the construction, operating principle, characteristics and applications of different types of protective relays.
- CO3: To be able to Illustrate the protection scheme for various power system apparatus transformer,generator, motor, bus bars and transmission line.
- CO4: To be able to get idea of numerical relay for Over current protection, transformer differentialprotection, distant protection of transmission lines
- CO5: To be able to outline the construction and operating principle of different types of circuit breaker

TEXT BOOKS:

1. Sunil S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, 2021.
2. B.Ravindranath and N.Chander, "Power System Protection and Switchgear", New Age International Pvt. Ltd., First Edition 2018.

REFERENCES:

1. BadriRam, B.H. Vishwakarma, "Power System Protection and Switchgear", New Age International Pvt Ltd Publishers, Second Edition 2017.
2. Y.G.Paithankar and S.R.Bhide, "Fundamentals of power system protection", Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
3. C.L.Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Ltd., 2010.
4. Ravindra P.Singh, "Switchgear and Power System Protection", PHI Learning Private Ltd.,New Delhi, 2009.
5. VK Metha, "Principles of Power Systems", S. Chand, 2005.

YouTube Resources:

1. https://nptel.ac.in/courses/108101039/#
2. https://www.coursera.org/lecture/electric-power-systems/systemdesign- switching-circuit-breakers-0MMaF
3. https://www.youtube.com/watch?v=A8JRydvIbXo
4. https://www.youtube.com/watch?v=udifI173vvs
5. https://www.youtube.com/watch?v=0yfyWiuvwXw

TOTAL:45 PERIODS

Course Code	Power System Operation and Control	L	T	P	C
EE4603		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- The significance of power system operation and control.
- Real power– frequency interaction and design of power– frequency controller.
- Reactive power– voltage interaction and the compensators for maintaining the voltage profile.
- The generation scheduling and economic operation of power system.
- SCADA and its application for real time operation and control of power systems.

Course Description:

This course provides an in-depth understanding of the operation and control of power systems, focusing on real and reactive power control, economic operation, and computer-aided control techniques. Topics covered include the power scenario in the Indian grid, load dispatching centers, voltage and frequency regulation, load forecasting, real power-frequency control, reactive power-voltage control, economic dispatch, and computer-aided control systems.

Prerequisites:

- Basic knowledge of electrical circuits and power systems
- Understanding of control theory and feedback systems
- Familiarity with mathematical modeling and analysis
- Knowledge of energy conversion processes and transmission systems

UNIT I Introduction **9**

Power scenario in Indian grid – National and Regional load dispatching centres – Requirements of good power system – Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - System load variation, load curves – Load forecasting – Computational methods in load forecasting.

UNIT II Real Power Frequency Control **9**

Basics of speed governing mechanisms and modelling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis – LFC of two area system –Tie line modelling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control – State variable model.

UNIT III Reactive Power – Voltage Control **9**

Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brushless AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Voltage drop in transmission line – Methods of reactive power injection – Tap changing transformer, SVC and STATCOM for voltage control.

UNIT IV Economic Operation of Power System **9**

Statement of economic dispatch problem – Input and output characteristics of thermal plant incremental cost curve – Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients). Statement of Unit Commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list – Special aspects of short term and long-term hydrothermal scheduling problems.

UNIT V Computer Aided Control of Power System **9**

Need of computer control of power system – Concept of energy control centers and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation – Various operating states – State transition diagram.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the day – to – day operation of power system.
CO2: Model and analyze the control actions that are implemented to meet the minute-to minute variation of system real power demand.
CO3: Model and analyze the compensators for reactive power control and various devices used for voltage control.
CO4: Prepare day ahead and real time economic generation scheduling.
CO5: Understand the necessity of computer control of power systems.

TEXTBOOKS:

1. Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 2nd edition, 2017.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 3rd edition, 2013.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Fourth Edition, 2018.

REFERENCE BOOKS:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw– Hill Education, Second Edition, Reprint 2018.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint, 2015.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi,12th reprint, 2015.
4. B.M. Weedy, B.J. Cory et al, 'Electric Power systems', Wiley, Fifth Edition, 2012.

YouTube Resources:

1. https://youtu.be/UeaTgT2p-WI?si=Vn3uo3iOGDdLBioS
2. https://youtu.be/1KHLiXSjOTU?si=cpEopag0P5Xm41GF
3. https://youtu.be/ZWXZMumRpuI?si=MRkJLT5-vHbFhMLg
4. https://youtu.be/J8eyJpVLJ54?si=_yBHEhVXSmfLdjA1
5. https://youtu.be/CWLpboXdx0s?si=lAhxBmKedQ5RRH5B

45 PERIODS

List of Experiment:

1. Computation of average load and load factor.
2. Load frequency dynamics of single area system.
3. Load frequency dynamics of two area system.
4. Modelling of AVR. (Automatic voltage Regulator).
5. Economic dispatch of power systems without losses.
6. Economic dispatch of power systems with losses.

45 PERIODS
TOTAL: 75 PERIODS

Course Code	NCC Credit Course Level 3 -AIR FORCE WING	L	T	P	C
-		2	0	0	2

UNIT I NCC General **6**

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness **4**

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development **7**

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership **5**

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development **8**

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 PERIODS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs e) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) f) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs e) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) f) Appeared for C Certificate Exam

Semester VII

Course Code	Electric Energy Generation, Utilization and Conservation	L	T	P	C
EE4701		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know the conversion of solar and wind energies into electrical energy for different
- applications.
- To study the domestic utilization of electrical energy.

Course Description:

This course provides a comprehensive understanding of various aspects related to the utilization and conservation of electrical energy. Topics covered include electric drives and traction systems, illumination engineering, heating and welding techniques, energy conservation principles and practices, and domestic utilization of electrical energy. Students will learn about the fundamentals of electric drives, different lighting technologies, heating methods, energy conservation laws, and domestic electrical systems.

Prerequisites:

- Basic knowledge of electrical circuits and principles
- Understanding of electromagnetism and power systems
- Familiarity with energy conversion processes
- Knowledge of electrical machines and devices

UNIT I Electric Drives and Traction **9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II Illumination **9**

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED UNIT

UNIT III Heating and Welding **9**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV Energy Conservation and Its Importance **9**

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor

controller. (Three phase circuit simulation with and without capacitor).

UNIT V Domestic Utilization of Electrical Energy **9**

House Wiring - working principle of air conditioning system, Induction based appliances, Online and OFF-line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

At the end of the course, students should have the:
CO1: Ability to choose suitable electric drives for different applications
CO2: Ability to design the illumination systems for energy saving
CO3: Ability to demonstrate the utilization of electrical energy for heating and welding purposes
CO4: Ability to know the effective usage of solar and wind energies for electrical applications
CO5: Ability to do electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.
CO6: To illustrate the need for energy conservation and to simulate three phase power control.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited, 1994 & Second Edition 2017 Feb.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and sons, 2000 2012th Edition, 2013, January.
3. G.D.Rai,"Non-Conventional Energy sources",Khanna publications Ltd.,New Delhi 1998
4. D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learing Private Limited, 3rd Edition 2022.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications 2nd Edition 2016.
2. H.Partab, Art and Science of Utilisation of Electrical Energy", Edition, Dhanpat Rai and Co., New Delhi-2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age international Pvt.Ltd., 3rd Edition, 2015 January.

SKILL DEVELOPMENT ACTIVITIES

1. Choosing electrical motors for drives and traction applications.
2. A general design procedure for lighting schemes.
3. Design of heating element and study of welding methods.
4. Practical case studies of energy conservation.
5. Power requirement for different domestic appliances.

YouTube Resources:

1. https://youtu.be/fQrZMMWo1mA?si=hDWZobFGnUrLLr9j
2. https://youtu.be/yyPd9GXYV5A?si=6vgIRGhA45AML1ha
3. https://youtu.be/1AT1yuQ9awM?si=nrRFWgBy8Ecuwo7E
4. https://youtu.be/zWvcM-4aUgg?si=zlzKvEoD6clEEkFo
5. https://youtu.be/JZ6f_i4ao6Y?si=5IPP0MPBROT0Lfry

TOTAL: 75 PERIODS

Course Code	Principles of Management	L	T	P	C
GE4701		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

Course Description:
This course provides an introduction to the fundamental concepts and principles of management and organizational behavior. Topics covered include the definition and evolution of management, different approaches to management, types of business organizations, planning, organizing, directing, and controlling functions of management. Additionally, the course delves into individual and group behavior, motivation, leadership, communication, and various control techniques used in organizations.

UNIT I Introduction to Management and Organizations **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II Planning **9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III Organising **9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV Directing **9**

Foundations of individual and group behavior– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V Controlling **9**

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGrawHill,1998.
2. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd.,10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, "Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

YouTube Resources:

1. https://youtu.be/TtbImDfUt4c?si=NJmgyRamwZBn7I6n
2. https://youtu.be/gAJDsUKJ3v8?si=f_qfWphkejQYdIId
3. https://youtu.be/gAJDsUKJ3v8?si=y0tlG69JDeimq5TK
4. https://youtu.be/nZd3tUvfjq4?si=GOAqJjVFNQG_APvT
5. https://youtu.be/90qpziPNRnY?si=T1rFGjh4GTWbdy6E

TOTAL: 45 PERIODS

APPENDIX A: VERTICALS AND COURSES TABLE

Vertical 1: EMBEDDED AND VLSI DESIGN							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V11	Embedded Programming	3	0	0	3
2.	Theory	EE4V12	IOT Applications in Electrical Engineering	3	0	0	3
3.	Theory	EE4V13	Embedded Control for Electric Drives	3	0	0	3
4.	Theory	EE4V14	VLSI Systems	3	0	0	3
5.	Theory	EE4V15	Validation and Testing Technology	3	0	0	3
6.	Theory	EE4V16	Low Power IC Design	3	0	0	3
						Total	**18**

Vertical 2: CONVERTERS AND ADVANCED DRIVES							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V21	Switched Mode Power Conversion	3	0	0	3
2.	Theory	EE4V22	Soft Switching Power Converters	3	0	0	3
3.	Theory	EE4V23	Grid Converters for Renewable Energy Applications	3	0	0	3
4.	Theory	EE4V24	PWM Converters and Applications	3	0	0	3
5.	Theory	EE4V25	Digital Controllers in Power Electronics Applications	3	0	0	3
6.	Theory	EE4V26	Industrial Control Systems and Power Electronics	3	0	0	3
						Total	**18**

Vertical 3: POWER ENGINEERING							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V31	SCADA and Energy Management Systems	3	0	0	3
2.	Theory	EE4V32	Power Quality & FACTS	3	0	0	3
3.	Theory	EE4V33	Power System Reliability	3	0	0	3
4.	Theory	EE4V34	Advanced Power System Analysis	3	0	0	3
5.	Theory	EE4V35	Smart Grid	3	0	0	3
6.	Theory	EE4V36	Power System Transients	3	0	0	3
						Total	**18**

Vertical 4: ELECTRIC VEHICLE TECHNOLOGY							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V41	Automotive Engineering For Electric Vehicles	3	0	0	3
2.	Theory	EE4V42	Sensors for EV System	3	0	0	3
3.	Theory	EE4V43	Energy Storage Systems For Electric Vehicle	3	0	0	3
4.	Theory	EE4V44	Electric Vehicle Charging Infrastructure and Analysis	3	0	0	3
5.	Theory	EE4V45	Electric Vehicle System Engineering and Policy	3	0	0	3
6.	Theory	EE4V46	Hybrid and Electric Vehicles	3	0	0	3
						Total	**18**

Vertical 5: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V51	Fundamentals of Data Sciences	3	0	0	3
1.	Theory	EE4V52	Data Analytics and Visualization	3	0	0	3
2.	Theory	EE4V53	Mathematics for Machine Learning	3	0	0	3
4.	Theory	EE4V54	AI for Robotics	3	0	0	3
5.	Theory	EE4V55	Big Data Analytics	3	0	0	3
6.	Theory	EE4V56	Generative Artificial Intelligence	3	0	0	3
						Total	**18**

Vertical 6: ROBOTICS							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V61	Collaborative Robotics	3	0	0	3
2.	Theory	EE4V62	Micro Robotics	3	0	0	3
3.	Theory	EE4V63	Robot Operating Systems	3	0	0	3
4.	Theory	EE4V64	Humanoid Systems	3	0	0	3
5.	Theory	EE4V65	Total Integrated Automation	3	0	0	3
6.	Theory	EE4V66	Virtual Instrumentation	3	0	0	3
						Total	**18**

Vertical 7: RENEWABLE AND NON-RENEWABLE ENERGY SOURCES							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE4V71	Renewable Energy Sources	3	0	0	3
2.	Theory	EE4V72	Basics of Power Plant Engineering	3	0	0	3
3.	Theory	EE4V73	Non-Conventional Sources of Energy	3	0	0	3
4.	Theory	EE4V74	Wind and Solar Energy Systems	3	0	0	3
5.	Theory	EE4V75	Power Electronic Controllers to Renewable Energy Systems	3	0	0	3
6.	Theory	EE4V76	Energy Storage Systems	3	0	0	3
						Total	**18**

Vertical 1: EMBEDDED AND VLSI DESIGN

Course Code	Embedded Programming	L	T	P	C
EE4V11		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To expose the students to the fundamentals of embedded Programming
- To study the basic concepts of embedded C.
- To teach the basics of ARM Processor and Peripherals
- To study the concept of IoT Architecture and Protocols
- To study the basic concepts of IoT System Design.

Course Description

This course focuses on embedded programming, covering both theoretical concepts and practical applications. Students will learn about typical C program development environments and delve into the fundamentals of C programming, including data types, operators, program control, functions, and arrays. The course then progresses to embedded C, where students will learn how to add structure to C code and meet real-time constraints, including creating hardware delays and implementing timeout mechanisms.

Prerequisites

- Basic Understanding of computer architecture and digital systems.
- Some knowledge of microprocessors and embedded systems would be beneficial.

UNIT I Basic C Programming **9**

Typical C Program Development Environment - Introduction to C Programming – Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II Embedded C **9**

Adding Structure to 'C' Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT III ARM Processor and Peripherals **9**

Complex systems and microprocessors– Embedded system design process, ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART.

UNIT IV IoT Architecture and Protocols **9**

Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT - Logical Design of IoT - IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M - IoT Communication Models and APIs – IoT Protocols – LoRaWAN, 6LoWPAN, CoAP, MQTT

UNIT V IoT System Design **9**

IoT Systems logic design using Python–packages for IoT- IoT Physical device & Endpoints- Basic building blocks of an IoT Device – Single board computer

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the concept of basic C Programming and to write the Programming in C
CO2: Deliver insight into embedded C programming and its salient features for embedded systems.
CO3: Understand the concept of ARM Processor and Peripherals
CO4: Gain the knowledge about IoT Architecture and Protocols.
CO5: IoT Systems logic design using Python

TEXT BOOKS:

1. Paul Deitel and Harvey Deitel, "C How to Program", 9thEdition, Pearson Education Limited, 2022, 1st edition.
2. MichaelJPont,"EmbeddedC" ,Addison-Wesley,AnimprintofPearsonEducation,2002.
3. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012
4. Muhammad Ali Mazidi, Sarmad Naimi , Sepehr Naimi' AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014.

REFERENCES:

1. Noel Kalicharan, "Learn to Program with C", Apress Inc.,2015,1st edition.
2. Steve Oualline, "Practical C programming", O' Reilly Media, 1997,3rdedition.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – Ahands-onapproach", Univ Press, 2015
4. Steve Furber, 'ARM system on chip architecture', Addision Wesley
5. Andrew N.Sloss, Dominic Symes, Chris Wright, John Rayfield' ARM System
6. Trevor Martin,' The Insider's Guide To The Philips ARM7-Based Microcontrollers,.

YouTube Resources:

1. https://youtu.be/XTiIiI-LOY8?si=qd4u07NEVeN12wsZ
2. https://youtu.be/qSacuVNWdtI?si=EhSzP5tXY3mfKfMf
3. https://youtu.be/vydldXpA6ec?si=7fcu7-QE6fxadOTQ
4. https://youtu.be/urUBLmXFKl0?si=DE_pyYY87vXhdSJo
5. https://youtu.be/kwgJpEnyqCA?si=W07CwOXDuw-nnGED

TOTAL: 45 PERIODS

Course Code	IOT Applications in Electrical Engineering	L	T	P	C
EE4V12		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To learn about a few applications of Internet of Things
- Distinguish between motion less and motion detectors as IoT applications
- To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- To understand about applications of IoT in smart grid
- To analyze new concept of IoE for various applications.

Course Description

This This course offers a comprehensive study of sensors and their applications in various fields, including occupancy detection, motion sensing, MEMS (Micro-Electro-Mechanical Systems) design, IoT (Internet of Things) for smart grid, and the Internet of Energy (IoE).

Prerequisites

- Understanding of basic networking concepts for IoT applications.
- Prior exposure to energy systems or renewable energy technologies would be advantageous but not required.

UNIT I Sensors **9**

Definitions, Terminology, Classification, Temperature sensors, Thermo resistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric.

UNIT II Occupancy and Motion Detectors **9**

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors -Resistive microphones, Piezoelectric, Photo resistors.

UNIT III MEMS **9**

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors.

UNIT IV IOT for Smart Grid **9**

Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

UNIT V Internet of Energy **9**

Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To learn the basics of sensors used in IOT.
CO2: To get exposed to recent trends in few applications of IoT in Electrical Engineering
CO3: To understand about usage of various types of motionless sensors and motion detectors
CO4: To get exposed to various applications of IoT in smart grid
CO5: To get exposed to future working environment with Energy internet.

TEXT BOOKS:

1. Jon S. Wilson, "Sensor Technology Hand book", Newnes Publisher, 2004
2. Tai Ran Hsu, "MEMS and Microsystems: Design and manufacture", 1st Edition, McGraw hill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, "From Smart grid to Internet of Energy", 1st Edition, Academic Press, 2019.

REFERENCES:

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, "Energy Harvesting Systems for IoT Applications": Generation, Storage and Power Management, 1st Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, "Internet of Things", Wiley, 2019.

YouTube Resources:

1. https://youtu.be/nE1C4ghfvac?si=hB-INTSfFDP-rpNj
2. https://youtu.be/p7kYStiASLo?si=mTUCVQ6VIbwKEjcw
3. https://youtu.be/hv-aBonZMRQ?si=cEIs2rsTzjrbKZcM
4. https://youtu.be/Q_OdV8m6cqk?si=dpEPdfpPKRYLnjMn
5. https://youtu.be/urUBLmXFKl0?si=9fHE8ncD4dlI9dGe

TOTAL: 45 PERIODS

Course Code	Embedded Control for Electric Drives	L	T	P	C
EE4V13		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To provide the control concept for electrical drives
- To emphasis the need for embedded system for controlling the electrical drives
- To provide knowledge about various embedded system- based control strategy for electrical drives
- To Impart the knowledge of optimization and machine learning techniques used for electrical drives
- To familiarize the high-performance computing for electrical drives.

Course Description

This course provides a comprehensive overview of electrical drives, focusing on various aspects such as drive classifications, dynamics of motor-load combinations, solid-state controlled drives, machine learning techniques, and the integration of IoT in electrical drive applications.

Prerequisites

- Basic Understanding of control theory concepts, including PID control and feedback systems.
- Some background knowledge in embedded systems and microcontroller programming would be advantageous but not mandatory.

UNIT I Introduction Electrical Drives **9**

Electric drive and its classifications, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives- IoT for Electrical drives applications

UNIT II Overview of Embedded Processor **9**

Embedded Processor architecture-RTOS – Hardware/software co-design-Programming with SoC processors.

UNIT III Induction Motor Control **9**

Types- Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three phase induction motor-FPGA based three phase induction motor control.

UNIT IV BLDC Motor Control **9**

Overview of BLDC Motor -Speed control methods -PWM techniques- ARM processor based BDLC motor control- ANN for BLDC Motor control and operation.

UNIT V SRM Motor Control **9**

Overview of SRM Motor -Speed control methods -PWM techniques- FPGA based SRM motor control DNN for SRM Motor control and operation.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Interpret the significance of embedded control of electrical drives
CO2: Deliver insight into various control strategy for electrical drives.
CO3: Developing knowledge on Machine learning and optimization techniques for motor control.
CO4: Develop embedded system solution for real time application such as Electric vehicles and UAVs.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.

TEXT BOOKS:

1. Ron Sass and Anderew G.Schmidt, " Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010.
2. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007.

REFERENCES:

1. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi,2010.
2. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw- Hill publishing company Ltd., New Delhi, 2002
3. K. Venkataratnam , Special Electrical Machines, Universities Press, 2014. 4. Steve Furber, 'ARM system on chip architecture', Addision Wesley,2010.

YouTube Resources:

1. https://youtu.be/1AT1yuQ9awM?si=GnCbHSxpP_Wk0hDp
2. https://youtu.be/GPNcPusIhhQ?si=3SKqDoHgRoSLpjr3
3. https://youtu.be/uFhDGagZzjs?si=TAXzxePN_AusT874
4. https://youtu.be/bhYjz7Yv5gs?si=LhpWapW1hjDY77BD
5. https://youtu.be/1AT1yuQ9awM?si=NUfO-iSHacpva_hC

TOTAL: 45 PERIODS

Course Code	VLSI Systems	L	T	P	C
EE4V14		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To explain the basic concepts of CMOS
- To introduce the IC fabrication methods
- To introduce the Reconfigurable Processor technologies
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description Language.

Course Description

This course provides an in-depth understanding of CMOS (Complementary Metal-Oxide-Semiconductor) technology, integrated circuit (IC) fabrication, programmable logic devices (PLDs), reconfigurable processors, and HDL (Hardware Description Language) programming. Students will learn about the design, fabrication, and programming aspects of digital circuits using CMOS technology, PLDs, and FPGAs (Field-Programmable Gate Arrays).

Prerequisites

- Basic understanding of digital electronics and logic circuits.
- Familiarity with semiconductor devices and MOSFET operation.

UNIT I CMOS Basics **9**

MOSFET Scaling - CMOS logic design- Dynamic CMOS –Transmission Gates- BiCMOS. Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

UNIT II CMOS IC Fabrication **9**

CMOS IC Fabrications: n well, p well, twin tub, SoI - Design Rules and Layout. NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up.

UNIT III Programable Logic Devices **9**

PAL, PLA, CPLD architecture and application. Programmable inversion and expander logic. Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines, Computation of interconnect delays in FPGAs Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

UNIT IV Reconfigurable Processor **9**

FPGA- Architecture, FPGA based application development- advanced FPGAs, IP cores, Soft core processors, Various factors determining the cost of a VLSI, Comparison of ASICs, FPGAs, PDSPs and CBICs. Fault tolerant VLSI architectures

UNIT VHDL Programming **9**

Verilog HDL- Overview - structural and behavioural modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Develop CMOS design techniques
CO2: Learn and build IC fabrication
CO3: Explain the need of reconfigurable computing with PLDs.
CO4: Design and development of reprogrammable FPGA.
CO5: Illustrate and develop HDL computational processes with improved design strategies.

TEXT BOOKS:

1. M.J.S Smith, "Application Specific integrated circuits", Addition Wesley Longman Inc. 1st Edition 2010.
2. Kamran Eshraghian, Douglas A.pucknell and Sholeh Eshraghian, "Essentials of VLSI circuits and system", Prentice Hall India,2005, 1st Edition.
3. N. H. E. Weste, D.F. Harris, "CMOS VLSI design", (3/e), Pearson, 2005.

REFERENCES:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002, 1st Edition.
2. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 7th Edition 2013.
3. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007, 1st Edition.
4. Pucknell & Eshraghian, "Basic VLSI Design", PHI, (3/e), 2003
5. Uyemura, "Introduction to VLSI Circuits and Systems", Wiley, 2002.

YouTube Resources:

1. https://youtu.be/faiEVOOCe-s?si=PSB7vEpqANjdZjTu
2. https://youtu.be/g6CCJAbdkK8?si=N-R4nfEG1wip5eSk
3. https://youtu.be/9SnR3M3CIm4?si=XV9bT_xsrOwotxB3
4. https://youtu.be/p4R0Ej6FCn0?si=syQjGZnHiJQYLZ0o
5. https://youtu.be/w3jNkZ-5s-U?si=pQqUeeK2YL6MejuW

TOTAL: 45 PERIODS

Course Code	Validation and Testing Technology	L	T	P	C
EE4V15		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Getting familiar with various IC technology.
- Learn MOS theory and testing
- Learn CMOS circuit theory and testing
- Getting expertise on CMOS characterization
- Explore circuit and device level testing methods.

Course Description

This course provides a comprehensive introduction to integrated circuit (IC) technology, focusing on MOS (Metal-Oxide-Semiconductor), PMOS (P-type MOS), NMOS (N-type MOS), CMOS (Complementary MOS), and BiCMOS (Bipolar-CMOS) technologies. It covers VLSI (Very Large-Scale Integration) fabrication processes, including oxidation, lithography, diffusion, ion implantation, metallization, and the integration of resistors and capacitors. The course also delves into MOS theory analysis, CMOS circuit characterization, performance estimation, and the basics of silicon validation.

Prerequisites

- Basic understanding of semiconductor devices and circuits.
- Familiarity with digital electronics and logic gates.

UNIT I Technology Introduction **9**

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

UNIT II MOS Theory Analysis-I **9**

Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.

UNIT III MOS Theory Analysis- II **9**

Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

UNIT IV CMOS Circuit Characterization and Performance Estimation **9**

Sheet Resistance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability.

UNIT V Basic Of Silicon Validation **9**

Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Complete overview to CMOS fabrication process.
CO2: Understand the fundamental concept of MOS FET and testing.
CO3: Explain the concept of MOS theory and analysis.
CO4: To give the student an understanding of CMOS performance testing and estimation.
CO5: Explain the basics of Testing and Fault Modeling.

TEXT BOOKS:

1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, "Essentials of VLSI Circuits and Systems" – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee, "CMOS VLSI Design" - Pearson Education, 1999.

REFERENCES:

1. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2004
2. N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003
3. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

YouTube Resources:

1. https://youtu.be/EbWmRJeNM9w?si=fiXUhmTAdPlspXnq.
2. https://youtu.be/zGHyXi_kNRM?si=78B_3MHIMwuHBPtx
3. https://youtu.be/HOPFliJflsc?si=5j1mnT_fyw0ODqeB
4. https://youtu.be/faiEVOOCe-s?si=Hj2-HmnvBnm0m7L2
5. https://youtu.be/lRf_UPXOnVU?si=ONRvu0R0z_j5ThPd

TOTAL: 45 PERIODS

Course Code	Low Power IC Design	L	T	P	C
EE4V16		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To learn the fundamentals of low power low voltage VLSI design.
- To understand the impact of power on system performances.
- To understand the different design approaches.
- To develop the low power Multipliers
- To develop the low power low voltage memories.

Course Description

This course focuses on the fundamentals of low-power circuit design, covering various sources of power dissipation and techniques for reducing power consumption in digital circuits. It explores low-power design approaches, including voltage scaling and switched capacitance minimization. Additionally, the course examines low-voltage, low-power design techniques for adders, multipliers, and memories.

Prerequisites

- Basic understanding of digital electronics and logic circuits.
- Familiarity with semiconductor devices and CMOS technology.

UNIT I Fundamentals of Low Power Circuits **9**

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect

UNIT II Low-Power Design Approaches **9**

Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures

UNIT III Low-Voltage Low-Power Adders **9**

Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques – Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.

UNIT IV Low-Voltage Low-Power Multipliers **9**

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier

UNIT V Low-Voltage Low-Power Memories **9**

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

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Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the fundamentals of Low power circuit design.
CO2: Attain the knowledge of architectural approaches.
CO3: Analyze and design Low-Voltage Low-Power combinational circuits.
CO4: Learn the design of Low-Voltage Low-Power Memories
CO5: Design and develop Low Power, Low Voltage Circuits

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004.

REFERENCES:

1. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012.
2. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998
3. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000.
4. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002
5. Bellamour, M. I. Elamasri, "Low Power CMOS VLSI Circuit Design", A Kluwer Academic Press, 1995.
6. Siva G. Narendran, Anatha Chandrakasan, "Leakage in Nanometer CMOS Technologies", Springer, 2005.

YouTube Resources:

1. https://youtu.be/ruClwamT-R0?si=2tzTZ8eVvs6PRkiw
2. https://youtu.be/TFOO1JAll2Y?si=bjC4OjXHRXLFLlse
3. https://youtu.be/q8adOpQx7tc?si=kvqg2uYDXGG1zgIJ
4. https://youtu.be/U6i8Xmi0Y20?si=O3lobyg5nL0x_FwT
5. https://youtu.be/U6i8Xmi0Y20?si=ZkOS4swjKZkFGZWe

TOTAL: 45 PERIODS

Vertical 2: CONVERTERS AND ADVANCED DRIVES

Course Code	Switched Mode Power Conversion	L	T	P	C
EE4V21		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the design concepts of reactive elements in Power Electronic Systems
- To study about the steady-state analysis Switched Mode power converters
- To know the modelling and control of switched Mode power converters
- To impart knowledge on the soft-switching DC – DC Converters
- To learn the realization of near ideal rectifier.

Course Description

This course provides an in-depth understanding of power electronic systems, focusing on the design, analysis, and operation of various types of converters commonly used in power electronics.

Prerequisites

- Basic Proficiency in 115odelling linear and non-linear circuits, including passive and active components, using techniques such as Kirchhoff's laws, nodal analysis, mesh analysis, Thevenin's and Norton's theorem, etc.
- Basic knowledge of control theory, including transfer functions, block diagrams, stability analysis, and feedback control.

UNIT I Introduction **9**

Design constraints of reactive elements in Power Electronic Systems: Design of inductor, transformer and capacitors for power electronic applications, Input filter design

UNIT II Steady-State Analysis of Converters **9**

Basic concepts and steady-state analysis of second and higher order Switched Mode power converters: PWM DC – DC Converters (CCM and DCM) – operating principles, constituent elements, characteristics, comparisons and selection criteria

UNIT III Dynamic Modelling of Converters **9**

Dynamic Modelling and control of second and higher order switched Mode power converters: analysis of converter transfer functions, Design of feedback compensators, current programmed, frequency programmed and critical conduction mode control

UNIT IV DC-DC Converters **9**

Soft-switching DC – DC Converters: zero-voltage-switching converters, zero-current- switching converters, Multi-resonant converters and Load resonant converters.

UNIT V Power Converters **9**

Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three-phase converter systems incorporating ideal rectifiers

and design examples. Non-linear phenomena in switched mode power converters: Bifurcation and Chaos.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Steady-State Analysis of switched-mode dc-dc power converters.
CO2. Design of Switched-Mode Converters, including selection of component values based on steady-state dc and ac ripple specifications.
CO3. Dynamic Modelling Development and Analysis for switched-mode dc-dc converters using averaging techniques, including the derivation and visualization of converter small-signal transfer functions.
CO4. Analysis and Design of Control Loops around switched-mode power converters using averaging small-signal dynamic models and classical control theory.
CO5. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the analysis and design of switched-mode power converters.

TEXT BOOKS:

1. Robert W. Erickson and Dragan Maksimovic, 'Fundamentals of Power Electronics', Springer, 2nd Edition, 2001.
2. Marian K. Kazimierczuk, 'Pulse-width Modulated DC-DC Power Converters' John Wiley & Sons Ltd., 1st Edition,2008.
3. Philip T Krein, 'Elements of Power Electronics', Oxford University Press, 2nd Edition, 2012.

REFERENCES:

1. Batarseh, 'Power Electronic Circuits', John Wiley, 2nd Edition, 2004.
2. H. W. Whittington, B. W. Flynn, D. E. Macpherson, 'Switched Mode Power Supplies', John Wiley & Sons Inc., 2nd Edition, 1997.

YouTube Resources:

1. https://youtu.be/HcwJKKG_LYY?si=hz86-DouGqFxfUGi
2. https://youtu.be/Ns_xqZrpLIM?si=6OXHoOaPzz9r1UPb
3. https://youtu.be/kyQCOzC1CbY?si=HdbQO-rgVopQCCL6
4. https://youtu.be/HcH0khFGwS8?si=c0N-H6Lpd8sNI1Ij
5. https://youtu.be/_gJPYgQQ01c?si=2IXHvfZ_9B2cvFDP

TOTAL: 45 PERIODS

Course Code	Soft Switching Power Converters	L	T	P	C
EE4V22		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduction to soft switching schemes for power converters
- To understand the concept of quasi-resonant switches
- To design the active clamp fly back converter
- To impart knowledge on basis of Soft Switching for PWM Full-Bridge Converters
- To learn the application of resonant and PWM soft switched converters.

Course Description

This course provides a comprehensive exploration of soft switching schemes in power electronic converters, focusing on various techniques to minimize switching losses and improve overall converter efficiency. It covers the evaluation of switching losses in hard-switched converters and introduces soft switching schemes as an alternative approach. Topics include resonant switches, zero voltage switching (ZVS), zero current switching (ZCS), and their combinations, along with parameters and selection criteria for semiconductor switches suitable for soft switching applications.

Prerequisites

- Basic Circuit Analysis: Proficiency in 117odelling linear and non-linear circuits, including passive and active components, using techniques such as Kirchhoff's laws, nodal analysis, mesh analysis, etc.
- Power Electronics: Familiarity with basic power electronic converters, such as rectifiers, inverters, and DC-DC converters, and their operating principles.

UNIT I Soft Switching Schemes **9**

Evaluation of switching loss in hard switched converters, Introduction to soft switching schemes, Comparison between hard switched and soft switching converters, Resonant switches, zero voltage switching (ZVS), zero current switching (ZCS), zero voltage zero-current switching (ZVS-ZCS), Parameters and selection of semiconductor switches for soft switching.

UNIT II Quasi-Resonant Switches **9**

Concept of resonance, Classification of Quasi-Resonant Switches, Non isolated Zero-Current-Switching Quasi-Resonant Converters, Non isolated Zero-Voltage-Switching Quasi-Resonant Converters, Series-Loaded Resonant Converters, Parallel-Loaded Resonant Converters, Series-parallel resonant converters, isolated high order resonant converters.

UNIT III Clamp Power Converters **9**

PWM Soft switched converter, Active clamp power converters with soft switching, design of active clamp ZVS fly back converter, high voltage gains ZVS converters, high voltage gains ZVS/ZCS converters.

UNIT IV PWM Bridge Converters **9**

Soft switched PWM Full bridge converters, Theoretical Basis of Soft Switching for PWM Full-Bridge Converters, Classification of Soft-Switching PWM Full-Bridge Converters, Zero-Voltage-Switching PWM Full-Bridge Converters, Modulation of the Lagging Leg, Modulation of the Leading Leg, Dual active bridge (DAB) converters and modulation strategy.

UNIT V Applications of Resonant Converters **9**

Application of resonant and PWM soft switched converters I renewable energy, on –board battery charging, wireless power transfer, power factor correction, DAB converters in solid state transformer.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the soft switching schemes for power converters
CO2: To be able to illustrate the concept of quasi-resonant switches
CO3: To be able to outline the design the active clamp fly back converter
CO4: To be able to interpret the basis of Soft Switching for PWM Full-Bridge Converters
CO5: To be able to learn the application of resonant and PWM soft switched converters.

TEXT BOOKS:

1. Robert Erickson, Dragan Maksimovic "Fundamentals of power electronics", Springer publications, 2001.
2. Marian K. Kazimierczuk, Dariusz Czarkowski, "Resonant Power Converters", Wiley Publications, Second Edition, 2010.
3. Simon S. Ang, Alejandro Oliva, "Power-Switching Converters" CRC Press Publications, 3nd edition, 2010.

REFERENCES:

1. D Xinbo Ruan, "Soft-Switching PWM Full-Bridge Converters: Topologies, Control, and Design" Wiley Publications, 2014.
2. Ivo Barbi, F. Pottker "Soft commutation Isolated DC/DC Converters" Springer Publications, 2019.

YouTube Resources:

1. https://youtu.be/UE-vtl-lKbo?si=IgAdrTKfkT8VXmnb
2. https://youtu.be/jL9L8Pd5HDM?si=oUiYUMda_584bAjo
3. https://youtu.be/_gJPYgQQ01c?si=AF3O2fSnji9UE8SW
4. https://youtu.be/cJcD6tRBU5g?si=_VKxp_jGvss23sXf
5. https://youtu.be/2F9BsGcD1Ok?si=BnkhJHg0pp4Pf89j

TOTAL: 45 PERIODS

Course Code	Grid Converters for Renewable Energy Applications	L	T	P	C
EE4V23		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study about 119odelling and control of grid-tied converters
- To understand the response to abnormal grid conditions
- To know the grid requirements for wind turbine systems
- To learn techniques for grid connected converters under unbalanced grid voltage conditions
- To impart knowledge on the control of grid converters under grid faults.

Course Description

This course offers a detailed examination of grid-tied converters and their integration with renewable energy sources such as photovoltaic (PV) and wind power systems. It covers various aspects of power quality, grid requirements, synchronization, and control techniques crucial for effective integration and operation within the power grid.

Prerequisites

- Basic Power Electronics: Familiarity with power electronic converters, including rectifiers, inverters, and DC-DC converters, as well as their operation and control.
- Control Systems: Knowledge of control theory, including feedback control, stability analysis, and controller design techniques.
- Renewable Energy Systems: Basic understanding of renewable energy sources, their characteristics, and integration with power systems.

UNIT I Soft Switching Schemes **9**

Photovoltaic power development, wind power development, grid converter structures, 119odelling and control of grid-tied converters.

UNIT II Power Quality Issues **9**

International regulations, response to abnormal grid conditions (voltage deviations, frequency deviations), power quality issues on DC current injection, current harmonics, power factor.

UNIT III Grid Requirements **9**

Grid requirements for wind turbine systems, grid code evolution, frequency and voltage deviation under normal operation, active and reactive power control in normal operation, 119odelling under grid disturbance.

UNIT IV Synchronization with PV and Wind **9**

Grid synchronization with PV and wind turbine systems, voltage vector under normal and abnormal grid conditions, synchronous reference frame PLL under unbalanced and distorted grid conditions, operation of different PLL techniques

UNIT V Control Technique Schemes **9**

Overview of control techniques for grid connected converters under unbalanced grid voltage conditions, control of grid converters under grid faults, control structures for unbalanced current injection, power control under unbalanced grid condition, flexible power control with current limitation.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the 120odelling and control of grid-tied converters
CO2: To be able to illustrate the response to abnormal grid conditions
CO3: To be able to outline the grid requirements for wind turbine systems
CO4: To be able to interpret the techniques for grid connected converters under unbalanced grid voltage conditions
CO5: To be able to learn the knowledge on the control of grid converters under grid faults.

TEXT BOOKS:

1. Remus Teodorescu, Marco Liserre, Pedro Rodriguez., Grid Converters for Photovoltaic and Wind power Systems, first edition, Wiley Publication 2011.
2. Amirnaser Yazdani, Reza Iravani., Voltage Sourced Converters in Power Systems, Modeling, Control and Applications, Wiley Publications 2010.

REFERENCES:

1. Ned Mohan, Tore M, Undelnad, William P, Robbins (3 Edition), Power Electronics: Converters, Applications and Design; Wiley 2002.
2. BinWu, Yongqiang Lang, Navid Zargari and Samir Kouro., 'Power Conversion and Control of Wind energy systems', John wiley & sons, inc., publication 2011.

YouTube Resources:

1. https://youtu.be/bA-yMfHPazI?si=LCmOquoFSdttxHWa
2. https://youtu.be/hX_UhF1HrF8?si=q5e6ndLUN414TXhp
3. https://youtu.be/hX_UhF1HrF8?si=aHf4Uj-nr7GXKJDw
4. https://youtu.be/-HljEywnEf0?si=wap0uQu27iEEKPr2
5. https://youtu.be/nClZct8Vmw4?si=iFe2cQhIHaaCGJZq

TOTAL: 45 PERIODS

Course Code	PWM Converters and Applications	L	T	P	C
EE4V24		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the applications of voltage source converters
- To study about the space vector based PWM and advanced PWM techniques
- To know the dynamic model of a PWM converter
- To impart knowledge on current ripple and torque ripple in inverter fed drives
- To learn the various compensation techniques.

Course Description

This course provides an in-depth exploration of pulse modulation techniques and advanced control strategies for power converters and drives. It covers various aspects of AC/DC and DC/AC power conversion, with a focus on voltage source converters (VSCs) and their applications. Topics include pulse modulation techniques such as bridge converters, multilevel inverters (diode-clamped and flying capacitor), and advanced PWM techniques including bus clamping PWM, space vector-based PWM, and practical considerations for device selection and loss calculation.

Prerequisites

- Power Electronics: Familiarity with power electronic converters, including rectifiers, inverters, and DC-DC converters, and their operation principles.
- Control Systems: Knowledge of control theory, including feedback control, stability analysis, and controller design techniques, as well as familiarity with advanced control strategies such as PWM modulation.
- Electrical Drives: Basic understanding of electric drives, including motor types, control techniques, and applications.

UNIT I Pulse Modulation Techniques **9**

AC/DC and DC/AC power conversion, overview of applications of voltage source converters, pulse modulation techniques for bridge converters, Multilevel Inverter – diode clamped inverter – flying capacitor inverter

UNIT II Advanced PWM Techniques **9**

Bus clamping PWM and advanced bus clamping PWM, space vector based PWM, advanced PWM techniques, practical devices in converter; calculation of switching and conduction losses.

UNIT III Voltage Regulation on Drives **9**

Compensation for dead time and DC voltage regulation; dynamic model of a PWM converter, multilevel converters; constant V/F induction motor drives.

UNIT IV Ripple Filtering Techniques **9**

Estimation of current ripple and torque ripple in inverter fed drives; line – side converters with power factor compensation.

UNIT V Compensation Technique Schemes **9**

Active power compensation, reactive power compensation; harmonic current compensation.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the applications of voltage source converters
CO2: To be able to illustrate the space vector based PWM and advanced PWM techniques
CO3: To be able to outline the dynamic model of a PWM converter
CO4: To be able to interpret the knowledge on current ripple and torque ripple in inverter fed drives
CO5: To be able to learn the various compensation techniques.

TEXT BOOKS:

1. Mohan, Undel and and Robbins, 'Power Electronics; Converters, Applications and Design', John Wiley and Sons, 1989.
2. Erickson R W, 'Fundamentals of Power Electronics', Chapman and Hall, 1997.

REFERENCES:

1. Vithyathil J, "Power Electronics: Principles and Applications", McGraw Hill, 1995.

YouTube Resources:

1. https://youtu.be/JXJaRPXPwjQ?si=JQ-ah3YoRW8x_v0w
2. https://youtu.be/ghunDtZMv0Y?si=onMe5ek867XRA51d
3. https://youtu.be/u5Gp-oid7hM?si=0RR8mR8-LckLnaUG
4. https://youtu.be/W7D8sYwVbUA?si=Ux5z_Kvce4mGWtFM
5. https://youtu.be/iuE7XwpTdBk?si=z2oBxKYqkcCKMwCI

TOTAL: 45 PERIODS

Course Code	Digital Controllers in Power Electronics Applications	L	T	P	C
EE4V25		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the components of the C2xx DSP core
- To understand the multiplexing and General Purpose I/O Control Registers
- To know the overview of the Event manager
- To impart knowledge on embedded coding through MATLAB
- To learn the converter control design.

Course Description

This This course offers a comprehensive overview of digital signal processor (DSP) architecture, focusing on the C2xx DSP core, its components, peripherals, memory organization, and assembly programming. It covers key concepts such as interrupts, event management, simulation tools, and converter control design.

Prerequisites

- Basic Microcontroller or DSP Architecture: Familiarity with microcontroller or DSP architecture, including registers, memory organization, and peripheral interfaces.
- Assembly Language Programming: Knowledge of assembly language programming concepts, including instruction set architecture and programming techniques.

UNIT I INTRODUCTION **9**

Introduction to the C2xx DSP core and code generation – The components of the C2xx DSP core -Mapping external devices to the C2xx core – peripherals and Peripheral Interface – System configuration registers – Memory – Types of Physical Memory – Memory Addressing Modes – Assembly Programming using C2xx DSP – Instruction Set – Software Tools

UNIT IIINTERRUPTS **9**

Pin Multiplexing (MUX) and General Purpose I/O Overview – Multiplexing and General Purpose I/O Control Registers – Introduction to Interrupts – Interrupt Hierarchy – Interrupt Control Registers – Initializing and Servicing Interrupts in Software.

UNIT III EVENT MANAGEMENT **9**

ADC Overview – Operation of the ADC in the DSP – Overview of the Event manager (EV) – Event Manage interrupts – General Purpose (GP) Timers – Compare Units – Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry – General Event Manager Information.

UNIT IV SIMULATION TOOLS **9**

Code composer studio, Embedded Coding through MATLAB and other modern simulation tools, PWM Generation, Dead band unit, Phase shifted PWM for full bridge converters, PWM for interleaved converters.

UNIT V CONVERTER CONTROL DESIGN **9**

Controlled Rectifier – Switched Mode Power Converters – PWM Inverters – DC motor control – Induction, Motor Control.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the components of the C2xx DSP core
CO2: To be able to illustrate the multiplexing and General Purpose I/O Control Registers
CO3: To be able to outline the overview of the Event manager
CO4: To be able to interpret the knowledge on embedded coding through MATLAB
CO5: To be able to learn the converter control design.

TEXT BOOKS:

1. Hamid. A. Toliyat and Steven G.Campbell, 'DSP Based Electro Mechanical Motion Control' CRC Press New York, 2004
2. XC 3000 series datasheets (version 3.1). Xilinx, Inc., USA, 1998.

REFERENCES:

1. XC 4000 series datasheets (version 1.6). Xilinx, Inc., USA, 1999
2. Wayne Wolf, 'FPGA based system design', Prentice hall, 2004.

YouTube Resources:

1. https://youtu.be/U6i8Xmi0Y20?si=grUVdUcN7-41XABk
2. https://youtu.be/UnLww6bH6C4?si=guhakN2nTgzjZjAD
3. https://youtu.be/HicZcgdGxZY?si=NIl-9FuGsR6lf6LV
4. https://youtu.be/kU7iRYMlaYo?si=RkTA3wlm3jImvmEQ
5. https://youtu.be/iIqhAX0I7lI?si=4d6R2_2-HmTBCchs

TOTAL: 45 PERIODS

Course Code	Industrial Control Systems and Power Electronics	L	T	P	C
EE4V26		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the various UPS topologies
- To understand the overview of sensors in industrial applications
- To know the various analog controllers
- To impart knowledge various heating and welding control
- To learn the programmable logic controllers.

Course Description

This course provides a comprehensive understanding of various aspects related to power systems, sensors, analog controllers, heating, welding, and supervisory control. It covers uninterrupted power supplies (UPS) topologies, industrial sensor applications, analog controllers, heating, welding techniques, and supervisory control systems.

Prerequisites

- Basic Control Systems: Familiarity with control theory concepts such as feedback control, stability analysis, and controller design.
- Sensors and Instrumentation: Basic knowledge of sensors and instrumentation techniques used in industrial applications.
- Analog Electronics: Understanding of analog circuits, including operational amplifiers, signal conditioning circuits, and voltage/current conversion techniques.

UNIT I UPS TOPOLOGIES **9**

Review of uninterrupted power supplies – offline and on-line topologies – analysis of UPS topologies, solid state circuit breakers and solid-state tap changing of transformer – advance energy storage systems, battery, ultra-capacitors, flywheel energy storage, fuel cells characteristics and applications.

UNIT II INDUSTRIAL APPLICATIONS OF SENSORS **9**

Overview of sensors in industrial applications – current sensors, current transformer, hall effect sensors – voltage sensors, non-isolated measurement, hall effect, temperature sensors, thermal protection of power components – speed sensors – position sensors.

UNIT III ANALOG CONTROLLERS **9**

Introduction to analog controllers – proportional controllers, proportional – integral controllers, PID controllers, derivative overrun, integral windup, cascaded control, feed forward control. Signal conditioners – instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters.

UNIT IV HEATING AND WELDING **9**

Solid state welding power source – introduction, classification, basic characteristics, volt ampere relationship and its measurements, control of volt ampere characteristics, volt control, slope control and dual control– pulsing techniques – testing of welding power source. Introduction to heating, classification, characteristics – applications

UNIT VSUPERVISORY CONTROL **9**

Introduction to programmable logic controllers, architecture, programming. Supervisory control and data acquisition (SCADA) Systems, components of SCADA systems, SCADA basic functions, SCADA application functions in electrical engineering. Energy saving in electrical drive systems.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the various UPS topologies
CO2: To be able to illustrate the overview of sensors in industrial applications
CO3: To be able to outline the various analog controllers
CO4: To be able to interpret the various heating and welding control
CO5: To be able to learn the programmable logic controllers.

TEXT BOOKS:

1. Michael Jacob, 'Industrial Control Electronics – Applications and Design', Prentice Hall, 1995.
2. Thomas E. Kissell, 'Industrial Electronics', Prentice Hall India, 2003
3. Curtis D. Jhonson 'Process Control Instrumentation technology' Pearson New International Eighth edition,2014
4. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles-Fundamentals, Theory and Design' CRC Press 2004.
5. Mini S. Thomas, John D McDonald, Power Systems SCADA and Smart Grid, CRC Press, Taylor and Francis.

REFERENCES:

1. Welding Handbook, Volume-2, Seventh Edition, American Welding Society.
2. Power Electronics Applied to Industrial Systems and Transports. Volume 5: Measurement Circuits, Safeguards and Energy Storage, Imprint – ISTE Press – Elsevier.

YouTube Resources:

1. https://youtu.be/bj5KpFR_LPU?si=nPAbk-WH9uQYWfo0
2. https://youtu.be/wn1UCt9Z6NQ?si=-7Q_vuKZmWnBZcfA
3. https://youtu.be/fv6dLTEvl74?si=jQUphDDdg5aiJmFG
4. https://youtu.be/LVvtFCtcJ3s?si=ehiqUuZHKlDP8xjP
5. https://youtu.be/fCLXreIlkG4?si=rx0joCUr7F9JPZ9W

TOTAL: 45 PERIODS

Vertical 3: POWER ENGINEERING

Course Code	SCADA and Energy Management Systems	L	T	P	C
EE4V31		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with architecture of a SCADA system,
- To familiarize the students with SCADA building blocks, operational requirements.
- To familiarize the students with parameters for process selection
- To providing an insight into its application in the field of power system control.
- To familiarize the students in transmission systems and cables

Course Description

This course provides a comprehensive understanding of electrical power cables and their integration into supervisory control and data acquisition (SCADA) systems. It covers various aspects such as cable architecture, dielectric theory, SCADA functions, supply distribution systems, transmission systems, cable installation, testing, maintenance, and energy management systems.

Prerequisites

- Basic Communication Systems: Understanding of communication systems, including data transmission, protocols, and networking concepts.
- Database Management: Familiarity with database management systems and their role in organizing and managing data in SCADA systems.

UNIT I INTRODUCTION TO ELECTRICAL POWER CABLES 9

SCADA: Overview and hierarchical structure of power system. Objective of Power System. Standard Operation. Different operational modes- Normal, Alert, Emergency, Restoration. SCADA- definition, functions – data acquisition, data communication, data processing and data presentation, control. Advantages of having SCADA. Applications for which SCADA is best suited. Basic components- MTU, RTU, Communication channel, Transducers. Transmission Medium – wired and wireless, wired- coaxial cable, twisted pair, fiber optics, wireless radio, microwave, infrared. Data Communication Fundamentals digital, analog, serial, parallel, synchronous, asynchronous, nodes, network- characteristics, topology. Transmission capacity, data rate, Nyquist theorem, Shannon capacity. Components of Communication System- transmitter, receiver, message, medium, protocol. OSI seven-layer model, different standard organization, message format- format control, error detection- CRC, checksum, parity, communication system message, medium, protocol. OSI seven-layer model, different standard organization, message format- format control, error detection- CRC, checksum, parity, communication system design

UNIT II CABLE ARCHITECHTURE, DIELECTRIC THEORY AND CHARACTERISTICS 9

Supervisory and Control functions: RTU Components – communication subsystem, logic subsystem, termination sub system, power supply, test MMI. Data Acquisition – status values, measured values- digital, analog. Energy values. Data reporting- current data, data snapshot, reporting by exception. Data Processing – ADC, DAC, current to voltage converters, voltage to current converters. Data Monitoring – Analog and Discrete, Data control – discrete control and analog control. Transducers – CT, PT, LVDT, Strain guage. Time Tagged Data – Historical data, planning data. Collected and calculated data.

Disturbance data collection and analysis, reports and calculations – load forecasting, load flow, state estimation, economic dispatch algorithms. Alarms and Event Processing – Alarm presentation according to priority, override feature. Regulatory Functions – open and closed loop process control, set points, P, D, I, PI, PID controllers

UNIT III SUPPLY DISTRIBUTIONS SYSTEMS AND CABLES 9

Man-Machine Interface: Operator Interface – definition, ergonomic features, Elements of operator interface- VDUs, key board, important works to be performed by the operator in the control room, console security and authority. VDU Displays and its Uses – static and dynamic information presentation. Poke points, mimic diagrams. Alarms and their Treatment at MTU – Status screens, control change screen, graphics and trending. Reports- classification, alarm log printer, printers for daily communication reports, printers for run reports. Master Station Performance – performance test, test criteria, selection of computer for MTU- speed, memory, MIPS, MFLOPS, whetstone test. Reliability – MTBF, MTTR, Availability of equipment/service, minimum reliable system, cold standby system, hot standby system, dual redundant system. Typical SCADA Configuration – dual redundant system with the following facilities- dual CPU, data link, MMI I/O, Communication I/O, Data acquisition I/O, local I/O, peripheral switch for connection printers archive PC, PC for programming etc. Examples of Process Configuration in MTU – a pipe line under the control of MTU, Monitoring of liquid on a 24 hr basis, on/off control of pumps and block valve for the control of liquid level through the pipe, report of the liquid going out of the pipe, handling of a leakage problem.

UNIT IV TRANSMISSION SYSTEMS AND CABLES 9

Database Management System – logical and physical data base structure. Need for data base, Advantages of having structured data base, important requirement of a data base for SCADA operation, logical database- hierarchical, relational, network. Real Time Operational Requirement. Protocols – Ethernet frame, Media access control- CSMA/CD. Fast Ethernet, gigabit Ethernet. TCP/IP, SMTP, HTTP, UDP. Field Bus Protocol – MODBUS-ASCII, RTU, PROFIBUS-DP, AP

UNIT V CABLE INSTALLATION, TESTING, MAINTENANCE 9

Energy Management System: Functions performed at the centralized management system, Overview of Regional Grid in India. Real time network 128odelling- Network 128odelling programs, Real time model validation, State estimation, Measurement errors detection/ identifier, implementation aspects. Security management- System Security, Security Analysis Function, Security Control, Security Modeling. Production control- Load Prediction, Local Control, Automatic Generation Control, Economic Dispatch Control, Unit Commitment, Security consideration. Training simulator- Education and Training, Design Aspects, Application.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the architecture of a SCADA system.

CO2: Know about the SCADA building blocks, operational requirements.

CO3: Know about parameters for process selection

CO4: Understand about SCADA application in the field of power system control

CO5: Understand about transmission systems and cables

TEXT BOOKS:

1. Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", ISA Publisher 2010
2. Torsen Cegrell, "Power System Control Technology", Prentice- Hall 1986
3. Thomas E. Kissel, "Industrial Electronics", Prentice- Hall 2002
4. Behrouz A. Forouzan, "Data Communication and Networking", McGraw Hill 2007
5. Krishna Kant, "Computer based Industrial Control", PHI 2004
6. George L. Kusic, "Computer Aided Power System Analysis", CRC Press 1986

REFERENCES:

1. R Behrouz A. Forouzan, "Data Communication and Networking", McGraw Hill 2007
2. Krishna Kant, "Computer based Industrial Control", PHI 2004
3. George L. Kusic, "Computer Aided Power System Analysis", CRC Press 1986

YouTube Resources:

1. https://youtu.be/nlFM1q9QPJw?si=w_8qJDIf8J4VHvbi
2. https://youtu.be/-0LzMfhoSts?si=NaeQzwyadJGfeRNI
3. https://youtu.be/jJc1SrpM2dg?si=6qnGYmGLIpquisi0
4. https://youtu.be/XbZE0Xd5Rls?si=EwCzwAKuHyBAn6eU
5. https://youtu.be/mBmO0AiWxMQ?si=man1z6N80GW3BRcR

TOTAL: 45 PERIODS

Course Code	Power Quality & FACTS	L	T	P	C
EE4V32		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Define power quality and explore various terms associated with it. Study voltage-related power quality issues, focusing on short and long interruptions.
- Conduct a detailed study on characterizing voltage sags, with a specific emphasis on magnitude and three-phase unbalanced voltage sags. Understand how power quality issues affect the behavior of power electronics loads and rotating machinery.
- Gain an understanding of FACTS controllers, their controllable parameters, and types. Explore the importance of shunt and series compensation, focusing on the control and comparison of STATCOM and SVC, and the functioning and regulation of other FACTS devices like GCSC, TSSC, and TCSC.
- To understand the working principles of devices to improve power quality.
- To understand the concept of UPFC

Course Description

This course provides a comprehensive understanding of power quality problems in distribution systems and various techniques for reactive power compensation. It covers topics such as transient and steady-state variations in voltage and frequency, waveform distortions, transmission line analysis, and series/shunt compensation methods. Additionally, it explores static shunt compensators, static series compensators, and combined compensators like the Unified Power Flow Controller (UPFC).

Prerequisites

- Basic Electrical Network Analysis: Familiarity with the analysis of electrical networks, including impedance, admittance, and power flow calculations.
- Control Systems: Basic knowledge of control systems and their applications in power system control and stability.
- Power Electronics: Understanding of power electronic devices and their applications in reactive power compensation.

UNIT I POWER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS 9

Power Quality Problems in Distribution Systems: Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement.

UNIT II TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION 9

Transmission Lines and Series/Shunt Reactive Power Compensation: 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 III STATIC SHUNT COMPENSATORS 9

Static Shunt Compensators: Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle, control approaches and characteristics

UNIT IV STATIC SERIES COMPENSATORS 9

Static Series Compensators: Objectives of series compensator, variable impedance type of series

compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control

UNIT V COMBINED COMPENSATORS **9**

Combined Compensators: Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, independent control of real and reactive power.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Develop an awareness of the severity of power quality issues in distribution systems, focusing on their impact and challenges.
CO2: Understand the concept of transforming voltage sags from upstream (higher voltages) to downstream (lower voltage) in the distribution system.
CO3: Demonstrate competence in selecting controllers based on specific applications and system requirements Thoroughly understand various systems and their requirements, including the control circuits of shunt controllers (SVC & STATCOM) and series controllers (GCSC, TSSC, and TCSC) for enhancing transient stability, preventing voltage instability, and damping power oscillations
CO4: Understand the FACTS devices and 131odelli reactive power requirements and management
CO5: Understand the concept of UPFC capabilities.

TEXT BOOKS:

1. Electrical Power Systems Quality, Dugan Roger C, Santoso Surya, Mc Granaghan, Marks F. Beaty and H. Wayre, Mc Graw Hill
2. Power Systems Quality Assessment, J. Arillaga, N.R. Watson, S.Clon, John Wiley.

REFERENCES:

1. Power Quality, C.Sankaran, CRC Press 4. Understanding power quality problems, Math H. Bollen, IEEE press.
2. "Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems" Narain G. Honorani, Laszlo Gyugyi

YouTube Resources:

1. https://youtu.be/o5ksmUHnMRs?si=5JLNn38wYlMX8qpX
2. https://youtu.be/iuE7XwpTdBk?si=vl_ed3_qGx67YmSn
3. https://youtu.be/jIlley7qdMY?si=RGkuBF6o4q9FVNA
4. https://youtu.be/h1b1wAz0nsc?si=unJ6uJVUp4bnr07p
5. https://youtu.be/eGRtNTt61TI?si=VqXsllw9kLnFHt5r

TOTAL: 45 PERIODS

Course Code	Power System Reliability	L	T	P	C
EE4V33		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To describe the generation system model and recursive relation for capacitive model building
- To explain the equivalent transitional rates, cumulative probability and cumulative frequency
- To develop the understanding of risk, system and load point reliability indices
- To understand the concept of Distribution System Reliability Analysis
- To Impart knowledge on substation circuit failures

Course Description

This course provides a comprehensive understanding of reliability analysis in power systems, focusing on both generating systems and distribution systems. It covers basic probability theory, reliability measures, and various analytical techniques used to assess the reliability of power generation and distribution systems.

Prerequisites

- Basic Electrical Engineering Fundamentals: Understanding of fundamental concepts in electrical engineering, including power systems, circuits, and electrical components.
- Mathematics: Proficiency in mathematical concepts such as algebra, calculus, and probability theory.

UNIT I INTRODUCTION **9**

Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation – Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models – Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failures.

UNIT II GENERATING SYSTEM RELIABILITY ANALYSIS **9**

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of loss of load and energy indices – Examples. Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2-level daily load representation – merging generation and load models – Examples.

UNIT III OPERATING RESERVE EVALUATION BULK & POWER SYSTEM RELIABILITY EVALUATION **9**

Operating Reserve Evaluation Basic concepts – risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modeling using STPM approach. Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures. Interconnected System Reliability Analysis Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity – imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

UNIT IV DISTRIBUTION SYSTEM RELIABILITY ANALYSIS 9

Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy-oriented indices – Examples. Basic concepts of parallel distribution system reliability

UNIT V SUBSTATIONS AND SWITCHING STATIONS 9

Effects of short-circuits – breaker operation – Open and Short-circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Describe merging generation and load models
CO2: Estimate loss of load and energy indices for generation systems model
CO3: Apply various indices for distribution system and evaluate reliability of interconnected systems
CO4: Describe the concept of Distribution System Reliability Analysis
CO5: Analyzing substation circuit failures

TEXT BOOKS:

1. R. Mohan Mathur, RajivK.Varma, "Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc , 2002.
2. Narain G.Hingorani,"Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi-110006, 2011.

REFERENCES:

1. K.R Padiyar, "FACTS controllers in Power Transmission and Distribution" ,New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T. John "Flexible A.C Transmission system" , Institution of Electrical and Electronic Engineers(IEEE), 1999.
3. V.K. Sood, HVDC and FACTS controllers–Applications of Static converters in Power system, APRIL 2004, Kluwer Academic Publisher, 2004.

YouTube Resources:

1. https://youtu.be/c06FZ2Yq9rk?si=_nQM0RT4Xka0GjAm
2. https://youtu.be/iUamPEJwtow?si=bUxo1BrWBGMlzELt
3. https://youtu.be/MayRywOTkDg?si=Obw5iimhjGtwnB4s
4. https://youtu.be/BQXnKpP2lrI?si=9GCWms68-tuhWrlf
5. https://youtu.be/YatN8EQn6MY?si=efew8hTnE59g8Hgb

TOTAL: 45 PERIODS

Course Code	Advanced Power System Analysis	L	T	P	C
EE4V34		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To perform steady state analysis and fault studies for a power system of any size and also to explore the nuances of estimation of different states of a power system.

Course Description

This course provides a comprehensive understanding of power system 134odelling, analysis, optimization, and state estimation. It covers various aspects of power system operation and control, including network 134odelling, load flow analysis, fault studies, power system optimization, and state estimation techniques.

Prerequisites

- Basic Power System Analysis: Familiarity with topics such as load flow analysis, fault analysis, and power system stability is recommended.
- Programming Skills: Basic programming skills in languages such as MATLAB or Python may be beneficial for implementing algorithms and conducting simulations in power system analysis.

UNIT I INTRODUCTION **9**

Network 134odelling – Single phase and three phase 134odelling of alternators, transformers and transmission lines, Conditioning of Y Matrix –- Incidence matrix method, Method of successive elimination, Triangular factorization – Sparse matrix

UNIT II LOAD FLOW ANALYSIS **9**

Load flow analysis – Newton Raphson method, Fast Decoupled method, AC-DC load flow –Single and three phase methods – Sequential solution techniques and extension to multiple and multi-terminal DC systems.

UNIT III ANALYSIS OF FAULT AND ITS CALCULATION **9**

Fault Studies -Analysis of balanced and unbalanced three phase faults – fault calculations – Short circuit faults – open circuit faults.

UNIT IV POWER SYSTEM OPTIMIZATION **9**

System optimization – strategy for two generator systems – generalized strategies – effect of transmission losses – Sensitivity of the objective function – Formulation of optimal power flow-solution by Gradient method Newton's method

UNIT V POWER SYSTEM STATE ESTIMATION **9**

State Estimation – method of least squares – statistics – errors – estimates – test for bad data – structure and formation of Hessian matrix – power system state estimation.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To construct models of power system components and apply them
CO2: To solve ac and dc load flow for single and there phase systems
CO3: To analyse the faults in the power system networks
CO4: To apply the concepts of optimization in power system.
CO5. To explain the concept of state estimation in power system and the role of statistics in state estimation.

TEXT BOOKS:

1. Arindam Ghosh and Gerad Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, First Edition, 2002.
2. G.T. Heydt, "Electric Power Quality", Stars in a Circle Publications, Second Edition, 2011.
3. George J. Wakileh, "Power System Harmonics – Fundamentals, Analysis and Filter Design", Springer–Verlag Berlin Heidelberg, New York, 2019.

REFERENCES:

1. R.C. Duggan, "Electric Power Systems Quality", Tata McGraw Hill Publishers, Third Edition, 2012.
2. Arrillga, "Power System Harmonics", John Wiley and Sons, 2003, 2nd Edition.
3. Derek A. Paice, "Power Electronic Converter Harmonics", IEEE Press, 1995, Wiley–IEEE Press, 1999, 18th Edition.

YouTube Resources:

1. https://youtu.be/4oRT7PoXSS0?si=p9BSCtB7gzYQSKz5
2. https://youtu.be/8ruTV8dtbFE?si=1lg11NcfPTWd9Mpv
3. https://youtu.be/zlHbsT4bhR8?si=jRfgPH_IU-jwDq02
4. https://youtu.be/o9MUMlWA5IE?si=3L826jwHtDkkIc3x
5. https://youtu.be/gTXKvM9q4gk?si=i0ZxeICHCVXaJINY

TOTAL: 45 PERIODS

Course Code	Smart Grid	L	T	P	C
EE4V35		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the various challenges and benefits of smart grid and the national and international initiatives taken.
- To understand the evolution of Smart and Interconnected energy systems.
- To understand the various computing technologies for Smart Operation.
- To get an insight into the various smart measurement technologies.
- To understand the concepts related to transmission and distribution in smart grid technologies.

Course Description

This course provides an extensive overview of smart grid technologies, covering their evolution, components, functions, and applications. It explores the concept of smart grids, including their differences from conventional grids and the opportunities and challenges they present. Additionally, it discusses microgrids and initiatives at both national and international levels.

Prerequisites

- Basic Knowledge of Power Systems: Understanding of fundamental concepts in powersystems, including transmission, distribution, and grid operation.
- Electrical Engineering Fundamentals: Familiarity with electrical circuits, systems, and components, as well as basic principles of energy generation, transmission, and distribution.

UNIT I INTRODUCTION **9**

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

UNIT II SMARTMETERING **9**

Introduction to Advanced Metering infrastructure (AMI) – drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU)

UNIT III SMART GRID TECHNOLOGIES (Transmission) **9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT IV SMART GRID TECHNOLOGIES (Distribution) **9**

DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the importance and objectives of Power System Grid.
CO2: To be able to know and understand the concept of a smart grid;
CO3: To identify and discuss smart metering Devices and associated technologies.
CO4: To be able to get an overview of Microgrid and Electric Vehicle Technology.
CO5: To be able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effective and efficient operation of Smart Grid.

TEXT BOOKS:

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase, CRC, 2018.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley, 2012.
3. James Momoh, Smart Grid Fundamentals of Design and Analysis, IEEE Press, 2012.

REFERENCES:

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC Press, 2018.
2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011. Doi: 10.1109/TII.2011.2166794.
3. X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid—The New and Improved Power Grid: A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944-980, Fourth Quarter 2012. Doi: 10.1109/SURV.2011.101911.00087.
4. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012.

YouTube Resources:

1. https://youtu.be/DW0jTe80kmM?si=ER5FPddeKnHJdiRO
2. https://youtu.be/4d29ePO3NiA?si=RXlGe7ZjNBcsl-AV
3. https://youtu.be/eSW_kdVP-8I?si=VC5SBf_q2B2SKjUT
4. https://youtu.be/Q_OdV8m6cqk?si=Q7tRo60hE4ryMY46
5. https://youtu.be/EjEUbpUAAP8?si=xaeYGdS0MGkU-sws

TOTAL: 45 PERIODS

Course Code	Power System Transients	L	T	P	C
EE4V36		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.
- To study the overvoltage induced by faults

Course Description

This course provides an in-depth understanding of transient phenomena in power systems, covering various types of transients, their sources, and their effects on system operation and equipment. It explores switching transients, lightning transients, computation of transients on transmission lines, and their impact on integrated power systems.

Prerequisites

- Basic Electrical Circuit Analysis: Familiarity with circuit analysis techniques, including RL, RC, and RLC circuits, transient response, and circuit elements 138odelling.
- Electromagnetic Theory: Understanding of electromagnetic principles, including Maxwell's equations, electromagnetic waves, and transmission line theory.

UNIT I INTRODUCTION AND SURVEY 9

Sources of different types of transients – RL circuit transient with sine wave excitation – double frequency transients – basic transforms of the RLC circuit transients – study of transients in system planning – Importance of grounding.

UNIT II SWITCHING TRANSIENTS 9

Basic concept of switching transients – resistance switching and equivalent circuit for interrupting the resistor current – load switching and equivalent circuit – waveforms for transient voltage across the load and the switch – normal and abnormal switching transients. Current suppression – current 195 chopping – effective equivalent circuit – capacitance switching with a restrike, with multiple restrikes – ferro resonance.

UNIT III LIGHTNING TRANSIENTS 9

Theories of cloud formation – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke – factors contributing to good line design – protection using ground wires – tower footing resistance – Interaction between lightning and power system

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients – transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept – step response – Bewely's lattice diagram – standing waves and natural frequencies – reflection and refraction of travelling waves. Computation of over voltages using EMTP.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM **9**

The short line and kilometric fault – distribution of voltages in a power system – Line dropping and load rejection – voltage transients on closing and reclosing lines – overvoltage induced by faults – switching surges on integrated system Qualitative application of EMTP for transient computation.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Explain the principles of transients and its concepts
CO2: Know the different types of switching transients and the way to draw the necessary Equivalent circuit.
CO3: Explain the concepts behind lighting and the way to protect the same.
CO4: Compute the transient 139odelling in transmission line
CO5: Explain the 139odelling of the Circuit during switching and to learn the simulation tool.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

YouTube Resources:

1. https://youtu.be/7Nh7ISeqn6E?si=fhlj73hS5tMr0He3
2. https://youtu.be/n3qT50pR5hI?si=1vxUx2AHXftyOaiS
3. https://youtu.be/cJPforDviTE?si=1JocBBnp5SS-VwUS
4. https://youtu.be/MQjtzVyc4tY?si=kJLRiIG9ob2CS1MD
5. https://youtu.be/XBGD9_pSugA?si=ikhX2a9nrRX9TWZi

TOTAL: 45 PERIODS

Vertical 4: ELECTRIC VEHICLE TECHNOLOGY

Course Code	Automotive Engineering For Electric Vehicles	L	T	P	C
EE4V41		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the functional blocks of Engine components and systems
- To study about the Chassis and Suspension system
- To know about the various types of Wheels and tires
- To impart knowledge on Braking and Steering systems
- To learn the EV Electric motors & batteries.

Course Description

These units cover a broad range of topics related to conventional vehicle systems, electric vehicles, chassis and suspension systems, wheels and tires, braking and steering systems, and electric motors & batteries. This syllabus provides a comprehensive understanding of various aspects of automobile engineering.

Prerequisites

- Battery performance degradation 140delling and analysis
- Hydraulic Power Steering (HPS), Electric Power Hydraulic Steering (EPHS), Electric Power Steering (EPS).

UNIT I CONVENTIONAL VEHICLE SYSTEMS 9

Conventional vehicle systems and configurations: Engine components and systems, four stroke engines, engine performance, air pollution, emission norms. Overview of Electric Vehicles: History of Electric vehicles, Basic construction of Electric vehicles, Electric vehicles vs Conventional vehicles. Battery electric vehicles (BEVs), hybrid electric vehicle (HEV), types of hybrid vehicles, plug-in hybrid electric vehicle (PHEV), fuel cell electric vehicle (FCEV): Electric vehicles standards and regulations

UNIT II CHASSIS AND SUSPENSION SYSTEM 9

Chassis and Body: Frames – Conventional, Semi-Integral, Integral type. Chassis – Ladder frame, Backbone, Monocoque, Tubular chassis. Advantages and disadvantages. Suspension system: Springs: coil springs, leaf springs, torsion bars. Dampers: Hydraulic dampers, Nitrox dampers, Telescopic and USD suspensions, MR and ER dampers. Types of suspension systems: rigid axle and independent suspensions, air suspension systems, electronic suspension systems, electromagnetic suspension, active and passive suspension systems.

UNIT III WHEELS AND TIRES 9

Types of wheels, Front /rear wheel drive configurations – Four/All-wheel drive configurations. Transmission system: Power train configurations and components, hub motor direct drive configuration, centrally mounted configuration, differential- classification and types.

UNIT IV BRAKING AND STEERING SYSTEMS **9**

Braking systems: Drum brakes, disc brakes, hydraulic brakes, power-assisted brake, air brakes, electric brakes, anti-lock braking system (ABS), electronic brake force distribution system (EBD), regenerative braking, brake assist system. Supplementary restraint system, air bags, pyrotechnic inflator, air bag control unit. Steering system: Steering mechanism, steering geometry, steering gears, power-assisted steering -hydraulic power steering (HPS), electric power hydraulic steering (EPHS), electric power steering (EPS).

UNIT V ELECTRIC MOTORS & BATTERIES **9**

Electric motors & batteries: Types of motors, Types of batteries, constructional details, thermal management of batteries, vent management system, Battery life analysis, Battery performance degradation modelling and analysis.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the functional blocks of Engine components and systems
CO2: To be able to outline the Chassis and Suspension system
CO3: To be able to illustrate the various types of Wheels and tires
CO4: To be able to interpret the knowledge on the Braking and Steering systems
CO5: To be able to learn the EV Electric motors & batteries.

TEXT BOOKS:

1. Mich H. Heisler, Advanced Vehicle Technology, 2nd ed. Butterworth–Heinemann, 2002.
2. M Ehsani, Y Gao, L K Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, 3rd Edition, Taylor and Francis, 2018.
3. Tom Denton, Electric and Hybrid Vehicles ,2nd ed., Routledge, 2020.

REFERENCES:

1. W. H. Crouse and D. L. Anglin, Automotive Transmission and Power Trains construction, 10th ed. McGraw Hill, 2008.
2. W. H. Crouse and D. L. Anglin, Automotive mechanics, 10th ed. Tata McGraw-Hill, 2004.
3. K. Newton, W. Steeds, and T. K. Garret, Motor Vehicle, 13th ed. Butterworth-Heinemann, 2004.

YouTube Resources:

1. https://youtu.be/tM9Akdo8QeA
2. https://youtu.be/Bc9_TUFoCAw
3. https://youtu.be/CWulQ1ZSE3c
4. https://youtu.be/Ty4ZTq7A7rc
5. https://youtu.be/izTtq9HY_oU

TOTAL: 45 PERIODS

Course Code	Sensors for EV System	L	T	P	C
EE4V42		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the functional blocks of measurement System
- To study about the Time response of first order system using simulation tool
- To know about the Sensor data management,
- To impart knowledge on Direct and indirect measurement
- To learn the Thick film sensors.

Course Description

Provides an in-depth exploration of sensors used in electric vehicle (EV) systems, covering principles, types, applications, and integration into EV platforms. Students will gain theoretical knowledge and practical skills in selecting, installing, and troubleshooting sensors critical for EV operation and performance optimization.

Prerequisites

- Basic understanding of electric circuits and systems
- Familiarity with fundamental principles of electromechanical devices
- Proficiency in mathematics, including algebra and calculus

UNIT I Measurement System **9**

Review of functional blocks of measurement System-Principles of sensors and transducers – Differences Measurement and Error-Accuracy and precision- Types of errors- Systematic and random errors, propagation of errors- Classification of Transducers-Static characteristics: Accuracy, precision, resolution, sensitivity, Linearity-Dynamic characteristics – Design of Zero order and first order systems using mathematical modelling

UNIT II Transducer **9**

Time response of first order system using simulation tool. Resistance Transducer: Potentiometer, strain gauge, resistance thermometer, thermistor, hotwire anemometer. Inductance Transducer: Hall effect transducer, LVDT. Capacitance Transducer: Principle, capacitive displacement transducer, practical capacitor pickups: Equibar differential pressure transducer.

UNIT III Speed measurement **9**

Speed measurement – Encoders, Resolvers, R/D Converters, Hall current sensors and current sampling – Optical tachometer, stroboscopic tachometer -Acceleration measurement: capacitive accelerometer, angular accelerometer, velocity sensor – Density measurement: Hydrometer, ultrasonic and sonic densitometer. Viscosity measurement: Capillary viscometer, efflux cup viscometer – Humidity measurement: Dew point hydrometer, electrolytic hygrometer – pH meter – Safety measures in industrial environment. Sensor data management, linearity, data processing, MEMS, error estimation, voltage drop stack up.

UNIT IV Direct and indirect measurement **9**

Direct and indirect measurement – capacitive level sensors, optical level sensors, conductivity level sensor, vibrating sensor, float switch sensor, continuous level measurement sensor, ultrasonic sensor, microwave sensor – Analog and Digital filter design and Adaptive filter design- design of amplifiers,

antialiasing filters. Classical parameter estimation: Cramer-Rao bound, Minimum mean squared error estimation, Minimum variance unbiased estimation, Best Linear Unbiased Estimation, Maximum Likelihood estimation, Method of Moments. Bayesian parameter estimation: Minimum mean squared error (MMSE) estimation, Maximum a posteriori estimation, Linear MMSE estimation, Sequential linear MMSE estimation, Kalman Filter

UNIT V Film sensor **9**

Thick film sensors, Thin film sensors- Semiconductor IC Technology-Micro electro mechanical system (MEMS)- Nano electro mechanical system (NEMS). Sensor data Acquisition-Feature Extraction-Supervised Learning-Unsupervised Learning-Learning from sensor data- Performance evaluation-Comparison with deep learning- Integration point of machine learning Algorithms-Tools for machine learning. Linear regression assignment, logistic regression, model selection: practical considerations...

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the functional blocks of measurement System
CO2: To be able to outline the Time response of first order system using simulation tool
CO3: To be able to illustrate the Sensor data management,
CO4: To be able to interpret the knowledge on the Direct and indirect measurement
CO5: To be able to learn the Thick film sensors

TEXT BOOKS:

1. Patranabis.D, "Sensors and Transducers", 2nd Edition, Prentice Hall of India, 2021.
2. Michael Stanley and Jongmin Lee, "Sensor analysis for the Internet of Things", 1st Edition, Morgan Claypool publishers, 2018.
3. D. Patranabis, "Principles of Industrial Instrumentation", 4th Edition, Tata McGraw Hill, New Delhi,2017.
4. Anupama Prashar, Pratibha Bansal, "Industrial safety and Environment", S.K. Kataria &sons, 2009..

REFERENCES:

1. We R. K. Jain, "Mechanical and Industrial Measurements", 12th Edition, Khanna publishers, 2015.
2. Randy Frank, Understanding Smart Sensors, Artec House Boston. London, 2000
3. Alan S. Morris and Reza Langari, 2nd ed., Measurement and Instrumentation, Theory and Application, Academic Press, 2015.

YouTube Resources:

1. https://youtu.be/xNEU7blg8JE
2. https://youtu.be/SAfgq243XpY
3. https://youtu.be/oHosYBZDubY
4. https://youtu.be/DVq10SGKHMU
5. https://youtu.be/hnFTv0cjvOI

TOTAL: 45 PERIODS

Course Code	Energy Storage Systems for Electric Vehicle	L	T	P	C
EE4V43		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the Energy Storage Requirements in Electric Vehicles
- To study about the overview of various fuel cells technology
- To know about the Selection of battery for EV
- To impart knowledge on Battery mounting arrangement
- To learn the design and applications of Energy Storage.

Course Description

Energy storage systems for electric vehicles encompass a variety of technologies tailored to meet different performance, efficiency, and application requirements. Continued advancements in battery technology, along with the integration of complementary storage technologies, will further enhance the performance and widespread adoption of electric vehicles.

Prerequisites

- Battery sizing and stand-alone applications.
- Charging methods: Constant current, constant voltage, and hybrid methods.
- Inductive chargers and their applications.

UNIT I Introduction **9**

Introduction to Energy Storage Requirements in Electric Vehicles – Different types of energy storage; Mechanical: Flywheel based energy storage; Chemical: Hydrogen production and storage; Electrical: Capacitors for EV, Super Capacitor, EDLC; Electrochemical: battery, fuel cell, biological, thermal; Magnetic Energy Storage, Superconducting Energy Storage systems, Hybridization of different energy storage devices. Modelling of various emerging storage systems – Simulation case studies

UNIT II Fuel cells technology **9**

Introduction and overview of fuel cells technology: low, medium and high temperature fuel cells – Types of fuel cells, liquid and methanol types, proton exchange membrane fuel cell, solid oxide, Microbial fuel cell, Thermodynamics of fuel cells, Fuel cell 144odelling-simulation and case studies, system integration, Safety issues and cost expectation and life cycle analysis of fuel cells, Placement of storage systems. Battery technology, Type of battery: Lead acid, Li-ion, Li-Polymer, Ni-MH, Ni-Cd and other advanced batteries for EV's. Battery 144odelling-simulation and case studies.

UNIT III Selection of battery **9**

Selection of battery cell and types, Standardized sizes and shapes pertaining to both primary and secondary batteries, Selection of Key technical terms: End of life, Depth of Discharge (DoD), State of Charge (SoC), Cycling rate (C-rate), Study of Battery critical parameters selection (voltage of cell, Specific energy, Charge and Discharge rate, Cycle life, current density), Cell equalization problem. Thermal runaway, Battery series parallel connection and string size. Measurement, estimation and tracking of SoC.

UNIT IV Battery packaging **9**

Battery mounting arrangement and installation methodology. State of health and charging efficiency and its effect on life cycle for various C-rates. Different battery management strategies, chemical properties,

charge balancing, recyclability, salt-based batteries, solid state batteries, battery packaging, safety considerations. Combination of super capacitor and battery – the application perspective.

UNIT V Battery testing **9**

Design and Applications of Energy Storage – Battery sizing and stand-alone applications, Constant current and constant voltage charging methods, Hybrid Methods, Inductive chargers, Battery power testing for various vehicles, Battery testing for urban and highway driving cycles, Battery management systems and controls, control of charge discharge cycles. Case studies. Combination of super capacitor and battery – the application perspective

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the Energy Storage Requirements in Electric Vehicles
CO2: To be able to outline the overview of various fuel cells technology
CO3: To be able to illustrate the Selection of battery for EV
CO4: To be able to interpret the knowledge on the battery mounting arrangement
CO5: To be able to learn the design and applications of Energy Storage.

TEXT BOOKS:

1. D. A. J. Rand, R. Woods, and R. M. Dell, "Batteries for Electric Vehicles," Society of Automotive Engineers," Warrendale PA, 2003.
2. F. A. Silva and M. P. Kazmierkowski, "Energy Storage Systems for Electric Vehicles [Book News]," in IEEE Industrial Electronics Magazine, vol. 15, no. 4, pp. 93-94, Dec. 2021.
3. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN – 978-1-84919 219-4), 2011.
4. Mehrdad Ehsani, Yimin Gao, and Ali Emadi, "Modern Electric, Hybrid and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.

REFERENCES:

1. Electric Power Research Institute (USA), "Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits" (1020676), December 2010.
2. Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, "The Role of Energy Storage with Renewable Electricity Generation", National Renewable Energy Laboratory (NREL) – A National Laboratory of the U.S. Department of Energy – Technical Report NREL/ TP6A2-47187, January 2010.

YouTube Resources:
1. https://youtu.be/j7RaL_XKywk
2. https://youtu.be/IgxY_Xz4OMA
3. https://youtu.be/lGPlrzk5iDE
4. https://youtu.be/gd1fTJ-csio
5. https://youtu.be/5No5DboThQg

TOTAL: 45 PERIODS

Course Code	Electric Vehicle Charging Infrastructure and Analysis	L	T	P	C
EE4V44		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the effect of EV charging on generation and load profile
- To study about the on board and off board charger specification
- To know about the Fire & safety aspects of charging stations
- To impart knowledge on various communication protocol and gateways
- To learn the nature and scope of reliability of charging stations.

Course Description

The course will also cover topics such as charging network planning, grid integration, demand-side management, pricing models, user 146odelling analysis, and environmental considerations. Through case studies, hands-on projects, and simulation exercises, students will gain practical skills in evaluating, designing, and optimizing EV charging infrastructure for different contexts and stakeholders.

Prerequisites

- Basic understanding of electrical engineering principles and power systems
- Familiarity with transportation systems and energy economics is beneficial but not required.

UNIT I Introduction **9**

EV charging options and infrastructure, energy, economic and environmental considerations, Impact of EV charging on power grid-distribution system, effect of EV charging on generation and load profile, Smart charging technologies, Identification of EV demand, EV penetration level for different scenarios, classification based on penetration level. General safety requirement for electric vehicle charging stations: IS/IEC 62305.

UNIT II Charging Infrastructure **9**

Types of charging stations and Charging Infrastructure, Battery Swapping Station, Move-and-charge zone. AC charging and DC charging – On board and off board charger specification – EVSE technical specification and charging time calculation – Selection and sizing of fast and slow charger (AC & DC) – AC Pile Charger, DC Pile Charger. Charging – Interoperability of chargers, impact of battery life due to chargers

UNIT III Renewable Energy based EV Charging Station **9**

Introduction to renewable Energy based EV Charging Station – Calculation and Selection – Components of Charging Station – Earth protection system for charging stations – Fire & safety aspects of charging stations, EV impacts on system demand: dumb charging, multiple tariff charging, smart charging, burp charging, negative pulse charging, random charging, high speed/fast charging, and different case studies of charging approach.

UNIT IV Communication protocol and gateway **9**

Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module) – Communication gateway – Specification of open charge point protocol (OCCP 1.6/2.0) – Bharat DC001 & AC001 Charger specification – Communication between AC charger and EV – Selection of DC charger connector GB/T, CHAdeMO, CCS-1 and CSS-2

UNIT V V2G and G2V **9**

Communication methodology of DC fast chargers. IoT based communication supporting systems for performance measures of Evs. Recent advancements in Vehicle to Grid (V2G) and Grid to Vehicle (G2V) technologies – Case Studies on EV charging. Reliability of charging stations – predicative approach and analysing for long-term maintenance free operation. Significance of bathtub curve, reliability prediction based on working condition

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the effect of EV charging on generation and load profile
CO2: To be able to outline the on board and off board charger specification
CO3: To be able to illustrate the Fire & safety aspects of charging stations
CO4: To be able to interpret the knowledge on various communication protocol and gateways
CO5: To be able to learn the nature and scope of reliability of charging stations.

TEXT BOOKS:

1. A. Khajepour, S. Fallah and A. Goodarzi, "Electric and Hybrid Vehicles Technologies, Modeling and Control: A Mechatronic Approach", John Wiley & Sons Ltd, 2014.
2. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
3. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
4. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.

REFERENCES:

1. Tariq Muneer and Irene IllescasGarcí´a, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.
2. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
3. Alam, M. S., Pillai, R. K., & Murugesan, N. (Eds.). (2022). Developing Charging Infrastructure and Technologies for Electric Vehicles. IGI Global.

YouTube Resources:

1. https://youtu.be/pLcqJ2DclEg
2. https://youtu.be/ThhPPQc3b7Y
3. https://youtu.be/Ie7qvo-aC5k
4. https://youtu.be/1HN3F3HZq7o
5. https://youtu.be/6vCKLC7GBmc

TOTAL: 45 PERIODS

Course Code	Electric Vehicle System Engineering and Policy	L	T	P	C
EE4V45		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the standardization in e-mobility
- To study about the electric vehicles testing and electric vehicle safety
- To know about the Energy Storage Testing for Safe Electrification of Transport
- To impart knowledge on various type of drive cycles
- To learn the nature and scope of policies to stimulate widespread EV adoption.

Course Description

This course delves into the interdisciplinary field of electric vehicle (EV) system engineering and the associated policy considerations. Students will explore the entire lifecycle of electric vehicles, from design and manufacturing to operation and end-of-life management, while also examining the policy frameworks that influence their adoption and integration into transportation systems.

Prerequisites

- Basic understanding of engineering principles and environmental science
- Familiarity with transportation systems and policy frameworks is beneficial but not required

UNIT I Introduction **9**

Introduction to EV technologies, Types of EV architecture, Electric vehicle and environment, Vehicle classification, Usage pattern for electric vehicles, Standardization in e-mobility, Government policies: standards and regulation, Design aerodynamics, Chassis model for battery operated vehicles BMS Design Considerations

UNIT II Testing of EV and batteries **9**

Electromagnetic compatibility testing, Efficiency and emissions testing, On-road electric vehicles testing, Battery Electric vehicle safety and crash worthiness. Range modelling of EV, Driving cycles. Acceleration performance parameter-based testing (Aerodynamic drag, hill climbing force, total tractive effort), Constant velocity range modelling, Dynamic tests, static tests, Charge and discharge testing, Battery performance, material performance and cell performance modelling

UNIT III Standards and specifications **9**

Energy Storage Testing for Safe Electrification of Transport, Range testing based on different types of battery (Li ion and fuel cell-based vehicles). Reliability index investigation on EV – Standards and specifications. Modelling of BEV-Forward looking Model-Driver Perspective, Backward Looking Model-Drive Cycle Perspective, Modelling of Driver, Modelling of Brake Control Unit, Modelling of Vehicle Control Strategy, and Modelling of Vehicle Chassis.

UNIT IV Steady state analysis **9**

Sizing of Components- Steady State Energy Balance Equation, Power train Dimensioning-Peak vs Continuous performance, Type of Drive cycles, Types of Control Strategy, Analysis-Performance, Range, and Consumption Prediction. Safety and security aspects of EV.

UNIT V Communication protocols **9**

Communication architecture for DC fast charging, communication protocols and verification procedures that support electric vehicle (EV)-grid connectivity, criteria for connecting EV to utility for AC level 1 and level 2 charging. Nature and scope of policies to stimulate widespread EV adoption and support EVCI station implementation; policy formulation and implementation at various levels of government; examples of policies and incentives for EV adoption; replacement of the gasoline tax funding source in an increasingly electrified environment.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the standardization in e-mobility
CO2: To be able to outline the electric vehicles testing and electric vehicle safety
CO3: To be able to illustrate the Energy Storage Testing for Safe Electrification of Transport
CO4: To be able to interpret the knowledge on various type of drive cycles
CO5: To be able to learn the nature and scope of policies to stimulate widespread EV adoption

TEXT BOOKS:

1. Mich "Electric powertrain: energy systems, power electronics & drives for hybrid, electric & fuel cell vehicles", Goodarzi, Gordon A., Hayes, John G, Wiley 2018.
2. Advanced Electric Drives – Analysis, Modeling, Control, RiK De Doncker, Springer publications.
3. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory and Design, Mehradad Eshani, Yimin Gao, Ali Emadi. Second Edition, CRC Press, Taylor and Francis Group, 2010.

REFERENCES:

1. W Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, Second Edition, CRC Press, Taylor and Francis Group, 2011.
2. Electric Vehicle Technology Explained, James Larminie John Lowry, Second Edition, Wiley, 2012.
3. Introduction of Hybrid Vehicle System Modelling and Control, Wei Liu, Wiley student edition 2013.
4. Power Electronics Convertor, Applications, and Design, NED MOHAN, Third Edition, Wiley, 2002.

YouTube Resources:

1. https://youtu.be/tJfERzrG-D8
2. https://youtu.be/6H5vtu5_SF4
3. https://youtu.be/ly8ikWtAY7s
4. https://youtu.be/wvPe4Zb0tUA
5. https://youtu.be/JHJQ6Ke2mYU

TOTAL: 45 PERIODS

Course Code	Hybrid and Electric Vehicles	L	T	P	C
EE4V46		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To know the social and environmental importance of hybrid and electric vehicles
- To understand the basics of Hybrid and Electric Drive-trains
- To impart knowledge on the configuration and control of electric motor drives
- To study the Energy Storage requirements in Hybrid and Electric Vehicles
- To learn the energy management strategies used in hybrid and electric vehicles.

Course Description

This course provides an in-depth understanding of hybrid and electric vehicles, covering their history, importance, drive-train technologies, control techniques, energy storage systems, and energy management strategies. Students will explore the social and environmental significance of hybrid and electric vehicles, as well as the impact of modern drive-trains on energy supplies.

Prerequisites

- Basic understanding of automotive engineering principles
- Fundamental knowledge of electric circuits and motors
- Familiarity with energy storage systems
- Proficiency in mathematical 150odelling and analysis

UNIT I Introduction **9**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies – Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT II Hybrid and Electric Drive-trains **9**

Basics of Hybrid and Electric Drive-trains: Basic concept of traction, introduction to various drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles

UNIT III Control techniques **9**

Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV Energy Storage **9**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Analysis of various energy storage devices – Battery, Fuel Cell, Super, Flywheel – Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor and power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT V Energy Management Strategies **9**

Introduction to energy management strategies used in hybrid and electric vehicles, classification, comparison and implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV) and Battery Electric Vehicle (BEV)

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To be able to understand the social and environmental importance of hybrid and electric vehicles
CO2: To be able to outline the basics of Hybrid and Electric Drive-trains
CO3: To be able to illustrate the configuration and control of electric motor drives
CO4: To be able to interpret the Energy Storage requirements in Hybrid and Electric Vehicles
CO5: To be able to learn the energy management strategies used in hybrid and electric vehicles

TEXT BOOKS:

1. I. Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003
2. M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005
3. A. E. Fuhs, Hybrid Vehicles and the Future of Personal Transportation, CRC Press, 2009
4. C. C. Chan and K. T. Chau, Modern Electric Vehicle Technology, Oxford Science Publication, 2001 Industrial Power and Automation, Department of Electrical Engineering, NIT Calicut – 673601 93.

REFERENCES:

1. G. Lechner and H. Naunheimer, Automotive Transmissions: Fundamentals, Selection, Design and Application, Springer, 1999
2. Gianfranco, Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market, Pistoia Consultant, Rome, Italy, 2010
3. M. H. Rashid, Power Electronics: Circuits, Devices and Applications, 3rd ed., Pearson, 2004
4. V. R. Moorthi, Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press, 2007

YouTube Resources:

1. https://youtu.be/0kCGoDjtnM4
2. https://youtu.be/8ON6pXbOm8g
3. https://youtu.be/MuDkdFRKpZM
4. https://youtu.be/LlhQCP0UFoo
5. https://youtu.be/2qZxfnMDrco

TOTAL: 45 PERIODS

Vertical 5: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	Fundamentals of Data Science	L	T	P	C
EE4V51		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

Course Description

This course covers data science fundamentals, including the data science process, data description, and relationships between data. Students will learn Python libraries for data wrangling and visualization to present and interpret data effectively.

Prerequisites

- Basic understanding of programming concepts, preferably in Python.

UNIT I Introduction **9**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data

UNIT II Describing Data **9**

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data in Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

UNIT III Describing Relationships **9**

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

UNIT-IV Python Libraries for Data Wrangling **9**

Indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT – V Data Visualization **9**

Importing Mat plot lib – Line plots – Scatter plots – visualizing errors – density and contour plots Histograms – legends – colors – subplots – text and annotation – customization – three-dimensionalplotting - Geographic Data with Base map - Visualization with Seaborn.

COURSE OUTCOME:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Define the data science process
CO2: Understand different types of data descriptions for data science process
CO3: Gain knowledge on relationships between data.
CO4: Use the Python Libraries for Data Wrangling
CO5: Apply visualization Libraries in Python to interpret and explore data

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III) Padeepz App Padeepz App 69 3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCES:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

YouTube Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://www.youtube.com/watch?v=plDCgJC0jfI&list=PLROOIV7hGpZinbHlKg5wHvbg_VYmPLlZh
3. https://www.youtube.com/watch?v=EnffE3Xre18
4. https://www.youtube.com/watch?v=pGsTw3P1D_4&pp=ygUjUHl0aG9uIExpYnJhcmllcyBmb3IgRGF0YSBXcmFuZ2xpbmc%3D
5. https://www.youtube.com/watch?v=CmorAWRsCAw&list=PLeo1K3hjS3uuASpe-1LjfG5f14Bnozjwy
6. https://www.youtube.com/watch?v=MiiANxRHSv4

45 PERIODS

Course Code	Data Analytics and Visualization	L	T	P	C
EE4V52		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the data science fundamentals and process.
- To learn to describe the relationship between data.
- To utilize present and interpret data using Python libraries for Data Wrangling and data visualization.
- To study the basic inferential statistics, sampling distribution and processes in data analytics
- To understand the data analytics techniques and apply descriptive data analytics techniques

Course Description

Data Analytics and Visualization involve the process of examining large datasets to uncover hidden patterns, correlations, trends, and insights. This field is crucial for organizations looking to make data-driven decisions, optimize processes, understand customer behaviour, and gain a competitive edge.

Prerequisites

- Understanding data can optimize operations by identifying inefficiencies, streamlining processes, and reducing costs.
- Visualization of key performance indicators (KPIs) allows for real-time monitoring and adjustments.

UNIT I INTRODUCTION **6**

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model– presenting findings and building applications – Data Mining – Data Warehousing – Basic Statistical descriptions of Data.

UNIT II DESCRIBING DATA **6**

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, 154odelli logic – fancy indexing – structured arrays – Data manipulation with Pandas – data in Types of Data – Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores. DESCRIBING RELATIONSHIPS: Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

UNIT III PYTHON LIBRARIES FOR DATA WRANGLING **6**

Indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables DATA VISUALIZATION: Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting – Geographic Data with Base map – Visualization with Seaborn.

UNIT IV DESCRIPTIVE ANALYTICS AND INFERENTIAL STATISTICS 6

DESCRIPTIVE ANALYTICS – Frequency distributions – Outliers –interpreting distributions – graphs – averages – describing variability – interquartile range – variability for qualitative and ranked data – Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean. INFERENTIAL STATISTICS – populations – samples – random sampling – Sampling distribution- standard error of the mean – Hypothesis testing – z-test – z-test procedure – decision rule – calculations – decisions – interpretations – one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size.

UNIT V ANALYSIS OF VARIANCE AND PREDICTIVE ANALYTICS 6

ANALYSIS OF VARIANCE - T-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests. PREDICTIVE ANALYTICS – Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.

Lab experiments

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
b. Bivariate analysis: Linear and logistic regression 155odelling
c. Multiple Regression analysis
d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.
a. Normal curves
7. Perform Z-test
8. Perform T-test
9. Perform ANOVA
10. Building and validating linear models
11. Building and validating logistic models
12. Time series analysis

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Define the data science process Understand different types of data descriptions for data science process
CO2: Gain knowledge on relationships between data and use the Python Libraries for Data Wrangling
CO3: Apply visualization Libraries in Python to interpret and explore data
CO4: Perform various statistical analyses to make statistical inferences and explain the end-to-end data analytics pipeline
CO5: Build, validate and communicate data analytical models for complex engineering problems

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. Padeepz App Padeepz App 69
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERENCES:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014.
2. Peter Bruce, Andrew Bruce, and Peter Gedek, "Practical Statistics for Data Scientists", Second Edition, O'Reilly Publishers, 2020.
3. Charles R. Severance, "Python for Everybody: Exploring Data in Python 3", Shroff Publishers, 2017
4. Bradley Efron and Trevor Hastie, "Computer Age Statistical Inference", Cambridge University Press, 2016.

YouTube Resources:

1.https://youtu.be/WyoYXvljxto
2.https://youtu.be/HuZiJ44_71M
3.https://youtu.be/nCrD5g8d3ow
4.https://youtu.be/NZJXNw_rzTQ
5.https://youtu.be/r-V1uZx-ndM

TOTAL: 45 PERIODS

Course Code	Mathematics for Machine Learning	L	T	P	C
EE4V53		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand fundamental linear algebra concepts, including vector spaces, matrices, eigenvalues, and eigenvectors.
- Gain proficiency in advanced calculus techniques, including gradient-based optimization, to train and fine-tune learning models effectively for optimal performance.
- Explore the role of probability and statistics in learning and understanding their significance in model training, uncertainty estimation, and probabilistic 157odelling.
- Apply mathematical models through hands-on projects, implementing machine learning models.
- Give exposure to the deep learning models and 157odelli their performance using mathematical tools.

Course Description

Mathematics plays a fundamental role in understanding and developing machine learning algorithms. Here are some key mathematical concepts that are commonly used in machine learning.

Prerequisites

- Mathematical Foundations of Machine Learning" equips students with the mathematical toolkit necessary to delve deep into the world of machine learning.
- Through a blend of theoretical concepts, practical implementations, and hands-on projects, participants gain the skills to develop, optimize, and 157odelli machine learning models effectively.

UNIT I LINEAR ALGEBRA, MATRIX, AND ANALYTICAL GEOMETRY 6

Introduction and Motivation – Linear Algebra, Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces, Analytic Geometry, Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations.

UNIT II MATRIX DECOMPOSITION AND VECTOR CALCULUS 6

Matrix Decompositions, Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen-decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Vector Calculus, Differentiation of Univariate, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Back propagation and Automatic Differentiation, Higher-Order Derivatives, Linearization, and Multivariate Taylor Series.

UNIT III PROBABILITY DISTRIBUTIONS AND RISK MINIMISATION 6

Probability and Distributions – Construction of a Probability Space-Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Independence and Gaussian Distribution – Conjugacy and the Exponential Family, Change of Variables/Inverse Transform, Continuous Optimization, Optimization Using Gradient Descent, Constrained Optimization and Lagrange

Multipliers, Convex Optimization. Machine Learning Models, Empirical Risk Minimization, Parameter Estimation, Probabilistic Modelling and Inference, Directed Graphical Models, Model Selection.

UNIT IV MACHINE LEARNING MODELS AND APPLICATIONS **6**

Linear Regression, Parameter Estimation, Dimensionality Reduction with Principal Component Analysis, Maximum Variance Perspective, PCA in High Dimensions, Latent Variable Perspective, EM Algorithm, Latent-Variable, Classification with Support Vector Machines.

UNIT V DEEP LEARNING MODELS **6**

Tensors from Machine Learning and Data Science, Deep Convolutional Neural Network Architectures for Image Classification, Latent Space and Generative Modelling, Autoencoders and Variational Autoencoders.

Lab experiments

1. Systems of Linear Equations Solver: Implement a program to solve systems of linear equations using methods like Gaussian elimination or LU decomposition.

2. Vector Space Visualization: Use a computational tool like MATLAB or Python with libraries such as NumPy and Matplotlib to visualize vector spaces, linear independence, basis, and rank.

3. Matrix Decomposition Analysis: Implement algorithms for matrix decomposition techniques such as eigen-decomposition, singular value decomposition (SVD), and Cholesky decomposition. Analyze their properties and computational complexities.

4. Gradient Computation: Develop code to compute gradients for univariate and multivariate functions using analytical methods and numerical approximation techniques like finite differences.

5. Optimization Algorithms: Implement gradient descent and its variants for unconstrained optimization problems. Study their convergence properties and compare their performance on benchmark functions.

6. Constrained Optimization with Lagrange Multipliers: Solve constrained optimization problems using the Lagrange multiplier method. Explore its applications in machine learning models and 158odelli trade-offs between constraints and objectives.

7. Probabilistic Modeling and Inference: Develop a probabilistic model for a given dataset and perform inference using methods like maximum likelihood estimation (MLE) or Bayesian inference. Implement algorithms for parameter estimation and compare their performance.

8. Support Vector Machine (SVM) Classifier: Implement a linear SVM classifier from scratch using optimization techniques like gradient descent or quadratic programming. Evaluate its performance on benchmark datasets and compare it with other classification methods.

9. Principal Component Analysis (PCA): Implement PCA for dimensionality reduction on datasets with high dimensions. Visualize the transformed data and 158odelli the explained variance ratio of principal components.

10. Deep Convolutional Neural Network (CNN) for Image Classification: Implement a CNN architecture using a deep learning framework like TensorFlow or PyTorch. Train the model on image classification tasks and evaluate its performance on standard datasets like CIFAR-10 or MNIST.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To understand fundamental linear algebra concepts, including vector spaces, matrices, eigen values, and eigenvectors.
CO2: To gain proficiency in advanced calculus techniques, including gradient-based optimization, to train and fine-tune learning models effectively for optimal performance.
CO3: Explore the role of probability and statistics in learning and understanding their significance in model training, uncertainty estimation, and probabilistic modelling.
CO4: To apply mathematical models through hands-on projects, implementing machine learning models.
CO5: To explore implementing deep learning models and analyse their performance using mathematical tools.

TEXT BOOKS:

1. Eugene Charniak, "Introduction to Deep Learning," MIT Press, 2018.
2. Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, "Python Deep Learning," Packt Publishing Ltd, 2019.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning," MIT Press, 2017.
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach" O'Reilly Media, 2017.
3. Umberto Michelucci "Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" The MIT Press, 2012.
5. Ethem Alpaydin, "Introduction to Machine Learning," MIT Press, Prentice Hall of India, Third Edition2014.

YouTube Resources:

1. https://youtu.be/FGt1zTVIlT4
2. https://youtu.be/FGt1zTVIlT4?t=5
3. https://youtu.be/TUkU3dDCn04?t=13
4. https://youtu.be/czymrnQV2p4?t=16
5. https://youtu.be/PFPt6PQNslE?t=6

TOTAL: 45 PERIODS

Course Code	AI for Robotics	L	T	P	C
EE4V54		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Study the concepts of Artificial Intelligence
- Learn the methods of solving problems using Artificial Intelligence
- Introduce the concepts of Expert Systems and machine learning
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence

Course Description

This course provides a comprehensive introduction to Artificial Intelligence (AI) in Robotics, covering key topics across five units. Beginning with an exploration of AI's historical context, contemporary state, and its critical role in robotics, the curriculum delves into problem-solving methodologies, planning strategies, reasoning under uncertainty, learning mechanisms, and their specific applications in robotics. Each unit addresses fundamental concepts such as intelligent agents, knowledge representation, probabilistic reasoning, reinforcement learning, and ethical considerations.

Prerequisites

- Computer Organization and System Architecture
- Data Modeling
- Sound knowledge of programming languages such as Python and R

UNIT I Introduction **9**

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

UNIT II Planning **9**

Planning with forward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world.

UNIT III Reasoning **9**

Uncertainity – Probabilistic reasoning–Filtering and prediction– Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV Learning **9**

Forms of learning – Knowledge in learning – Statistical learning methods – reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V AI In Robotics **9**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Identify problems that are amenable to solution by AI methods
CO2: Identify appropriate AI methods to solve a given problem
CO3: Formalize a given problem in the language/framework of different AI methods
CO4: Implement AI algorithms
CO5: Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India 2003.
2. Negnevitsky, M,"Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison-Wesley, 2002.

REFERENCES:

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992. Content Beyond

YouTube Resources:

1. https://youtu.be/VYA17BrH9rU?si=GkRlyzSx27dQjRC_
2. https://youtu.be/yCXm5cgG0UA?si=oopQY2K-GUsSZtja
3. https://youtu.be/VW1ssjF80AY?si=ZH8MQ6fVpyiuTv3M
4. https://youtu.be/wGWVKkYEHBE?si=7MaqYtrhZDULS7gp
5. https://youtu.be/bRsjfbqHj8k?si=7LuGGN8Nlp6gjB13

TOTAL: 45 PERIODS

Course Code	BIG DATA ANALYTICS	L	T	P	C
EE4V55		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand big data
- To learn and use NoSQL big data management.
- To learn Map-Reduce analytics using Hadoop and related tools.
- To work with map-reduce applications
- To understand the usage of Hadoop-related tools for Big Data Analytics.

Course Description

Having these prerequisites will prepare you for the technical aspects of working with Big Data Analytics tools and frameworks. Big Data courses often involve hands-on projects where you'll work with real-world datasets, design and execute data processing pipelines, and derive meaningful insights from the data.

Prerequisites

- Basic Understanding of Data Analysis.
- Operating Systems and Command Line.

UNIT I UNDERSTANDING BIG DATA **9**

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT II NOSQL DATA MANAGEMENT **9**

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency – Cassandra – Cassandra data model –Cassandra examples – Cassandra clients

UNIT III MAPREDUCEAPPLICATIONS **9**

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats.

UNIT IV BASICS OF HADOOP **9**

Data format – 162odelling data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures – Cassandra – Hadoop integration

UNIT V HADOOP RELATEDTOOLS **9**

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.Hive – data types and file formats – HiveQL data definition – Hive QL data manipulation–HiveQL queries.

Lab experiments

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm
5. Installation of Hive along with practice examples.
6. Installation of Hbase, Installing thrift along with Practice examples
7. Practice importing and exporting data from various databases.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Describe big data and use cases from selected business domains.
CO2: Explain NoSQL big data management.
CO3: Install, configure, and run Hadoop and HDFS.
CO4: Perform map-reduce analytics using Hadoop.
CO5: Use Hadoop-related tools such as Hbase, Cass andra, Pig, and Hive for big data analytics.

TEXT BOOKS:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. "NoSQL distilled", 2013.

REFERENCES:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "Hbase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.

YouTube Resources:

1. https://youtu.be/0buKQHokLK8?t=17
2. https://youtu.be/B3gJT3t8g4Q?t=3
3. https://youtu.be/Q-w-hM1rGdg
4. https://youtu.be/aReuLtY0YMI?t=34
5. https://youtu.be/8r7kHT4K1pA?t=14

TOTAL: 45 PERIODS

Course Code	Generative Artificial Intelligence	L	T	P	C
EE4V56		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the principles and theory behind generative AI.
- Gain practical experience in developing generative AI models
- Analyze and evaluate the ethical and societal implications of generative AI.
- Apply generative AI techniques to real-world problems and domains
- Keep up-to-date with the latest developments and trends in the field of generative AI..

Course Description

This course introduces the theory and practical applications of Generative Artificial Intelligence. Students will learn the fundamental concepts and techniques related to generative models and gain hands-on experience with creating and using generative AI systems.

Prerequisites

- Basic knowledge of machine learning and deep learning.
- Familiarity with a programming language (e.g., Python).

UNIT I INTRODUCTION TO GENERATIVE AI **9**

Overview of Generative AI and its applications – Difference between generative and discriminative models – Historical perspective and key milestones – Ethical and societal implications.

UNIT II PROBABILITY AND STATISTICS FOR GENERATIVE AI **9**

Probability distributions and their role in generative models – Maximum Likelihood Estimation (MLE) – Bayesian Inference and Maximum a Posteriori (MAP) estimation – Generative models as probabilistic models.

UNIT III GENERATIVE MODEL **9**

Introduction to Autoencoders – Variational Autoencoders (VAE) – Generative Adversarial Networks (GAN) – Flow-based models – Practical implementation and hands-on exercises (using TensorFlow, PyTorch, Jupyter Notebook, Keras, etc).

UNIT IV APPLICATIONS OF GENERATIVE AI **9**

Image generation and manipulation – Text generation and natural language processing – Anomaly detection and data augmentation – Style transfer and artistic applications – Real-world use cases (Art & Design, Medical Imaging, Content creation, Chatbots, Virtual Assistants, Cybersecurity, etc.) and industry examples. Guest Lectures by Industry Experts, and Researchers.

UNIT VEVALUATION AND ETHICAL CONSIDERATIONS **9**

Metrics for evaluating generative models (e.g., Inception Score, FID) – Ethical concerns in generative AI, including bias and fairness – Privacy and security considerations – Future trends and emerging technologies in Generative AI

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the fundamental principles and applications of Generative Artificial Intelligence and distinguish between generative and discriminative models.
CO2: Apply probability and statistics concepts to 165odelli and model data, with a focus on their role in generative models.
CO3: Implement and evaluate various generative models, including Autoencoders, Variational Auto encoders (VAE), and Generative Adversarial Networks (GANs).
CO4: Apply generative AI techniques to solve real-world problems, including image generation, text generation, and artistic applications.
CO5: Evaluate generative models using appropriate metrics and critically 165odelli the ethical implications, privacy concerns, and societal impact of generative AI technologies.

TEXT BOOKS:

1. David Foster, "Generative Deep Learning", Second Edition, O'Reilly Media, 2023.
2. Jakub Langr and Vladimir Bok, "GANs in Action: Deep learning with Generative Adversarial Networks" Manning, 2019.
3. Jacob Emerson, "Ripples of Generative AI", IngramSpark, 2023.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2016.
2. Hannes Hapke, Cole Howard, Hobson Lane "Natural Language Processing in Action", Manning, 2019.
3. Alberto Chierici, "The Ethics of AI", New Degree Press, 2021.
4. Andreas C. Muller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, 2017.
5. Eric Matthes, "Python Crash Course", Third Edition, No Starch Press, 2023.

YouTube Resources:

1. https://youtu.be/2IK3DFHRFfw?t=12
2. https://youtu.be/UCOgtcwwim4?t=3
3. https://youtu.be/CG9iLLhqQF8?t=9
4. https://youtu.be/eYTvHhJWAo0?t=608
5. https://youtu.be/gEFPmqwQe34

TOTAL: 45 PERIODS

Vertical 6: ROBOTICS

Course Code	Collaborative Robotics	L	T	P	C
EE4V61		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To know the fundamentals of Collaborative Robotics
- To introduce Swarm robot and trajectory planning for Swarm
- To introduce Modular Robotics and its Mechanics
- To learn about various Natural models of robot collaboration
- To introduce the concept of Reconfigurable robot

Course Description

Collaborative Robotics, often referred to as "Cobots", is a field of robotics focused on the development and implementation of robots designed to work alongside humans in a shared workspace.

Prerequisites

- Robotics Fundamentals, Mechanical Engineering Basics.
- Computer Science and Programming, Safety and Risk Assessment.

UNIT I INTRODUCTIONTO ROBOTICS **9**

Collaborative Robotics- Properties – Introduction to Modern Mobile Robots: Swarm Robots, Cooperative and Collaborative Robots, Mobile Robot Manipulators-Current Challenges.

UNIT II SWARM ROBOTICS **9**

Introduction, mapping, kinematics and trajectory error compensation, state transitions, collective decision making and methodologies, swarm robot scenarios-aggregation, clustering dispersion, pattern formation, sorting, flocking and collective motion, shepherding, heterogeneous swarms, Error Detection and Security.

UNIT III MODULAR ROBOTICS **9**

Module Designs – Modular Robot Representation -Modular Serial Robot Kinematics – Kinematic Calibration for Modular Serial Robots- Modular Serial Robot Dynamics – Modular Parallel Robot Kinematics.

UNIT IV NATURALLY INSPIRED COLLABORATION **9**

Overview of BLDC Motor -Speed control methods -PWM techniques- ARM processor based BDLC motor control- ANN for BLDC Motor control and operation.

UNIT V SRM MOTOR CONTROL **9**

Collective Decision-Making. Group Decision Making in Animals, Collective Motion as Decision Process, Models for Collective Decision-Making Processes, Urn Models, Voter Model ,Majority Rule, Hegselmann and Krause , Kuramoto Model , Axelrod Model, Ising Model, Fiber Bundle Model, Sznajd Model, Bass Diffusion Model, Sociophysics and Contrarians.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Recognize the fundamentals of Collaborative Robotics
CO2: Apply Swarm robots technology in real time applications
CO3: Analyze and select the suitable concept of Modular Robotics and its Mechanics for modelling a collaborative robot
CO4: Create various Natural models for robot collaboration
CO5: Develop collaborative robots for various requirement in industrial tasks.

TEXT BOOKS:

1. Guilin Yang, I-Ming Chen, "Modular Robots: Theory and Practice", Springer, 2022.
2. Giandomenico Spezzano, "Swarm Robotics", Applied Sciences, MDPI, 2019.

REFERENCES:

1. Heiko Hamann, "Collective Decision-Making in Swarm Robotics: A Formal Approach", Springer, 2019.

YouTube Resources:

1. https://youtu.be/rYWJdZ5qg6M?list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_&t=
2. https://youtu.be/xrwz9IxpMJg?list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_&t=1
3. https://youtu.be/j8vYClEnyk0?list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_&t=1
4. https://youtu.be/o0NLi-wJS1I?list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_&t=3
5. https://youtu.be/MH26PuRNMXM?t=2

TOTAL: 45 PERIODS

Course Code	Micro Robotics	L	T	P	C
EE4V62		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To expose students to the fundamental aspects of the emerging field of micro robotics.
- To expose students to micro scale, technologies for fabricating small devices, bioinspired design, and applications of the field.
- To expose students to various Mathematical formalism for flexures, Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuator and other sensors.
- To apply micro robotics to various applications
- To engage students in implementation of micro robotics

Course Description

Microrobotics is a specialized field of robotics that focuses on the design, fabrication, control, and application of tiny robots at the microscale. These robots, often called "microrobots" or "microbots," are typically on the order of micrometers to 168odelling168s in size.

Prerequisites

- Microrobot Fabrication Techniques, Actuation and Sensing at the Microscale.
- Control and Navigation of Microrobots, Applications of Micro robotics.

UNIT I INTRODUCTIONTOMICROROBOTICS 9

Introduction to Micro robotics -MST (Micro System Technology) – Micromachining – Working principles of Microsystems Applications of Microsystems – Micro-fabrication principles-Design selection criteria for micromachining – Packaging and Integration aspects – Micro-assembly platforms and manipulators

UNIT II SCALINGLAWSANDMATERIALSFORMEMS 9

Introduction – Scaling laws – Scaling effect on physical properties scaling effects on Electrical properties – scaling effect on physical forces – Physics of Adhesion – Silicon – compatible material system- Shape memory alloys – Material properties – Piezo resistivity, Piezoelectricity and Thermoelectricity

UNIT III FLEXURES, ACTUATORS AND SENSORS 9

Elemental flexures – Flexure systems – Mathematical formalism for flexures – Electrostatic actuators- Piezo-electricactuators-Magneto-strictiveactuators-Electromagneticsensors-Optical- based displacement sensors-Motion tracking with microscopes

UNIT IV MICROROBOTICS 9

Introduction – Task specific definition of micro-robots – Size and Fabrication Technology based definition of micro- robots- Mobility and Functional-based definition of micro-robots- Applications for MEMS based micro-robots.

UNIT V IMPLEMENTATIONOFMICROROBOTS 9

Arrayed actuator principles for micro-robotic applications – Micro-robotic actuators- Design of locomotive micro-robot devices based on arrayed actuators – Micro-robotics devices – Micro

grippersandothermicro-tools-Micro-conveyors-WalkingMEMSMicro-robots-Multi-robot system: Micro-robot powering, Micro- robot communication.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES:

The Student will be able to

CO1: Explain and apply the concepts of mass, energy, and momentum balance in micro robotics.

CO2: Apply adapt, and synthesize learned engineering skills to create micro robot.
CO3: Model microrobots for different robotics applications
CO4: Formulate the specifications and design of mechatronic systems.
CO5: Program the Micro robot for different robotics applications

TEXT BOOKS:

1. Mohamed Gad-el-Hak , "The MEMS Handbook", 2nd Edition, CRC Press, New York, 2019.
2. Yves Bellouard, "Microrobotics Methods and Applications", CRC Press, Massachusetts, 2019

REFERENCES:

1. NadimMaluf and Kirt Williams, "An Introduction to Micro electro mechanical systems Engineering", 2nd edition, Artech House, 2004.
2. Julian W Gardner, "Microsensors: Principles and Applications", 2nd edition, Wiley, 2007.
3. MetinSitti, "Mobile Microrobotics", MIT Press, 2017.
4. Nicolas Chaillet, Stephane Rangier, "Microrobotics for Micromanipulation", John Wiley & Sons, 2013

YouTube Resources:

1. https://youtu.be/uJBCVXaZ_T0?t=1
2. https://youtu.be/uL6e3co4Qqc?t=42
3. https://youtu.be/zLHyJ030ay0?t=5
4. https://youtu.be/zLHyJ030ay0?t=36
5. https://youtu.be/_JnTHW7saB0?t=2

TOTAL: 45 PERIODS

Course Code	Robot Operating Systems	L	T	P	C
EE4V63		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce ROS and programming
- To develop the Robot environment
- To obtain the simulation robots in ROS with GAZEBO
- To simulate robots with V-Rep
- To understand mapping, navigation and motion planning ROS with Move-it
- To provide thecontrol concept for electrical drives

Course Description

Micro robotics is a specialized field of robotics that focuses on the design, fabrication, control, and application of tiny robots at the microscale. These robots, often called “microrobots” or “microbots,” are typically on the order of micrometers to 170odelling170s in size.

Prerequisites

- Microrobot Fabrication Techniques, Actuation and Sensing at the Microscale.
- Control and Navigation of Microrobots, Applications of Micro robotics.

UNIT I ROS ESSENTIALS **9**

Introduction to ROS- Advantages and Disadvantages of ROS – ROS Framework- ROS package C++, Python – ROS computation Graph – nodes, Messages, topics, services, bags, ROS Master- ROS Community- Basic programming and Syntax overview in C++ and Python – start with ROS programming – Creating Environment – Services-Actions and Nodes- Simple Interaction with the Simulation environment.

UNIT II BUILD YOUR OWN ROBOT ENVIRONMENT **9**

CAD Tools for Robot Modelling – ROS Packages for robot modelling – Unified Robot Description Format and Tags- Kinematics and Dynamics Library – Create URDF Model – Robot Modelling using Unified Robot Description Format (URDF),-ROS parameter server and adding real-world object representations to the simulation environment _ Create Robot description using 7 DOF: joint number, name, type and angle limits – Xacro – Rviz – viewing of 7 DOF arm – creation of wheeled robot.

UNIT III SIMULATION ROBOTS IN ROS WITH GAZEBO **9**

Robot simulation – Gazebo –create simulation model at Gazebo- Adding colors, textures, transmission tags, 3D vision sensor to Gazebo- Moving robot joints using ROS Controllers ROS controller interacts with Gazebo, interfacing state controller, simulation of moving the robot joints – simulation of differential wheeled robot in Gazebo.

UNIT IV ROS WITH VREP **9**

V-REP is a multi-platform robotic simulator – Simulating the robotic arm using V-REP – Adding the ROS interface to V-REP joint – Simulating a differential wheeled robot, Adding a laser sensor, 3D vision sensor.

UNIT VMAPPING, NAVIGATION AND MOTION PLANNINGROS WITH MOVEIT 9

Move it Instattion – Generating the Self-Collision matrix. virtual joints, planning groups, robot poses, robot end effector – MoveIt Architecture Diagram – Trajectory from Rviz GUI executing in Gazebo – Planning scene overview diagram- Collision Checking – Motion Planning, Pick and Place Behaviors using Industrial Robots with ROS Moveit – ROS with MATLAB – ROS with Industrial.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the concept of ROS and programming.
CO2: Evaluate various robot algorithms in ROS programming
CO3: Deploy mapping, navigation and motion planning ROS with Move-it.
CO4: Simulate robots in ROS with GAZEBO and V-REP
CO5: Program a Robot using ROS and its tool boxes

TEXT BOOKS:

1. Lentin Joseph, Jonathan Cacace, “Mastering ROS for Robotics Programming”, Second Edition, Packt Publishing, 2018.

REFERENCES:

1. Lentin Joseph, Aleena Johny, “Robot Operating System (ROS) for Absolute Beginners Robotics Programming Made Easy”, Second Edition, Apress, 2022.
2. Lentin Joseph, “ROS Robotics Projects”, Packt publishing, 2017

YouTube Resources:

1. https://youtu.be/uJBCVXaZ_T0?t=1
2. https://youtu.be/uL6e3co4Qqc?t=42
3. https://youtu.be/zLHyJ030ay0?t=5
4. https://youtu.be/zLHyJ030ay0?t=36
5. https://youtu.be/_JnTHW7saB0?t=2

TOTAL: 45 PERIODS

Course Code	Humanoid Systems	L	T	P	C
EE4V64		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To know the basic knowledge about Humanoid robots.
- To impart knowledge in kinematics of humanoids.
- To learn about the dynamics in humanoid robots.
- To understand the basic in biped walking.
- To know about the different walking patterns.

Course Description

Humanoid Systems refer to robots or robotic systems that are designed to mimic or resemble the physical structure and capabilities of humans. These robots typically have a humanoid form, with a head, torso, arms, and legs, allowing them to interact with the environment in a manner similar to humans.

Prerequisites

- To effectively engage with a Humanoid Systems course and understand the principles, technologies, and applications involved, it's beneficial to have a foundation in the Robotics Fundamentals.

UNIT I INTRODUCTION **9**

Historical development of Humanoids, Human Likeness of a Humanoid Robot, Trade-Offs in Humanoid Robot Design, Human-Friendly Humanoid Robot Design, characteristics of humanoid robots.

UNIT II KINEMATICS **9**

Kinematic structure, forward and inverse kinematic problems, differential kinematics, Twist, Spatial Velocity, and Spatial Transform, Inverse Differential Kinematic Relations. Differential kinematics at singular configurations- Gait Analysis.

UNIT III ZMP AND DYNAMICS **9**

ZMP Overview,2D Analysis,3D Analysis, Measurement of ZMP, General Discussion- ZMP of Each Foot, ZMP for Both Feet Contact, Dynamics of Humanoid Robots, Humanoid Robot Motion and Ground Reaction Force, Momentum, Angular Momentum, Angular Momentum and Inertia Tensor of Rigid Body, Calculation of Robot's Center of Mass, Link Speed and Angular Velocity, Calculation of Robot's Momentum and Angular Momentum.

UNIT IV BIPED WALKING **9**

Two-Dimensional Walking Pattern Generation, Two-Dimensional Inverted Pendulum, Behavior of Linear Inverted Pendulum, Orbital Energy, Support Leg Exchange, Planning a Simple Biped Gait, Extension to a Walk on Uneven Terrain.

UNIT V WALKING PATTERN GENERATION **9**

ZMP Based Walking Pattern Generation, Cart-Table Model, Off-Line Walking Pattern Generation, Stabilizer, Principles of Stabilizing Control, Stabilizing Control of Honda Humanoid Robot, Advanced Stabilizers.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones.

TEXT BOOKS:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016.

REFERENCES:

1. John Baichtal, "Building Your Own Drones: A beginners' Guide to Drones, UAVs and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018

YouTube Resources:

1. https://youtu.be/uJBCVXaZ_T0?t=1
2. https://youtu.be/uL6e3co4Qqc?t=42
3. https://youtu.be/zLHyJ030ay0?t=5
4. https://youtu.be/zLHyJ030ay0?t=36
5. https://youtu.be/_JnTHW7saB0?t=2

TOTAL: 45 PERIODS

Course Code	Total Integrated Automation	L	T	P	C
EE4V65		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and their applications.
- To know about the basic in SCADA and DCS systems.
- To gain knowledge in communication protocols in an integrated system
- To know about the advanced in automation industries.
- To provide the control concept for electrical drives.

Course Description

Total Integrated Automation (TIA) is an approach that aims to integrate all aspects of automation within an industrial or manufacturing environment into a cohesive and efficient system. It involves the seamless integration of various automation technologies, including Programmable Logic Controllers (PLCs), Human-Machine Interfaces (HMIs), Supervisory Control and Data Acquisition (SCADA) systems, robotics, sensors, actuators, and more.

Prerequisites

- Automation Technologies in TIA, Industrial Communication Protocols.
- Sensors and Actuators Integration.

UNIT I TOTALLY INTEGRATED AUTOMATION 9

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT II HUMAN MACHINE INTERFACE (HMI) 9

Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI- Text display – operator panels – Touch panels – Panel PCs – Integrated displays (PLC & HMI).

UNIT III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

Overview – Developer and runtime packages – architecture – Tools – Tag – Internal &External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT IV COMMUNICATION PROTOCOLS OF SCADA 9

Proprietary and open Protocols – OLE/OPC- UPC UA/DA – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field devices

UNIT V DISTRIBUTED CONTROL SYSTEMS (DCS) 9

DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces. APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO 1: Knowledge of PLC & PAC automation

CO 2: Knowledge in HMI systems and to integrate it with other systems.

CO 3: Ability to apply SCADA and usage of C programming for report generation

CO 4: Acquiring information's on communication protocols in automation systems

CO 5: Ability to design and develop automatic control system using distributed control systems

TEXT BOOKS:

1. John. W. Webb& Ronald A. Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2009.
2. Michael P. Lukas, "Distributed Control systems", "Van Nostrand Reinfold Company"1995

REFERENCES:

1. Win C Software Manual, Siemens, 2003
2. RS VIEW 32 Software Manual, Allen Bradly, 2005
3. CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004

YouTube Resources:

1. https://youtu.be/uL6e3co4Qqc?t=42
2. https://youtu.be/zLHyJ030ay0?t=5
3. https://youtu.be/zLHyJ030ay0?t=36
4. https://youtu.be/_JnTHW7saB0?t=2
5. https://youtu.be/uJBCVXaZ_T0?t=1

TOTAL: 45 PERIODS

Course Code	Virtual Instrumentation	L	T	P	C
EE4V66		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce virtual instrumentation concepts and applications.
- To train to program virtual instrumentation software for biomedical applications
- To understand the data acquisition and control in VI
- To obtain the knowledge in instrument interfaces
- To analyse the applications of VI in Bio Medical Engineering.

Course Description

Virtual Instrumentation refers to the use of software-based solutions to create, configure, and control measurement and automation systems. It involves the integration of hardware components such as sensors, actuators, and data acquisition devices with software platforms to create customized measurement and control systems.

Prerequisites

- Introduction to Virtual Instrumentation, Hardware Components and Interfaces.
- Data Acquisition and Signal Processing.

UNIT I INTRODUCTION **9**

History of Virtual Instrumentation (VI), advantages, block diagram and architecture of a virtual instrument, Programming paradigms – Virtual Instrumentation – Lab VIEW software – Lab VIEW basics – Lab VIEW environment.

UNIT II VI USING LABVIEW **9**

Embedded Processor architecture-RTOS – Hardware/software co-design-Programming with SoC processors.

UNIT III DATA ACQUISITION AND CONTROL IN VI **9**

Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems

UNIT IV INSTRUMENT INTERFACES **9**

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

UNIT V APPLICATION OF VI IN BIOMEDICAL ENGINEERING **9**

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Noninvasive Blood Pressure Measurement, Biofeedback, Virtual Reality & 3D graphical 176odelling, Virtual Prototyping.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentation.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To comprehend and appreciate the significance and role of this course in the present contemporary World.
CO2: Identify salient traits of a virtual instrument.
CO3: Understand the use of VI for data acquisition.
CO4: Experiment, analyze and document different types of interfaces.
CO5: Apply the virtual instrumentation technologies for medical applications

TEXT BOOKS:

1. Daniel Gary Johnson, "LABVIEW Graphical Programming", McGraw Hill, 4th edition, 2006.
2. Lisa K. Wells and Jeffrey Travis, "LABVIEW for Everyone", PHI, 1997.
3. Skolkoff, "Basic concepts of LABVIEW 4", PHI, 1998.
4. Jerome, Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2010.
5. Sanjay Gupta and Joseph John, "Virtual Instrumentation using Lab VIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2010.

REFERENCES:

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2003.
2. S. Gupta, J.P. Gupta, "PC Interfacing for Data Acquisition and Process Control", ISA, 2nd Edition, 1994.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.
4. Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in Lab VIEW" Pearson Education, 2001.

YouTube Resources:

1. https://youtu.be/uL6e3co4Qqc?t=42
2. https://youtu.be/zLHyJ030ay0?t=5
3. https://youtu.be/zLHyJ030ay0?t=36
4. https://youtu.be/_JnTHW7saB0?t=2
5. https://youtu.be/uJBCVXaZ_T0?t=1

TOTAL: 45 PERIODS

Vertical 7 RENEWABLE AND NON-RENEWABLE ENERGY SOURCES

Course Code	Renewable Energy Sources	L	T	P	C
EE4V71		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion
- To know the alternative energy sources with the grid systems.

Course Description

Renewable energy sources are natural resources that can be replenished within a human lifetime. They are considered sustainable because they do not deplete the Earth's resources and do not contribute to harmful greenhouse gas emissions or air pollution.

Prerequisites

- Hydropower harnesses the energy of flowing or falling water to generate electricity.
- Geothermal energy utilizes heat from beneath the Earth's surface.

UNIT I INTRODUCTION **9**

Renewable Sources of Energy-Grid-Supplied Electricity-Distributed Generation-Renewable Energy Economics-Calculation of Electricity Generation Costs –Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems. Wind Power Plants Appropriate Location -Evaluation of Wind Intensity -Topography -Purpose of the Energy Generated – General Classification of Wind Turbines-Rotor Turbines-Multiple-Blade Turbines Drag Turbines -Lifting Turbines-Generators and Speed Control used in Wind Power Energy Analysis of Small Generating Systems.

UNIT II PHOTOVOLTAIC POWER PLANTS **9**

Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV Cell Characteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parameters for Photovoltaic Panels-Photovoltaic Systems-Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy. Fuel Cells: The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electrolyser Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

UNIT III INDUCTION GENERATORS **9**

Principles of Operation-Representation of Steady-State Operation-Power and Losses Generated-Self Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process-Interconnected and Stand-alone operation -Speed and Voltage Control – Economical Aspects.

UNIT IV STORAGE SYSTEMS **9**

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels –Superconducting Magnetic Storage System-Pumped Hydroelectric Energy Storage – Compressed Air Energy Storage – Storage Heat -Energy Storage as an Economic Resource.

UNIT V INTEGRATION OF ALTERNATIVE SOURCES OF ENERGY **9**

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection. Interconnection of Alternative Energy Sources with the Grid: Interconnection Technologies – Standards and Codes for Interconnection – Interconnection Considerations – Interconnection Examples for Alternative Energy Sources.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the principles of wind power and solar photovoltaic power generation fuel cells.
CO2: Assess the cost of generation for conventional and renewable energy plants
CO3: Design suitable power controller for wind and solar applications
CO4: Analyze the issues involved in the integration of renewable energy sources to the grid
CO5: To understand the concept of alternative sources of energy.

TEXT BOOKS:

1. Felix A. Farret, M. Godoy Simoes, “Integration of Alternative Sources of Energy”, John Wiley& Sons, 2006.
2. Solanki: Renewable Energy Technologies: Practical Guide for Beginners, PHI Learning Pvt. Ltd., 2008.

REFERENCES:

1. D. Mukherjee: Fundamentals of Renewable Energy Systems, New Age International publishers, 2007.
2. Remus Teodorescu, Marco Liserre, Pedro Rodrí´guez: Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.
3. Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

YouTube Resources:

1. https://youtu.be/cGHlV0EavaQ?t=13
2. https://youtu.be/v7UwbJ8n9L0?t=2
3. https://youtu.be/VfowJHJz6-s
4. https://youtu.be/EhDjkRqxNFQ
5. https://youtu.be/cGHlV0EavaQ?t=44

TOTAL: 45 PERIODS

Course Code	Basics of Power Plant Engineering	L	T	P	C
EE4V72		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To provide an overview of power plants and the associated energy conversion issues.
- To know about the gas turbine plants and combined power plants.
- To know the concept of nuclear energy conversion plants.
- To know the overview and concept of hydro power plants.
- To the economic and environmental aspects of different power plants.

Course Description

Power Plant Engineering is a branch of engineering that deals with the study, design, operation, and maintenance of power plants, which are facilities that generate electricity.

Prerequisites

- Power Generation Systems, Basic knowledge of machine learning and deep learning.
- Developing control systems to regulate the operation of power plants, ensuring stability, efficiency, and safety.

UNIT I COAL BASED THERMAL POWER PLNT 9

Basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

UNIT II GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT III BASICS OF NUCLEAR ENERGY CONVERSION 9

Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT IV HYDROELECTRIC POWER PLANTS 9

Classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES 9

Power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES:

CO1: To understand the concepts and overview of power plants and associated energy Conversion issues.

CO2: To understand the concept of gas turbine and combined power plants.

CO3: To understand the concept of nuclear energy conversion system.

CO4: To understand the concept of hydroelectric power conversion system.

CO5: The students can understand the principles of operation for different power plants and Their Economics.

TEXT BOOKS:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

REFERENCES:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

YouTube Resources:

1. https://youtu.be/HGVDu1z5YQ8?t=4
2. https://youtu.be/9RD08xQxAVw?t=1
3. https://youtu.be/knEwjThIAU0?t=6
4. https://youtu.be/ZSUoClnyyN4?t=5
5. https://youtu.be/9RD08xQxAVw?t=8

TOTAL: 45 PERIODS

Course Code	Non-Conventional Sources of Energy	L	T	P	C
EE4V73		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion.
- To study the concept of different energy conversion system.

Course Description

Non-conventional sources of energy offer immense potential for sustainable, clean, and reliable power generation. Professionals in this field play a vital role in advancing renewable energy technologies, reducing greenhouse gas emissions, and mitigating the impacts of climate change.

Prerequisites

- Ocean thermal energy uses the temperature difference between warm surface waters and cold deep waters.
- Familiarity with environmental regulations and policies related to renewable energy development.

UNIT I PRINCIPLES OF SOLAR RADIATION 9

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power – Physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data. Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT II SOLAR ENERGY STORAGE AND APPLICATIONS 9

Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications – solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion. Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

UNIT III BIO-MASS: 9

Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of biogas, utilization for cooking, I.C. Engine operation, and economic aspects.

UNIT IV GEOTHERMAL ENERGY 9

Resources, types of wells, methods of harnessing the energy, potential in India. Ocean Energy – OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave energy: Potential and conversion techniques, mini-hydel power plants, their economics

UNIT V DIRECT ENERGY CONVERSION **9**

Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermoelectric generators, See beck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

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

CO1: Identify renewable energy sources and their utilization. Understand the basic concepts of solar radiation and 183odelli the working of solar and thermal systems.
CO2: Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
CO3: Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
CO4: Identify methods of energy storage for specific applications
CO5: Understand the different methods of power conversion systems.

TEXT BOOKS:

1. Renewable Energy Resources / Tiwari and Ghosal / Narosa
2. Non- conventional Energy Sources / G.D. Rai/ Khanna Publishers
3. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/ E&FN Spon.

REFERENCES:

1. Renewable Energy Sources / Twidell & Weir.
2. Solar Power Engineering / B.S. Magal Frank Kreith & J.F. Kreith.
3. Principles of Solar Energy / Frank Krieth & John F Kreider.
4. Non-Conventional Energy / Ashok V Desai / Wiley Eastern.
5. Non-Conventional Energy Systems / K Mittal / Wheeler.
6. Renewable Energy Technologies / Ramesh & Kumar / Narosa.

YouTube Resources:

1. https://youtu.be/GOcelB_F6Ys
2. https://youtu.be/FkqMspkGmTw
3. https://youtu.be/PLBK1ux5b7U?t=5
4. https://youtu.be/osBVRfvkmAU?t=1
5. https://youtu.be/osBVRfvkmAU?t=7

TOTAL: 45 PERIODS

Course Code	Wind and Solar Energy Systems	L	T	P	C
EE4V74		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the physics of wind power and energy, understanding the principles governing wind generator operation.
- To study the concept of wind generator topologies.
- To gain knowledge about solar power resources, 184odelli solar photovoltaic cells, and discuss solar thermal power generation.
- To identify and understand network integration issues associated with renewable energy sources like wind and solar power.
- To study the concept of solar radiation types.

Course Description

Wind and solar energy systems play crucial roles in the transition to sustainable and renewable energy sources. Professionals in these fields contribute to the development, installation, and management of clean energy solutions to address global energy challenges.

Prerequisites

- Wind and solar energy systems play crucial roles in the transition to sustainable and renewable energy sources. Professionals in these fields contribute to the development, installation, and management of clean energy solutions to address global energy challenges.
- Wind and solar energy systems play crucial roles in the transition to sustainable and renewable energy sources. Professionals in these fields contribute to the development, installation, and management of clean energy solutions to address global energy challenges.

UNIT I PHYSICS OF WIND POWER **9**

History of wind power, Indian and Global statistics, Wind physics, Betz limit ratio, stall and pitch control, Wind speed statistics-probability distributions, and Wind power-cumulative distribution functions.

UNIT II WIND GENERATOR TOPOLOGIES **9**

Review of modern wind turbine technologies, Fixed and Variable speed wind turbine, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator configurations, Converter Control.

UNIT III THE SOLAR RESOURCE **9**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Solar Photovoltaic: Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power point Tracking (MPPT) algorithms. Converter Control

UNIT IV NETWORK INTEGRATION ISSUES **9**

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 185odellin during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

UNIT V SOLAR THERMAL POWER GENERATION **9**

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the energy scenario and the consequent growths of the power generate renewable energy sources.
CO2: Understand the basic physics of wind and solar power generation.
CO3: Understand the power electronic interfaces for wind and solar generation and grid-integration issues.
CO4: Understand the concept of hybrid systems.
CO5: Understand the concept of different solar radiation systems.

TEXT BOOKS:

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.

REFERENCES:

1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
2. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
3. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
4. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

YouTube Resources:

1. https://youtu.be/nNp21zTeCDc?t=38
2. https://youtu.be/otQszp_LK4c?t=2
3. https://youtu.be/nNp21zTeCDc?t=3
4. https://youtu.be/otQszp_LK4c?t=28
5. https://youtu.be/nNp21zTeCDc?t7

TOTAL: 45 PERIODS

Course Code	Power Electronic Controllers to Renewable Energy Systems	L	T	P	C
EE4V75		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To know the introduction of PV systems.
- To know the inverter module and topology.
- To impart knowledge on different types of renewable energy systems.
- To 186odelli the operation of electrical generators used for the wind energy conversion Systems.
- To know the operation of power converters and PV systems operation.

Course Description

Power electronics play a crucial role in renewable energy systems by enabling efficient conversion, control, and management of electrical energy.

Prerequisites

- Grid-tied inverters convert the direct current (DC) output from solar panels or wind turbines into alternating current (AC) that can be synchronized with the utility grid.
- Off-grid inverters are used in standalone renewable energy systems, such as remote cabins or off-grid communities.

UNIT I INTRODUCTION PV SYSTEMS **9**

Solar cell characteristics and their measurement, PV Module, PV array, Partial shading of a solar cell and a module, the diode, Power conditioning unit, maximum power point tracker, Implementation of Perturb and Observe Method, Incremental Conductance Method, Battery charger/discharge controller.

UNIT II INVERTER TOPOLOGY PV MODULE **9**

Centralized Inverters, String Inverters, Multi-string Inverters, Module Integrated Inverter/Micro-inverters, Inverter Topology, Model of Inverter, Sizing Batteries and Inverters for a Solar PV System. Types of PV Systems: Grid-Connected Solar PV System, Stand-Alone Solar PV System.

UNIT III WIND TURBINE TOPOLOGY **9**

Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators.

UNIT IV ROLE OF SYNCHRONOUS AND INDUCTION GENERATORS FOR WECS **9**

Modelling of Permanent Magnet Synchronous Generators, Doubly Fed Induction Generators, Squirrel cage Induction Generators wind turbine, Control of Power converters for WECS.

UNIT V HYBRID ENERGY SYSTEMS **9**

Hybrid Energy Systems, Need for Hybrid Energy Systems, Range and types of Hybrid systems, Hybrid Solar PV/Wind Energy System, Architecture of Solar-Wind Hybrid System and Grid connected issues.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Proficiently demonstrate various renewable energy technologies utilized for electrical power generation.
CO2: Analyze the operating principles of different types of wind generators and identify suitable converters (AC-DC, DC-DC, AC-AC) for renewable energy systems.
CO3: Interpret and analyze various wind and photovoltaic (PV) systems, including stand- alone, grid connected, and hybrid configurations, showcasing a comprehensive understanding of renewable energy applications.
CO4: To understand the concept of different types of generators.
CO5: To understand the concept of Hybrid energy systems.

TEXT BOOKS:

1. S. N. Bhadra, D. Kastha, S. Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. S. N. Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
3. Rashid. M. H, "Power Electronics Hand book", Academic Press, 2001.

REFERENCES:

1. Rai. G. D, "Non-conventional energy sources", Khanna Publishers, 1993.
2. Rai. G.D," Solar energy utilization", Khanna Publishes, 1993.
3. Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 1995.
4. B.H.Khan "Non-conventional Energy sources", Mc Graw-hill, 2nd Edition, 2009

YouTube Resources:

1. https://youtu.be/nNp21zTeCDc?t=38
2. https://youtu.be/otQszp_LK4c?t=2
3. https://youtu.be/nNp21zTeCDc?t=3
4. https://youtu.be/otQszp_LK4c?t=28
5. https://youtu.be/nNp21zTeCDc?t7

TOTAL: 45 PERIODS

Course Code	Energy Storage Systems	L	T	P	C
EE4V76		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce generalized storage techniques and 188odelli the different features of storage Systems.
- To know the management and applications of energy storage technologies.
- To know the applications of Electrical Energy storage systems.
- To know about electrical energy storage market potential by different forecasting methods.
- To forecast of EES market potential by 2030.

Course Description

Energy Storage Systems are instrumental in the transition to a sustainable and resilient energy infrastructure. Professionals in this field contribute to the development, implementation.

Prerequisites

- Effective communication skills for coordinating with engineers, technicians, utility providers, regulators, and stakeholders.
- Understanding of grid codes, regulations, and standards related to the integration of energy storage systems with the electrical grid.

UNIT I THE ROLES OF ELECTRICAL ENERGY STORAGE TECHNOLOGIES IN ELECTRICITY USE **9**

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable, Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT II TYPES AND FEATURES OF ENERGY STORAGE SYSTEMS **9**

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Lead-Acid Batteries, Lithium-Ion Batteries, Flow batteries, Other Batteries in Development, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG), Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES),Thermal storage systems, Standards for EES, Technical comparison of EES technologies

UNIT III APPLICATIONS OF EES **9**

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), EES installed capacity worldwide, new trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles.

UNIT IV MANAGEMENT AND CONTROL HIERARCHY OF EES **9**

Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems and distributed generation (Virtual Power Plant), “Battery SCADA” – aggregation of many

dispersed batteries. Demand For Energy Storage: Growth in Variable Energy Resources, Relationship between balancing services and variable energy resources, Energy Storage Alternatives, Variable Generator Control, Demand Management, Market Mechanisms, and Longer-Term Outlook. Valuation Techniques: Overview, Energy Storage Operational Optimization, Market Price Method, Power System Dispatch Model Method, Ancillary Service Representation, Energy Storage Representation, Survey of Valuation Results.

UNIT V FORECAST OF EES MARKET POTENTIAL BY 2030 **9**

EES market potential for overall applications, EES market estimation by Sandia National Laboratory (SNL), EES market estimation by the Boston Consulting Group (BCG), EES market estimation for Li-ion batteries by the Panasonic Group, EES market potential estimation for broad introduction of renewable energies, EES market potential estimation for Germany by Fraunhofer, Storage of large amounts of energy in gas grids, EES market potential estimation for Europe by Siemens, EES market potential estimation by the IEA, Vehicle to grid concept, EES market potential in the future.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

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

CO1: Understand the role of electrical energy storage technologies in electricity usage.
CO2: Know the behavior and features and applications of energy storage system.
CO3: Understand the applications of EES
CO4: Understand the hierarchy, demand for energy storage and valuation techniques.
CO5: Understand the concept of forecast EES market potential by 2030.

TEXT BOOKS:

1. Power System Energy Storage Technologies, 1st Edition by Paul Breeze, Academic Press
2. Energy Storage: Systems and Components, by Alfred Rufer, CRC Press, 2017

REFERENCES:

2. Energy Storage Fundamentals, Materials and Applications, by Huggins and Robert, Springer.
3. www.ecofys.com/com/publications

YouTube Resources:

1. https://youtu.be/IzDIN-inyUk
2. https://youtu.be/cv-q0h6-T0I?t=25
3. https://youtu.be/vRjvMAzlIWw?t=5
4. https://youtu.be/IzDIN-inyUk **6**
5. https://youtu.be/cv-q0h6-T0I?t=38

TOTAL: 45 PERIODS

APPENDIX B: OPEN ELECTIVE COURSES

OPEN ELECTIVES – I							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	EE46O1	Design Techniques for SMPS	3	0	0	3
2.	Theory	CY4601	Engineering Chemistry	3	0	0	3
3.	Theory	ME46O5	Nano Technology	3	0	0	3
4.	Theory	EE46O4	Drinking water supply and Treatment	3	0	0	3
5.	Theory	EE46O5	Power Station Practices	3	0	0	3
6.	Theory	EE46O6	Introduction to PLC Programming	3	0	0	3
7.	Theory	EE46O7	Energy Management and Auditing	3	0	0	3
8.	Theory	BM4601	Biomedical Instrumentation	3	0	0	3
						Total	**24**

OPEN ELECTIVES – II							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	ME4703	Nanomaterials and Applications	3	0	0	3
2.	Theory	EE47O2	Sustainable Manufacturing	3	0	0	3
3.	Theory	ME47O4	Concepts in Mobile Robotics	3	0	0	3
4.	Theory	EE47O4	Industrial Management Techniques	3	0	0	3
5.	Theory	EE47O5	Process Control and Quality Engineering	3	0	0	3
6.	Theory	ME4707	Renewable Energy Technologies	3	0	0	3
7.	Theory	EE47O7	Solar Power Batteries	3	0	0	3
8.	Theory	EE47O8	Design Techniques of Electrical Machines	3	0	0	3
						Total	**24**

OPENELECTIVE-I

Course Code	Design Techniques for SMPS	L	T	P	C
EE46O1		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the basics of supply schemes
- To study about the various configurations of Converters
- To know the design of high frequency chokes & transformers
- To impart knowledge on performance evaluations of SMPS
- To learn the various power supplies IEC standards.

Course Description

This course offers a comprehensive overview of power supply schemes and their fundamental components in the field of power electronics. It covers basic concepts of semiconductors, low-power supplies (LPS), and switch-mode power supplies (SMPS), along with the basic topologies used in SMPS circuits.

Prerequisites

- Basic Electronics: Familiarity with semiconductor devices, including diodes, transistors, MOSFETs, and IGBTs, and their characteristics.
- Circuit Analysis: Proficiency in modelling circuits containing passive and active components using techniques such as Kirchhoff's laws, nodal analysis, and mesh analysis.
- Power Electronics Basics: Basic knowledge of power electronic devices, circuits, and their operating principles.

UNIT I BASICS OF SUPPLY SCHEMES **9**

Power Electronics Basics of semiconductors, Basics of supplies-LPS & SMPS, Basic topologies in SMPC, Control of power semiconductors, Basics of high frequency magnetic, Basics of EMC &any power simulation environment.

UNIT II CONVERTERS CONFIGURATIONS **9**

Continuous & discontinuous modes of operation, Isolated converters, Various configurations of Converters, Selection of Components: Selection of Resistors, Chokes, Capacitors, Diodes, MoSFETs & IGBTs, Connectors, Design of Magnetics Fundamentals & ideal conditions, design of High frequency chokes & transformers, Selection of wire gauge, sealing of magnetic.

UNIT III GUIDE TO INSTRUMENTATION **9**

Basics of measurements using DMM, Oscilloscope, Electronic loads, etc Design of Magnetics Fundamentals & ideal conditions, design of High frequency chokes & transformers, Selection of wire gauge, sealing of magnetics Design of Feedback circuits Basic control requirements, Current &voltage mode control fundamentals& system stability conditions Design of Control and Monitoring circuits Practical Control circuitry & Monitoring circuitry requirements.

UNIT IV EVALUATIONS AND THERMAL MANAGEMENT **9**

Performance evaluations of SMPS& thermal loss calculations and cooling options& packaging of converter EMI control requirements Overview of EMC, differentiating signal and noise, Layout concepts Low & High frequency filtering requirements, Optimal filter design Worst case analysis Introduction to datasheet reading, operation tuned to datasheet, typical worst- case analysis.

UNIT V DIGITAL CONTROL OF POWER SUPPLIES **9**

Standards governing the power supplies IEC standards f or Electrical &Environmental testing, certification standards, Ingress protection standards Recent trend in Power supplies Recent advancements in components, Recent advancements in topologies, Digital control of power supplies, Power Integration &its Low power applications. Analysis and Simulation using PSIM: BUCK, BOOST & BUCK, BOOST, Typical discrete power factor corrector circuit.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Choose appropriate components and configure various converter topologies.
CO2: Design various control, monitoring and measurement circuitry for Switched Mode Power Supplies
CO3: Evaluate thermal performance of SMPS units and design appropriate filters
CO4: Appreciate standards and recent advancements related to SMPS.
CO5: Analyze and simulate the various converter topologies using PSIM.

TEXT BOOKS:

1. Ned Mohan, Undel and and Robbins, 'Power Electronics Converters, Applications and Design',2ndEdition, JohnWiley&sons,1995.
2. AbrahamI Pressman, Keith Billings, Taylor Morey, 'Switching Power Supply Design', 3rd Edition, McGraw-Hill 2009.

REFERENCES:

1. L. Umanand and SR Bhat, 'Design of Magnetic Components for Switched Mode Power Converters', Wiley Eastern Limited.
2. International Standard, IEC 60571Edition2.12006-12.

YouTube Resources:

1. https://youtu.be/Z9KeHF-qL84?si=ZlmFzevQHHhHFOWK
2. https://youtu.be/I8RN7SAe7Js?si=vnGCxHeJ1lpINrwN
3. https://youtu.be/-49bJXh1VPg?si=gmmoPqA4FEl-8QzG
4. https://youtu.be/VK9SkB-rTkU?si=D1vFokhId4BGric6
5. https://youtu.be/A3jngDXShWE?si=-9Qv_wnREYjcWIxf

TOTAL: 45 PERIODS

Course Code	ENGINEERING CHEMISTRY	L	T	P	C
CY4601		3	0	0	3

COURSE OBJECTIVES

- To inculcate sound understanding of water quality and water treatment techniques.
- To impart knowledge on the preparatory methods of nano-material's. To introduce the properties and applications of composites
- To facilitate the understanding of fuel classification, preparation, combustion, and environmental impact.
- To conversant with the principle electro-chemistry, cell reactions, and corrosion protection techniques.
- To acquire a deep understanding of renewable energy sources along with energy storage technologies and innovation in sustainable energy systems.

COURSE DESCRIPTION

- This course provides a foundational understanding of chemistry principles and their applications in engineering disciplines.
- It covers key topics such as atomic structure, chemical bonding, thermodynamics, kinetics, electro-chemistry, materials science, and environmental chemistry.
- Emphasis is placed on linking fundamental chemical concepts to engineering applications and technological advancements.

PREREQUISITES

- Basic knowledge of chemistry concepts, including atomic structure, chemical bonding, stoichiometry, and thermodynamics, is recommended for successful participation in this course.
- Proficiency in algebra and basic calculus is also beneficial.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, hardness, alkalinity. Treatments – sterilization – break point chlorination, UV, Ozonation, Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment Ion exchange demineralization and zeolite process.

UNIT II NANO MATERIALS & COMPOSITE 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Types of nanomaterials: Definition, properties and uses of nano particles and nanotube. Preparation of nano materials: laser ablation, and electro spinning. An application of nano materials in medicine, agriculture, energy, electronics and catalysis

Composite: Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. FRP – Hybrid composites – definition and examples

UNIT III FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Flue gas analysis – ORSAT Method. CO_2 emission and carbon foot print.

UNIT IV ELECTRO CHEMISTRY AND CORROSION CONTROL 9

Electrochemistry – Introduction, Electrochemical cells – electrolytic cell – reversible and irreversible cells. Electrode potential – Oxidation and reduction Potentials – emf, Nernst equation and applications - Reference electrodes – Calomel electrode – Electrochemical series – its applications
Corrosion protection – cathodic protection – sacrificial anodic and impressed current protection methods; advanced protective coatings: electroplating and electroless plating.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Solar energy conversion: Principle, working and applications of solar cells; recent developments in solar cell materials. Wind energy; Geothermal energy. Hydrogen as fuel: Sources of hydrogen – Hydrogen production methods – electrolysis, limitations and applications.
Storage Devices: Batteries – Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium – ion – battery; Electric vehicles – working principles; Fuel cells: H_2 – O_2 fuel cell.

TOTAL HOURS (THEORY): 45

COURSE OUTCOMES

After the completion of the course, students will be able to

- To infer the quality of water and propose suitable treatment methodologies for hard water.
- To identify and apply basic concepts of nanomaterial's preparation for engineering applications.
  To gain knowledge of fuel properties, manufacturing processes, combustion characteristics, and environmental considerations.
- To attain expertise in electrochemical principles, cell reactions and corrosion protection techniques.
- To attain proficiency in different forms of energy resources and fuel cell utilization, fostering the lead advancements in renewable energy and energy storage solutions.

TEXT BOOKS

1. Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
2. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
3. K. Klabunde, G. Sergeev, Nano chemistry, 2nd Edition, Springer Publisher, 2013.
4. S.A. Sherif, D. Yogi Goswami, E.K. (Lee) Stefanakos, Aldo Steinfeld "Handbook of Hydrogen Energy", 1st Edition, CRC Press, 2014.

REFERENCE BOOKS

1. Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2. Kazunari Sasaki, Hai – Wen Li, Akari Hayashi, Junichiro Yamabe, Teppei Ogura, Stephen M. Lyth, Hydrogen Energy Engineering A Japanese Perspective, Springer, 2016.
3. Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
4. Lefrou.,Christine., Fabry., Pierre., Poignet., Jean – claude., "Electrochemistry – The Basics, with examples" Springer. 2012.
5. Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition, 2012.

YOUTUBE RESOURCES:

1. **Chemical Engineering Guy:** This channel covers various topics in chemical engineering, including engineering chemistry concepts such as chemical kinetics, thermodynamics, and materials science.
2. **Learn ChemE -** Chemical Engineering: Learn Chem E offers a series of video tutorials and lectures on chemical engineering topics, including chemistry fundamentals, process design, and materials engineering.
3. **MIT Open Course Ware** - Chemistry: MIT's Open Courseware provides lectures and course materials on chemistry topics relevant to engineering, such as organic chemistry, physical chemistry, and chemical kinetics. Khan Academy - Chemistry: Khan Academy's chemistry videos cover fundamental concepts in chemistry, including atomic structure, chemical bonding, thermodynamics, kinetics, and electro-chemistry.

Course Code	Nano Technology	L	T	P	C
ME4605		3	0	0	3

COURSE OBJECTIVES:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I Introduction 9

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact

UNIT II Synthesis Of Nanomaterials 9

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III Nano Composites 9

Definition- importance of nanocomposites- nano composite materials-classification of composites metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer-based influence of size, shape and role of interface in composites applications.

UNIT IV Nano Structures and Characterization Techniques 9

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V Applications of Nano Materials 9

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications
CO2: Able to acquire knowledge about the different types of nano material synthesis
CO3: Describes about the shape, size, structure of composite nano materials and their interference.
CO4: Understand the different characterization techniques for nanomaterials
CO5: Develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS:

1. Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES:

1. R.H.J. Hannink & A.J. Hill, Nanostructure Control, Wood Head Publishing Ltd., Cambridge, 2006.
2. C.N.R. Rao, A. Muller, A.K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J. Muray,' The physics of Micro/Nano – Fabrication', Springer International Edition,2010

Course Code	Drinking water supply and Treatment	L	T	P	C
EE4604		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To equip the students with the principles and design of water treatment units and distribution system.
- To understand the sources of water and their characteristics.
- To gain knowledge of conveyance systems, including pipes, conduits, and pumps.
- To understand the principles and processes of water treatment, including coagulation, filtration, and disinfection.
- To explore advanced water treatment technologies such as desalination, membrane systems, and ion exchange.

Course Description

This course provides students with an in-depth understanding of water supply systems, including the planning, design, and operation of water sources, conveyance systems, treatment plants, and distribution networks. Students will learn about the characteristics of different water sources, the design of intake structures and transmission mains, principles and processes of water treatment, advanced water treatment technologies, and the design and operation of water distribution systems.

Prerequisites

- Basic knowledge of fluid mechanics and hydraulics.
- Understanding of environmental science and water quality parameters.
- Familiarity with engineering design principles.

UNIT I Sources of Water **9**

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

UNIT II Conveyance from the Source **9**

Water supply–in take structures–Functions; Pipes and conduits for water –Pipe materials –Hydraulics of flow in pipes –Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III Water Treatment **9**

Objectives–Unit operations and processes–Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation–-sand filters-Disinfection– Construction, Operation and Maintenance aspects.

UNIT IV Advanced Water Treatment **9**

Water softening – Desalination- R.O. Plant – demineralization –Adsorption – Ion exchange– Membrane Systems – Iron and Manganese removal – Defluorination – Construction and Operation and Maintenance aspects

UNIT V Water Distribution and Supply **9**

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs – Functions – Network design – Economics – Computer applications – Appurtenances–Leak detection Principles of design of water supply in buildings – House service connection–Fixtures and fittings systems of plumbing and types of plumbing

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1 An understanding of water quality criteria and standards, and their relation to public health
CO2 The ability to design the water conveyance system
CO3 The knowledge in various uni tope rations and processes in water treatment
CO4 An ability to understand the various systems for advanced water treatment

TEXT BOOKS:

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C,ArunK.Jain,Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", February2022
4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

REFERENCES:

1. Fair.G.M., Geyer.J.C.,"Water Supply and Waste water Disposal",JohnWileyand Sons, 1954.
2. Babbit.H.E, and Donald.J.J,"Water Supply Engineering",McGrawHillbookCo, 1984.
3. Steel. E.W.et al., "Water Supply Engineering", Mc Graw Hill International book Co, 1984.
4. Duggal.K.N., "Elememts of public Health Engineering", S. Chand and Company Ltd, NewDelhi,1998.

YouTube Resources:

1. https://youtu.be/yZwfcMSDBHs?si=h-va7awNWu862fMB
2. https://youtu.be/ZQKpu-obzlU?si=0DUbNWO0rw7RPq_q
3. https://youtu.be/u4k2XY-fJJY?si=5EQUC2t6NuJlFhEx
4. https://youtu.be/Ki8LmnPt6qE?si=5X2oJ-3vltWlT35I
5. https://youtu.be/iyVdiQonEA0?si=9OoaiwtiHGKablZj

TOTAL: 45 PERIODS

Course Code	Power Station Practices	L	T	P	C
EE4605		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with power plant operations
- To familiarize the students with economics of power generation.
- To familiarize the students with automation and design of sub-station.
- To familiarize the students with safety practices in power plants.
- To familiarize the students with neutral grounding

Course Description

This course provides a comprehensive understanding of various aspects related to conventional power plants, power generation economics, substation design and automation, electrical plant maintenance, and neutral grounding in electrical systems. It covers essential concepts, methodologies, and practices involved in the operation and maintenance of power generation and distribution systems.

Prerequisites

- Basic Power Generation Basics: Familiarity with the basics of power generation, including different types of power plants, generation processes, and power generation equipment.
- Electrical System Operation: Knowledge of electric power system operation, including load characteristics, power flow, and system stability.

UNIT I INTRODUCTION **9**

Overview of conventional power plants, structure of electric power system, load curve, load factor, demand factor, diversity factor, base load, peak load, plant capacity factor and plant use factor, maximum demand number and size of generation units, interconnected grid system, advantages of coordinated operation of different types of power plants

UNIT II ECONOMICS OF POWER GENERATION **9**

Cost analysis of power generation, running cost and fixed cost, tariffs, types of tariffs- flat rate, block rate, two part and three-part, comparison of tariffs and computation of monthly/ annual bill, methods of determining depreciation, availability-based tariff (ABT), power trading, economics of power factor improvement.

UNIT III SUB-STATION DESIGN AND AUTOMATION **9**

Classification, Outdoor, indoor, transformer, switching, power factor correction, frequency changer, underground, pole mounted substations, different equipment, bus bar arrangement, layout/key diagram of a typical substation, substation automation.

UNIT IV ELECTRICAL PLANT & AUXILIARY EQUIPMENT MAINTENANCE **9**

Switchgears, Isolators, Motors, Transformers, Batteries, Cable & earthing, Actuators. Industrial Safety & Hazards: Industrial Hazards, Safe Working Practices in Power Plant, permit to work system, Safety in Movement and storage of Materials, Safety Rules

UNIT V NEUTRAL GROUNDING **9**

Grounding, equipment grounding, system grounding, ungrounded neutral system, neutral grounding, methods of neutral grounding, voltage transformer earthing, grounding transformer.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the overview of power plants and its structure.

CO2: Know about the economics of power generation

CO3: Know about automation and design of sub-station

CO4: Understand about safety practices in power plants.

CO5: Understand different protection and control scheme.

TEXT BOOKS:

1. Weedy B.M. and Cory B.J., "Electric Power Systems", 4th Ed., Wiley India. 2008
2. Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited 2008
3. Hadi Saadat, Power System Analysis, Mc-Graw Hill, Newyork. 1999
4. M.V. Deshpande, "Elements of Electrical Power Station Design", A. H. Wheeler and Co. Pvt. Ltd. Allahabad 2008

REFERENCES:

1. C.L. Wadhwa," Generation Distribution and Utilization of Electrical Engineering", Wiley Eastern Ltd., New Delhi. 1989
2. NPTI Manual on Power Plant Maintenance.
3. BHEL Operation & Maintenance Manual.

YouTube Resources:

1. https://youtu.be/Zgp86PVXXuQ?si=hPcDW80jWirZFV-G
2. https://youtu.be/_HxM6DAYQ4U?si=sHDvM43FxgZ8mGri
3. https://youtu.be/Xu3W_KTl9WI?si=SdgyD-rlpyFZXX_F
4. https://youtu.be/9JEl1xQstjI?si=TMpDO4F_FWlRKZ_s
5. https://youtu.be/r4k2N7HqDAs?si=t7MEyX3WTPT4n1vw

TOTAL: 45 PERIODS

Course Code	Introduction to PLC Programming	L	T	P	C
EE4606		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Familiarize different programming language of PLC.
- Develop PLC logic for simple applications using ladder logic.
- Understand the hardware and software behind PLC and SCADA.
- Exposures about communication architecture of PLC/SCADA.

Course Description

This course provides students with a comprehensive understanding of Programmable Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA) systems used in industrial automation. Students will learn about the fundamentals of PLCs, programming techniques, communication protocols, and their integration with SCADA systems. Case studies will be utilized to illustrate real-world applications of PLC and SCADA technology.

Prerequisites

- Basic understanding of electrical circuits and industrial automation systems.
- Familiarity with programming concepts and logic.

UNIT I Introduction to PLC **9**

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

UNIT II PLC INSTRUCTIONS **9**

PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays- Interlock examples- Timers, Counters, Examples.

UNIT III PLC Programming **9**

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

UNIT IV Communication of PLC and SCADA **9**

Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT V Case Studies **9**

Stepper Motor Control – Elevator Control – CNC Machine Control – conveyor control-Inter locking Problems.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, and online resources

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Know the basic requirement of a PLC input/output devices and architecture.
CO2: Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.
CO3: Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Biock.
CO4: Able to develop a PLC logic for a specific application on real world problem.
CO5: Ability to Understand the Concepts of Communication used for PLC/SCADA.

TEXT BOOKS:

1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W.Webb, Ronald A.Reis, Programmable Logic Controllers Principles and applications, PHI publication

REFERENCES:

1. Madhuchannd Mitra and Samerjit Sengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.
2. J.R.Hackworth and F.D.Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication.

YouTube Resources:

1. https://youtu.be/Y5NgUc_dxlA?si=ftn2jWz0DghyfEW5
2. https://youtu.be/qaI48NCUvkA?si=ZM5nHTKw6kTzeuVg
3. https://youtu.be/y2eWdLk0-Ho?si=qcmk_85ns4ixqhNA
4. https://youtu.be/dbSkqDw_UlQ?si=qiYQcX-C2DTnuBKG
5. https://youtu.be/jQGxJOZDfZI?si=0Vfl2hhLGog_EY3B

TOTAL: 45 PERIODS

Course Code	Energy Management and Auditing	L	T	P	C
EE46O7		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the concepts behind economic analysis and Load management
- To understand the basics of materials and energy balance.
- To modelling the energy efficiency in thermal utilities.
- To know the concept of compressed air system
- To illustrate the concept of lighting systems and cogeneration.

Course Description

This course provides a comprehensive understanding of energy management and energy audit techniques, focusing on improving energy efficiency in various thermal, compressed air, and electrical utilities.

Prerequisites

- Basic Engineering Principles: Understanding of basic engineering principles related to thermal, mechanical, and electrical systems.
- Energy Management Principles: Familiarity with principles of energy management, conservation, and audit techniques would be beneficial.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT 9

Commercial and Non-commercial energy – final energy consumption – energy needs of growing economy – energy pricing – energy conservation and its importance – Re-structuring of the energy supply sector – Energy Conservation Act 2001, Energy Conservation (Amendment) Act, 2010, and its features – electricity tariff- Thermal Basics- need and types of energy audit – Energy management/audit approach-understanding energy costs – maximizing system efficiencies – optimizing the input energy requirements – energy audit instruments – Case study.

UNIT II MATERIAL AND ENERGY BALANCE 9

Methods for preparing process flow – material and energy balance diagrams – Energy policy purpose – location of energy management – roles and responsibilities of energy manager – employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return – Case Study.

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Introduction to fuels – properties of fuel oil, coal and gas – principles of combustion – combustion of oil, coal and gas – Boilers: Types, combustion in boilers, performances evaluation, analysis of losses – energy conservation opportunities – FBC boilers – Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings – Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss – Cogeneration: classification and saving potentials – Case Study.

UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM 9

Compressed Air System: Types of air compressors – efficient compressor operation – Compressed air system components – leakage test – savings opportunities – Refrigeration System: Vapour compression refrigeration cycle – refrigerants – coefficient of performance – factors affecting Refrigeration and Air

conditioning system – savings opportunities – Vapour absorption refrigeration system: working principle – types and comparison with vapour compression system – saving potential – Cooling Tower: Types and performance evaluation, efficient system operation – flow control strategies and energy saving – Diesel Generating system: Factors affecting selection – energy performance assessment of diesel conservation avenues – Case Study.

UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES 9

Electrical load management and maximum demand control – power factor improvement and its benefit – selection and location of capacitors – performance assessment of PF capacitors – automatic power factor controllers – transformer losses – Electric motors: Types – losses in induction motors – motor efficiency – factors affecting motor performance – rewinding and motor replacement issues – energy saving opportunities with energy efficient motors – soft starters with energy saver – variable speed drives – Fans and blowers: Types – efficient system operation – flow control strategies -Pumps and Pumping System: Types – system operation – flow control methods – Lighting System: Light source, choice of lighting, luminance requirements – ballast – occupancy sensors – energy efficient lighting controls – energy conservation avenues – Case Study.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Students able to acquire knowledge in the field of energy management and auditing process.
CO2: Learned the about basic concepts of economic analysis and load management.
CO3: Able to design the effective thermal utility system.
CO4: Able to improve the efficiency in compressed air system.
CO5: Acquired the design concepts in the field of lighting systems, light sources and various

TEXT BOOKS:

1. Mehmet Kanoglu, Yunus Acengel, "EnergyEfficiencyand Management for Engineers", McGraw-Hill Education, First Edition, 2020.

REFERENCES:

1. Moncef Krati, 'Energy Audit of Building Systems: An Engineering Approach', Third Edition, CRC Press, Dec. 2020.
2. Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited, 2015.
3. Michael P. Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits', American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
4. Thomas D. Eastop, 'Energy Efficiency: For Engineers and Technologists', Longman Scientific & Technical, 1990, 1st Edition.
5. 'Energy Managers and Energy Auditors Guidebook', Bureau of Energy Efficiency, 2006.
6. Larry C. Witte, Philip S. Schmidt, David R. Brown, 'Industrial Energy Management and Utilization', Springer Berlin Heidelberg, 1988

YouTube Resources:

1. https://youtu.be/mo3dtxxZonY?si=viKrBwAf5swJksBX
2. https://youtu.be/oqTdUidltUY?si=v064HmKYxqEajqGg
3. https://youtu.be/dTpfta1tztU?si=UCrmrk8bY9-jC90N
4. https://youtu.be/1GjeToOkXE4?si=DgwjSn8w7InXKzmW
5. https://youtu.be/pU1WF402pro?si=ydI24IJ7uyEN_zU7

TOTAL: 45 PERIODS

Course Code	Biomedical Instrumentation	L	T	P	C
BM46O1		3	0	0	3

COURSE OBJECTIVES:

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals.
- To understand the design of bio amplifiers
- To explain the different techniques used for measurement of non-electrical bio parameters
- To explain the biochemical measurement techniques as applicable for diagnosis and treatment.

UNIT I Electrode Configurations **9**

Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT II Bio-signal Characteristics **9**

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode. ECG, EEG, EMG, ERG, EOG, GSR, PCG.

UNIT III Bio-amplifiers **9**

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference, Electrical Isolation (optical and electrical)

UNIT IV Measurement of Bio Signals **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: Auscultatory methods, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements

UNIT V Biochemical Measurements **9**

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, Colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer. Safety of Biomedical Instruments

TOTAL: 45 PERIODS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Illustrate the origin and characteristics of various biological
CO2: Gain knowledge on characteristics of bio signals
CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of bio-signals.
CO4: Explain the different measurement techniques for non-electrical bio-parameters
CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. John Enderle, Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, second edition, Academic Press, 2005.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

OPEN ELECTIVE-II

Course Code	Nanomaterial and Applications	L	T	P	C
ME47O3		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications.
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterization techniques employed to characterize the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS 9

Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS 9

Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING 9

Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique

UNIT IV STRUCTURAL CHARACTERISTICS 9

Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nano indentation, Grain size, phase formation, texture, stress analysis.

UNIT V APPLICATIONS 9

Applications of nanoparticles, quantum dots, nanotubes, nanowires, nano-coatings; applications in electronic, electrical and medical industries

TOTAL: 45 HOURS

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Evaluate nanomaterials and understand the different types of nanomaterials
CO2: Explain working of basic instruments used in characterization of nanoparticles.
CO3: Discuss the application of nanotechnology to mechanical and civil domains
CO4: Classify the nanomaterials based on the dimensions.
CO5: Assess the suitability of nanomaterials for various device applications

TEXT BOOKS:

1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007.
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

REFERENCES:

1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003
2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004
3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008
4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000
5. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004.

Course Code	Sustainable Manufacturing	L	T	P	C
EE47O2		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

Course Description

This course delves into the multidimensional aspects of sustainability within the context of manufacturing operations. It explores economic, social, and environmental sustainability principles, strategies, and practices. Students will learn about the historical context of sustainability, emerging issues, innovative products, and competitive manufacturing strategies. Additionally, the course covers sustainability assessment methods, management techniques, and the integration of sustainability into manufacturing strategies and operations.

Prerequisites

- Basic understanding of economics and business management
- Familiarity with manufacturing processes and operations
- Knowledge of environmental issues and sustainability concepts
- Proficiency in data analysis and modeling techniques

UNIT I Economic Sustainability **9**

Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status – Emerging issues- Innovative products- Reconfiguration manufacturing enterprises – Competitive manufacturing strategies – Performance evaluation- Management for sustainability – Assessments of economic sustainability.

UNIT II Social and Environmental Sustainability **9**

Social sustainability – Introduction-Work management -Human rights – Societal commitment – Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution – Use of resources -Pressure to reduce costs – Environmental management: Processes that minimize negative environmental impacts – environmental legislation and energy costs – need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT III Sustainability Practices **9**

Sustainability awareness – Measuring Industry Awareness-Drivers and barriers – Availability of sustainability indicators -Analysis of sustainability practicing -Modelling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers – Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model

UNIT IV Manufacturing Strategy for Sustainability **9**

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme – Manufacturing strategy in business success strategy formation and

formulation – Structured strategy formulation – Sustainable manufacturing system design options – Approaches to strategy formulation – Realization of new strategies/system designs.

UNIT V Trends in Sustainable Operations **9**

Principles of sustainable operations – Life cycle assessment manufacturing and service activities – influence of product design on operations – Process analysis – Capacity management – Quality management -Inventory management – Just-In-Time systems – Resource efficient design – Consumerism and sustainable well-being.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations and online resources.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

Upon successful completion of the course, students should be able to:
CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

TEXT BOOKS:

1. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0",Springer International Publishing., United States, 2016, ISBN 13: 978-3319293042.
2. Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2010, ISBN: 978-1-848-21212-1.

REFERENCES:

1. Jovane F, Ęmper, W.E. and Williams, D.J., "The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing", Springer,2009, United States, ISBN 978-3-540-77011-4.
2. Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.
3. Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer, United States, 2012, ISBN 978-3-642-27289-9.

YouTube Resources:

1. https://youtu.be/QHDW0gKO9_w?si=fJ2sWDU_N06GbuAZ
2. https://youtu.be/sMqtwbKc8EA?si=8CZ7zRvfxw3prgS-
3. https://youtu.be/0wU0UCNrkhU?si=bIss9IZUKJzK7T0I
4. https://youtu.be/4SHEu9q8TTk?si=Lb8ReAXMGGk-Ynz5
5. https://youtu.be/kC3VTg-8f0s?si=yXAn2KM9v-SVAI-i

TOTAL: 45 PERIODS

Course Code	Concepts in Mobile Robotics	L	T	P	C
ME47O4		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce mobile robotic technology and its types in detail.
- To learn the kinematics of wheeled and legged robot.
- To familiarize the intelligence into the mobile robots using various sensors.
- To acquaint the localization strategies and mapping technique for mobile robot.
- To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT I INTRODUCTION TO MOBILE ROBOTS 9

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles

UNIT II KINEMATICS 9

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Maneuverability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots

UNIT III PERCEPTION 9

Sensors for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction

UNIT IV LOCALIZATION 9

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).

UNIT V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 9

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Evaluate the appropriate mobile robots for the desired application.

CO2: Create the kinematics for given wheeled and legged robot.

CO3: Analyse the sensors for the intelligence of mobile robotics.

CO4: Create the localization strategies and mapping technique for mobile robot.

CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications

TEXT BOOKS

1. Roland Siegwart and Illah Nour bakish, "Introduction to Autonomous Mobile Robots" MIT Press, Cambridge, 2004.

REFERENCES

1. Dragomir N. Nenchev, Atsushi Konno, Teppei Tsujita, "Humanoid Robots: Modelling and Control", Butterworth-Heinemann, 2018
2. Mohanta Jagadish Chandra, "Introduction to Mobile Robots Navigation", LAP Lambert Academic Publishing, 2015.
3. Peter Corke, "Robotics, Vision and Control", Springer, 2017.
4. Ulrich Nehmzow, "Mobile Robotics: A Practical Introduction", Springer, 2003.
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, "Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions", Intec Press, 2009.
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.

Course Code	Industrial Management Techniques	L	T	P	C
EE47O4		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce fundamental concepts of industrial management
- To understand the approaches to the study of Management
- To learn about Decision Making, Organizing and leadership
- To analyze the Managerial Role and functions
- To know about the Supply Chain Management.

Course Description

This course provides a comprehensive overview of the principles and practices of management in organizations. It covers topics such as technology management, functions of management (planning, organizing, leading, controlling), organizational behavior, group dynamics, and modern management concepts. Students will explore the evolution of management thought, different forms of organization, organizational culture, leadership styles, communication, decision-making, conflict resolution, and contemporary management approaches such as Management by Objectives (MBO), Strategic Management, and Information Technology in Management.

Prerequisites

- Basic knowledge of basic financial accounting.
- Familiarity with Accounting, Engineering Economics.

UNIT I Introduction **9**

Technology Management – Definition – Functions – Evolution of Modern Management- Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership – Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work- Share Holders – Board of Directors – Committees – Chief Executive Line and Functional Managers, -Financial-Legal-Trade Union.

UNIT II Functions of Management **9**

Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and staff – Decentralization -Organizational culture, Staffing – selection and training. Placement – Performance appraisal – Career Strategy – Organizational Development. Leading – Managing human factor - Leadership. Communication-Controlling – Process of Controlling – Controlling techniques, productivity and operations management – Preventive control, Industrial Safety.

UNIT III Organizational Behavior

Definition – Organization – Managerial Role and functions -Organizational approaches, Individual behavior – causes – Environmental Effect – Behavior and Performance, Perception – Organizational Implications. Personality – Contributing factors – Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behavior-Learning Curves, Work Design and approaches.

UNIT IV Group Dynamics **9**

Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group Decision Making – Leadership Role in Group Decision, Group Conflicts – Types -Causes – Conflict Resolution -Inter group relations and conflict, Organization

centralization and decentralization – Formal and informal – Organizational Structures Organizational Change and Development -Change Process – Resistance to Change – Culture and Ethics.

UNIT V Modern Concepts **9**

Management by Objectives (MBO) – Management by Exception (MBE), Strategic Management – Planning for Future direction – SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Reengineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (AM) – Global Perspective – Principles and Steps Advantages and disadvantage.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations and online resources.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4: Analyze the learning curves
CO5: Understand the placement and performance appraisal

TEXT BOOKS:

1. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing. United States, 2016, ISBN 13: 978-3319293042.
2. Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2010, ISBN: 978-1-848-21212-1.

REFERENCES:

1. Maynard H.B, "Industrial Engineering Hand book", McGraw-Hill, sixth 2008
2. Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer, United States, 2012, ISBN 978-3-642-27289-9.

YouTube Resources:

1. https://youtu.be/zHpi7mnGdg0?si=YuL4o4CAFCvf4Cf3
2. https://youtu.be/jOLHwYi-waI?si=Osjcmd4D9DOjuxV5
3. https://youtu.be/pHg3ZfGk5j0?si=sfpHalDwksop1fdK
4. https://youtu.be/YctbIjIo5wI?si=iaMJcC_2Ofm29oCe
5. https://youtu.be/Nwo3D4tQ_AU?si=SqWasBUp7gwVDplh

TOTAL: 45 PERIODS

Course Code	Process Control and Quality Engineering	L	T	P	C
EE47O5		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing the special control procedures for service and process-oriented industries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

Course Description

This course introduces the principles and techniques of quality management and statistical process control (SPC). Topics covered include quality dimensions, quality definitions, qualitycontrol methods such as inspection, quality assurance, and quality planning. Students will also learn about control charts for variables and attributes, special control procedures, statistical process control techniques for process stability and capability analysis, as well as acceptance sampling methods.

Prerequisites

- Basic understanding of statistics
- Familiarity with manufacturing processes
- Knowledge of quality management principles is helpful but not required

UNIT I Introduction **9**

Quality Dimensions – Quality definitions – Inspection – Quality control – Quality Assurance– Quality Planning-Quality costs–Economics of quality– Quality loss function

UNIT II Control Charts **9**

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts – p, np, c and u- Construction and application

UNIT III Special Control Procedures **9**

Warning and modified control limits, control chart for individual measurements, multi-variable chart, X- chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV Statistical Process Control **9**

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V Acceptance Sampling **9**

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD- 414E & IS 2500standards.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations and online resources.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defect sin manufacturing companies.
CO3: Control the occurrence of defect sin services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.

TEXT BOOKS:

1. David Foster, "Generative Deep Learning", Second Edition, O'Reilly Media, 2023.
2. Joseph Babcock and Raghav Bali, "Generative AI with Python and TensorFlow 2", Packt Publishing, 2021
3. Jakub Langr and Vladimir Bok, "GANs in Action: Deep learning with Generative Adversarial Networks",Manning, 2019.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2016.
2. Hannes Hapke, Cole Howard, Hobson Lane "Natural Language Processing in Action", Manning, 2019.
3. Alberto Chierici, "The Ethics of AI", New Degree Press, 2021.
4. Jacob Emerson, "Ripples of Generative AI", IngramSpark, 2023.
5. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, 2017.
6. Eric Matthes, "Python Crash Course", Third Edition, No Starch Press, 2023.

YouTube Resources:

2. https://youtu.be/FmH5cgIWaMY?si=q6zAmC7uI_Qd-V9-
3. https://youtu.be/Aj7lJLR-7b4?si=MmAVejNtR6WwcGzq
4. https://youtu.be/c-DPxardFZs?si=ufpss9GoxJecMULD
5. https://youtu.be/5w2ALtjWqGQ?si=7Dd-Golna328F5Xy
6. https://youtu.be/1d8a_FFJrz8?si=EwnTQzXNX8amBOFI

TOTAL: 45 PERIODS

Course Code	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
ME47O5		3	0	0	3

COURSE OBJECTIVES:

- To know the Indian and global energy scenario
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status. Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications

UNIT III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues – Applications.

UNIT IV BIO-ENERGY 9

BIO resources – Biomass direct combustion – thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production – Applications

UNIT V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Discuss the Indian and global energy scenario.
CO2: Describe the various solar energy technologies and its applications.
CO3: Explain the various wind energy technologies.
CO4: Explore the various bio-energy technologies.
CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, McGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 812034470

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme. S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015

Course Code	Solar Power Batteries	L	T	P	C
EE47O7		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the concepts of solar PV systems.
- To understand the PV systems and the solar power batteries operation
- To modelling the solar PV system storage with batteries.
- To understand Grid Tie vs. Off-Grid Solar Battery System.
- To understand the environmental factors for solar batteries.

Course Description

Solar power batteries are essential components of renewable energy systems, providing reliable and sustainable energy storage solutions for off-grid, hybrid, and grid-tied applications.

Prerequisites

- Effective communication skills for working with clients, contractors, engineers, and regulatory authorities.
- Understanding of power electronic converters used for charging and discharging solar power batteries.

UNIT I SOLAR PV SYSTEMS **9**

Introduction to solar PV systems, basics of Storage for solar PV systems, Storage for solar PV systems: the batteries, Introduction to Solar Power Batteries, terminology associated, understanding Solar Battery Specifications, working principle, Series Vs. Parallel, Charging parameters, cycle life, Temperature effects, Battery Design and Construction, Important components in battery construction.

UNIT II TYPES OF BATTERIES **9**

Primary and Secondary batteries, Classification of Secondary batteries, i.e Lead-Acid, Lead-Antimony, Lead-Calcium, Lead-Acid Battery Chemistry, Nickel-Cadmium Batteries and their types.

UNIT III BATTERIES FOR PV SYSTEMS **9**

AC Coupled Storage vs. DC Coupled Storage, working of Solar Batteries with a Solar Power System and Hybrid Inverter, Main Degradation mechanisms of Solar Batteries, Battery Strengths and Weaknesses, Battery System Design and Selection Criteria, Life Expectancy, Battery standards, Safety precautions.

UNIT IV CHOICE OF SELECTION OF SOLAR BATTERIES **9**

Solar Battery Costs, Declining Cost, factors contribute to the performance of solar battery, selection of suitable batteries based on the application, Grid Tie vs. Off-Grid Solar Battery System, Benefits and disadvantages of using solar batteries.

UNIT V ENVIRONMENTAL FACTORS FOR SOLAR BATTERIES **9**

The environmental impacts of batteries: Introduction, Service life of the components, Energy requirements for production and transport of the PV-battery system components, Contributing components, Influence of different user conditions, Uncertainties, Future research, Energy return factor, the overall battery efficiency, Different efficiency measures and battery design, The Future of Solar Battery Storage.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:
CO1: Know the different level of PV systems.
CO2: Know operating principles of different types of solar power batteries
CO3: Use the batteries for effective storage of solar PV.
CO4: know the choice of selection of solar batteries.
CO5: Gain the knowledge on environmental impacts of solar power batteries.

TEXT BOOKS:

1. S. Sumathi and L. Ashok Kumar, Solar PV and Wind Energy Conversion Systems: An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques, Springer 2011
2. H.A. Kiehne, "Battery Technology Handbook" by Publisher: CRC Press 2003 https://core.ac.uk/download/pdf/30044842.pdf
3. Handbook on Battery Energy Storage System
4. https://www.adb.org/sites/default/files/publication/479891/handbook-battery-energy-storage

REFERENCES:

1. Cristina Archer and S. Lovejoy, Battery Technology for Electric Vehicles: Public Science and Private Innovation, Springer 2015
2. Soteris A. Kalogirou, "Solar Energy Engineering: Processes and Systems" by, Academic Press, Year: 2009
3. https://files.bregroup.com/bre-co-uk-file- librarycopy/filelibrary/nsc/Documents%20Library /NSC%20Publications/88031 -BRE_Solar-Consumer- Guide-A4-12pp.pdf
4. https://www.sunwize.com/tech-notes/solar-battery-basics/
5. https://palmetto.com/learning-center/blog/how-does-a-solar-battery-work
6. https://www.letsgosolar.com/faq/what-is-a-solar-battery/
7. https://www.purevolt.ie/domestic-solar/equipment/solar-storage-batteries.php

YouTube Resources:

1. https://youtu.be/fC48rVyM3Ws
2. https://youtu.be/uediUqshuWQ
3. https://youtu.be/R2pVtTeqg3k?t=2
4. https://youtu.be/fC48rVyM3Ws5
5. https://youtu.be/uediUqshuWQ1

TOTAL: 45 PERIODS

Course Code	Design Techniques of Electrical Machines	L	T	P	C
EE4708		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Magnetic circuit parameters and thermal rating of various types of electrical machines.
- Armature and field systems for D.C. machines.
- Core, yoke, windings and cooling systems of transformers.
- Design of stator and rotor of induction machines and synchronous machines.
- The importance of computer aided design method.

Course Description

This course provides an in-depth understanding of the design principles and methodologies for electrical machines, covering various aspects such as magnetic circuits, transformers, DC machines, induction motors, and synchronous machines. Students will learn about major considerations in electrical machine design, materials selection, construction, output equations, main dimensions, specific loadings, and design calculations for various components. Computer programs for design calculations and simulations will also be introduced.

Prerequisites

- Basic knowledge of electrical engineering principles
- Understanding of electromagnetism and circuit theory
- Familiarity with basic design principles is beneficial but not required

UNIT I Design of Field System and Armature **9**

Major considerations in Electrical Machine Design – Materials for Electrical apparatus –Design of Magnetic circuits – Magnetizing current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding

UNIT II Design of Transformers **9**

Construction – KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No-load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single-phase core transformer

UNIT III Design of Dc Machines **9**

Construction – Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions.

UNIT IV Design of Induction Motors **9**

Construction – Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics: Magnetizing current – Short circuit current – Circle diagram – Computer program: Design of slip-ring rotor

UNIT V Design of Synchronous Machines **9**

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – 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 -Computer program: Design of Stator main dimensions-Brushless DC Machines

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations and online resources

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Explain the electrical engineering materials and standard specifications.
CO2: Categorize dimensions and different types of loadings in DC machines.
CO3: Design main dimensions and cooling systems of a transformer.
CO4: Compute leakage reactance and electrical proportions of induction motors.
CO5: Interpret armature design parameters and windings of synchronous machines.

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

REFERENCES:

1. A. Shanmuga sundaram, G. Gangadharan, R. Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. 'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1981.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017. 4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008.

YouTube Resources:

1. https://youtu.be/gO6Il36c60w?si=aTRehbFg2fuux7gX
2. https://youtu.be/mGfqVEZWKQA?si=_4J0QE2DYxCKE08U
3. https://youtu.be/AOC7uTnxmTI?si=sk07v4yIsxMT3AiB
4. https://youtu.be/gs9NO-ht6Q4?si=zdoH3qvEZ9TBM_Zz
5. https://youtu.be/tTh_cKW0Vk?si=ivVPH3_F9hCFUG4v

TOTAL: 45 PERIODS

APPENDIX C: MANDATORY COURSES

MANDATORY COURSE I							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	MC4301	Environmental Sciences and Sustainability	2	0	0	0
2.	Theory	MC4302	Introduction to Women and Gender Studies	2	0	0	0
3.	Theory	MC4303	Elements of Literature	2	0	0	0
4.	Theory	MC4304	Film Appreciation	2	0	0	0
5.	Theory	MC4305	Disaster Management	2	0	0	0
6.	Theory	MC4306	Design Thinking	2	0	0	0

MANDATORY COURSE II							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	Theory	MC4401	Well-Being with Traditional Practices-Yoga, Ayurveda Siddha	2	0	0	0
2.	Theory	MC4402	History of Science and Technology in India	2	0	0	0
3.	Theory	MC4403	Political and Economic Thought for a Humane Society	2	0	0	0
4.	Theory	MC4404	State, Nation Building and Politics in India	2	0	0	0
5.	Theory	MC4405	Industrial Safety	2	0	0	0

MANDATORY COURSE I

Course Code	Environmental Sciences and Sustainability	L	T	P	C
MC4301		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization

Course Description

This course provides a comprehensive overview of environmental studies, focusing on key concepts, issues, and practices related to environment and sustainability. Through a combination of theoretical knowledge, case studies, and practical applications, students will explore topics such as biodiversity, environmental pollution, renewable energy sources, sustainability, and sustainable practices.

Prerequisites

- There are no specific prerequisites for this course. However, a basic understanding of science and environmental concepts would be beneficial

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and preventive of water, soil, air and noise pollution. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy

UNIT IV SUSTAINABILITY AND MANAGEMENT **6**

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols - Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILY PRACTICES **6**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio- economical and technological change

Course Format

The course will be delivered through a combination of lectures, discussions, multimedia presentations, case studies, and hands-on activities. Guest lectures from industry experts and field visits may also be included to provide real-world perspectives.

Assessments & Grading

Quizzes / Assignments, Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation
CO2: To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
CO4: To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5: To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

YouTube Resources:

- TED-Ed: Environmental Studies Playlist
- Khan Academy: Environmental Science Playlist

TOTAL: 30 PERIODS

Course Code	Introduction to Women and Gender Studies	L	T	P	C
MC4302		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the distinction between sex and gender, and critically analyze the concepts of masculinity, femininity, and gender roles within various social contexts.
- Explore the mechanisms of socialization and the role of patriarchy in shaping gender relations and hierarchies.
- Examine key feminist theories including liberal, Marxist, socialist, radical, psychoanalytic, postmodernist, and ecofeminist perspectives, and critically evaluate their contributions to understanding gender issues.
- Analyze the global, national, and local dynamics of women's movements, tracing their historical development, key actors, and major achievements.
- Investigate the relationship between gender and language, exploring linguistic forms, narratives, and how language both reflects and constructs gender identities and power dynamics.

Course Description

This course delves into the interdisciplinary field of gender studies, examining key concepts, feminist theories, women's movements, and the intersection of gender with language and representation in media

Prerequisites

- There are no specific prerequisites for this course, although a basic understanding of social sciences and cultural studies would be beneficial.

UNIT I CONCEPTS **6**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour

UNIT II FEMINIST THEORY **6**

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL **6**

Rise of Feminism in Europe and America. Women's Movement in India

UNIT IV GENDER AND LANGUAGE **6**

Linguistic Forms and Gender. Gender and narratives

UNIT V GENDER AND REPRESENTATION **6**

Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.

Course Format

The course will be delivered through a combination of lectures, discussions, multimedia presentations, case studies, and hands-on activities. Guest lectures from industry experts and field visits may also be included to provide real-world perspectives.

Assessments & Grading

Quizzes / Assignments, Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Critically analyze key concepts in gender studies, including sex vs. gender, patriarchy, power dynamics, and gender roles.
CO2: Evaluate diverse feminist theories and their contributions to understanding gender inequality and social change.
CO3: Examine the historical development and contemporary dynamics of women's movements globally and locally.
CO4: Analyze the relationship between gender and language, including linguistic forms, narratives, and discourses.
CO5: Evaluate the representation of gender in various media forms, including advertising, visual media, alternative media, and social media, and assess their impact on shaping perceptions and reinforcing or challenging gender norms.

TEXT BOOKS:

1. "Gender: Ideas, Interactions, Institutions" by Lisa Wade and Myra Marx Ferree

REFERENCES:

1. "Feminist Theory: From Margin to Center" by bell hooks
2. Gender Trouble: Feminism and the Subversion of Identity" by Judith Butler

YouTube Resources:

- TED-Ed: Environmental Studies Playlist
- Crash Course: Sociology Series covering topics related to gender and feminism

TOTAL: 30 PERIODS

Course Code	Elements of Literature	L	T	P	C
MC4303		3	0	0	0

COURSE OBJECTIVES:

To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

Course Description

The "Introduction to Elements of Literature" course provides students with an overview of the fundamental components and genres of literature. Through the exploration of fiction, poetry, and drama, students will analyze key elements such as plot, character, perspective, emotions, figurative language, and theatrical performance

Prerequisites

- There are no specific prerequisites for this course, although a basic understanding of literature and language would be beneficial

I COURSE CONTENTS

Introduction to Elements of Literature

1. Relevance of literature
   - ✓ Enhances Reading, thinking, discussing and writing skills.
   - ✓ Develops finer sensibility for better human relationship.
   - ✓ Increases understanding of the problem of humanity without bias.
   - ✓ Providing space to reconcile and get a cathartic effect.
2. Elements of fiction
   - ✓ Fiction, fact and literary truth.
   - ✓ Fictional modes and patterns.
   - ✓ Plot character and perspective.
3. Elements of poetry
   - ✓ Emotions and imaginations.
   - ✓ Figurative language.
   - ✓ (Simile, metaphor, conceit, symbol, pun and irony).
   - ✓ Personification and animation.
   - ✓ Rhetoric and trend.
4. Elements of drama
   - ✓ Drama as representational art.
   - ✓ Content mode and elements.
   - ✓ Theatrical performance.
   - ✓ Drama as narration, mediation and persuasion.
   - ✓ Features of tragedy, comedy and satire.

II READING

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.

4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

III OTHER SESSIONS

1. *Tutorials:
2. *Laboratory:
3. *Project: The students will write a term paper to show their understanding of a particular piece of literature

IV *ASSESSMENT

1. HA:
2. Quizzes-HA:
3. Periodical Examination: one
4. Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
5. Final Exam

Course Format

The course will be delivered through a combination of lectures, discussions, readings, multimedia presentations, and hands-on activities. Students will engage with literary texts through close reading, analysis, and interpretation

Assessments & Grading

Quizzes / Assignments, Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon successful completion of the course, students should be able to:

Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

TEXT BOOKS:

1."An Introduction to the Study of English Literature" by W.H. Hudson, Atlantic, 2007.

REFERENCE BOOKS:

1. "An Introduction to Literary Studies" by Mario Klarer, Routledge, 2013.

2. "The Experience of Poetry" by Graham Mode, Open College of Arts with Open University Press, 1991.

YouTube Resources:

- Crash Course: Literature and Writing

TOTAL: 30 PERIODS

Course Code	Film Appreciation	L	T	P	C
MC4304		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Course Description

This course introduces the theory and practical applications of Generative Artificial Intelligence. Students will learn the fundamental concepts and techniques related to generative modelsand gain hands-on experience with creating and using generative AI systems.

Prerequisites

- There are no specific prerequisites for this course, although a basic understanding of literature and language would be beneficial

Theme - A: The Component of Films

- ✓ A-1: The material and equipment
- ✓ A-2: The story, screenplay and script
- ✓ A-3: The actors, crew members, and the director
- ✓ A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

- ✓ B-1: Film language, form, movement etc.
- ✓ B-2: Early cinema… silent film (Particularly French)
- ✓ B-3: The emergence of feature films: Birth of a Nation
- ✓ B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

- ✓ C-1: Realist theory; Auteurists
- ✓ C-2: Psychoanalytic, Ideological, Feminists
- ✓ C-3: How to read films?
- ✓ C-4: Film Criticism / Appreciation

Theme – D: Development of Films

- ✓ D-1: Representative Soviet films
- ✓ D-2: Representative Japanese films
- ✓ D-3: Representative Italian films
- ✓ D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

- ✓ E-1: The early era

- ✓ E-2: The important films made by the directors
- ✓ E-3: The regional films
- ✓ E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these

Course Format

Guest speakers, including filmmakers and scholars, may be invited to provide insights into specific topics.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the various components of filmmaking, including material and equipment, story development, casting, crew roles, and the filmmaking process.
CO2: Analyze the evolution of film language, from early cinema to the emergence of talkies and beyond.
CO3: Explore different film theories and criticism, including realist theory, auteurism, psychoanalytic theory, ideological criticism, and feminist theory
CO4: Develop the skills to critically analyze and interpret films, including understanding film form, narrative structure, and visual language
CO5: Examine the development of films in different cultural contexts, including representative films from Soviet, Japanese, Italian, and Hollywood cinema.

TEXT BOOKS:

1."Understanding Movies" by Louis Giannetti

REFERENCES:

1."Film Art: An Introduction" by David Bordwell and Kristin Thompson

YouTube Resources:

- CrashCourse: Film History and Analysis

TOTAL: 30 PERIODS

Course Code	Disaster Management	L	T	P	C
MC4305		3	0	0	0

COURSE OBJECTIVES:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

Course Description

This course provides an in-depth understanding of hazards, vulnerability, and disaster risks, along with strategies for disaster risk reduction (DRR) and disaster management. Through the exploration of various types of disasters, including natural, human-induced, and climate change-induced, students will analyze their causes, impacts, and management approaches.

Prerequisites

There are no specific prerequisites for this course, although a basic understanding of environmental science and public policy would be beneficial.

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS **6**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) **6**

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies- Relevance of indigenous Knowledge, appropriate technology and Local resources

UNIT III DISASTER MANAGEMENT **6**

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT **6**

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development – Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES **6**

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge

Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management- Fieldwork-Mock drill

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
CO3: To develop disaster response skills by adopting relevant tools and technology
CO4: Enhance awareness of institutional processes for Disaster response in the country
CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423.
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

YouTube Resources:

- UNDRR: United Nations Office for Disaster Risk Reduction
- TEDx Talks: Discussions on Disaster Management and Resilience

TOTAL: 30 PERIODS

Course Code	Design Thinking	L	T	P	C
MC4306		2	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- Introduce students to the fundamental concepts and principles of design thinking.
- Develop students' ability to empathize with users and identify their needs.
- Equip students with skills for problem-solving and generating innovative solutions.
- Foster collaboration and interdisciplinary teamwork among students.
- Apply design thinking methodologies to real-world engineering challenges.

Course Description

This course offers an exploration of the principles and methodologies behind design thinking, emphasizing on a human-centered approach to innovation and problem-solving. Through a blend of lectures, hands-on exercises, and interactive workshops, participants learn to empathize with users, define problems, generate creative solutions, and iterate on prototypes.

UNIT I Introduction to Design Thinking **2**

Definition and principles of design thinking – Importance and applications in engineering – Case studies of successful design thinking projects

UNIT II Empathize and Define **2**

Understanding user needs and motivations – Techniques for empathetic research (interviews, observations, etc.) – Defining problem statements based on user insights

UNIT III Ideate and Prototype **2**

Techniques for generating ideas (brainstorming, mind mapping, etc.) – Prototyping methods and tools – Iterative design process and feedback loops

UNIT IV Test and Iterate **2**

User testing and feedback collection – Analyzing and interpreting feedback – Iterating on prototypes based on feedback

UNIT V Application and Workshop **2**

Applying design thinking to engineering challenges – Workshop sessions for hands-on practice – Presentation (Posters / PPT / Demonstration) of final projects and reflection on the design process

Workshop Ideas:

1. Design Sprints: Conduct short, intensive workshops where students work collaboratively to solve a specific problem within a constrained timeframe.
2. Design Challenges: Pose open-ended design challenges to students and facilitate group work sessions where they brainstorm and prototype solutions.
3. User Persona Creation: Have students create user personas based on research findings and use them to guide the design process.
4. Prototyping Sessions: Provide materials and tools for students to create rapid prototypes of their ideas, encouraging experimentation and creativity.
5. Design Critiques: Organize sessions where students present their prototypes to peers for feedback and constructive criticism, fostering a culture of iteration and improvement.

Course Format

Lectures and discussions, Workshops, Group discussions and presentations,

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the principles and process of design thinking.
CO2: Identify user needs through empathetic research.
CO3: Generate creative ideas and solutions through brainstorming and prototyping.
CO4: Apply design thinking methodologies to solve engineering problems effectively.
CO5: Work collaboratively in multidisciplinary teams to address complex challenges.

TEXT BOOKS:

1. Tim Brown, "Change by Design", Revised and Updated, Harper, 2019.
2. Christian Müller-Roterberg, "Handbook of Design Thinking: Tips & Tools for How to Design Thinking", Independently Published, 2018.
3. Jeanne Liedtka, and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.

REFERENCES:

1. Don Norman, "The Design of Everyday Things", Basic Books, 2015.
2. Hasso Plattner, Christoph Meinel, and Larry Leife (editors), "Design Thinking: Understand – Improve – Apply", Springer-Verlag, 2013.
3. Richard Banfield, C. Todd Lombardo and Trace Wax, "Design Sprint: A Practical Guidebook for Building Great Digital Products", O'Reilly Media, 2015.

TOTAL: 10 PERIODS

MANDATORY COURSE II

Course Code	Well-Being with Traditional Practices-Yoga, Ayurveda Siddha	L	T	P	C
MC4401		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders.

Course Description

This course introduces the theory and practical applications of Generative Artificial Intelligence. Students will learn the fundamental concepts and techniques related to generative modelsand gain hands-on experience with creating and using generative AI systems.

Prerequisites

There are no specific prerequisites for this course, although a basic understanding of human biology and physiology would be beneficial.

UNIT I HEALTH AND ITS IMPORTANCE 6

Health: Definition - Importance of maintaining health - More importance on prevention than Treatment - Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 6

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH – AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) – Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 6

Emotional health - Definition and types - Three key elements: the subjective experience – the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and longterm effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 6

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life

Course Format

The course will be delivered through a combination of lectures, discussions, practical demonstrations, and experiential learning activities. Students will engage with theoretical concepts and practical applications related to health and wellness.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Learn the importance of different components of health
CO2: Gain confidence to lead a healthy life
CO3: Learn new techniques to prevent lifestyle health disorders.
CO4: Understand the importance of diet and workouts in maintaining health
CO5: Apply practical techniques and lifestyle modifications to enhance personal health and well-being.

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

YouTube Resources:

Yoga with Adriene: YouTube channel offering yoga practices for various levels and purposes

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/imple lifestyle modifications to maintain health
2. https://www.niddk.nih.gov/health-information/diet-utrition/changinghabitsbetterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more:https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. Benefitsofhealthyeatinghttps://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html
6. Foodadditiveshttps://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditi
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
8. https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle-who recommendation.

TOTAL: 30 PERIODS

Course Code	History of Science and Technology In India	L	T	P	C
MC4402		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the historical development of science and technology in India, spanning from ancient civilizations to the post-independent era.
- To analyze key concepts and perspectives in the study of history, including objectivity, determinism, causation, and moral judgment, as applied to the field of science and technology
- To explore the impact of historical events, interactions, and cultural exchanges on the evolution of science and technology in India.
- To develop critical thinking, research, and analytical skills through the study of historical perspectives on science and technology in India.
- To foster an appreciation for the rich heritage and legacy of scientific knowledge and technological innovations in India, and their relevance to contemporary issues and challenges.

Course Description

This course delves into the historical perspectives and developments of science and technology in India, spanning from ancient times to the post-independent era. Through an exploration of key concepts, historiography, and significant historical periods, students will gain insights into the evolution of scientific thought, technological advancements, and their societal impacts.

Prerequisites

There are no specific prerequisites for this course, although a basic understanding of history, science, and technology would be beneficial.

UNIT I CONCEPTS AND PERSPECTIVES 6

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 6

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S.Irfan Habib, Deepak Kumar, Dhruv Raina, and others

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 6

Technology in pre-historic period-Beginning of agriculture and its impact on technology-Science and Technology during Vedic and Later Vedic times-Science and technology from 1st century AD to C-1200

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 6

Legacy of technology in Medieval India, Interactions with Arabs-Development in medical knowledge, interaction between Unani and Ayurveda and alchemy-Astronomy and Mathematics: interaction with Arabic Sciences-Science and Technology on the eve of British conquest.

UNIT V GENDER AND REPRESENTATION 6

Science and the Empire-Indian response to Western Science-Growth of techno-scientific institutions

UNIT VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA 6

Science, Technology and Development discourse -Shaping of the Science and Technology Policy Developments in the field of Science and Technology-Science and technology in globalizing India-Social implications of new technologies like the Information Technology and Biotechnology

Course Format

The course will be delivered through a combination of lectures, readings, discussions, and presentations. Students will engage with primary and secondary sources, including works by prominent historians and scholars in the field.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the meaning, scope, and importance of history, with a focus on the historiography of science and technology in India.
CO2: Analyze key concepts and perspectives in the study of history, including objectivity, determinism, causation, and moral judgment.
CO3: Examine the evolution of science and technology in ancient and medieval India, including technological advancements, interactions with other cultures, and the legacy of knowledge.
CO4: Evaluate the impact of colonialism on science and technology in India, including responses to Western science and the establishment of techno-scientific institutions.
CO5: Explore the role of gender in science and technology representation, and its implications for societal development.

TEXT BOOKS:

1.Explore the role of gender in science and technology representation, and its implications for societal development.

REFERENCES:

1. "The Illustrated History of Science and Invention in India" by A.K. Bag
2. "Science and Technology in Medieval India" by S. M. Ali
3. "Modern Indian History and Culture" by Raghavan Iyer

YouTube Resources:

1. Indian Institute of Science: Lectures on the history of science and technology in India
2. National Institute of Science, Technology and Development Studies (NISTADS): Webinars on science and technology policy in India
3. Centre for Studies in Social Sciences, Calcutta (CSSSC): Videos on gender representation in science and technology

TOTAL: 30 PERIODS

Course Code	Political and Economic Thought For A Humane Society	L	T	P	C
MC4403		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

This course will begin with a short overview of human needs and desires and how different political-economic systems try to full them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

Course Description

This course offers an in-depth exploration of various socio-political and economic ideologies and systems that have shaped human societies throughout history. Through lectures, readings, and discussions, students will examine the fundamental principles, historical contexts, and key figures associated with capitalism, liberalism, fascism, communism, the welfare state, Gandhian thought, and essential elements of Indian civilization.

Course Topics

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each)

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Prerequisites

There are no specific prerequisites for this course, although a basic understanding of history, political science, and economics would be beneficial.

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. **(5 lectures)**

(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. **(2 lectures)**

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

(Refs: Marx, Lenin, Mao, M N Roy) **(5 lectures)**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. **(3 lectures)**

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. **(6 lectures)**

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. **(3 lectures)**

(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. **(4 lectures)**
(Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

GRADING:

Mid sems	30
End sem	20
Home Assign	10
Term paper	40

Course Format

The course will be delivered through a series of lectures, readings, discussions, and assignments. Each lecture will focus on a specific topic, providing historical background, key concepts, and critical analysis

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

TEXT BOOKS:
Authors mentioned along with topics above. Detailed reading list will be provided.

TOTAL: 30 PERIODS

Course Code	State, Nation Building And Politics In India	L	T	P	C
MC4404		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

Course Description

This course provides an in-depth understanding of the political landscape of India, focusing on the development of the nation-state, the role of the state and politics, the organs of the state, and the challenges of nation-building and national integration

Prerequisites

There are no specific prerequisites for this course, although a basic understanding of political science, history, and sociology would be beneficial.

Course Topics

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary - federal, Presidential-Parliamentary,

The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.

Goals, objective and philosophy.

Why a federal system?

National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)

New social movements.

The changing nature of Indian Political System, the future scenario. What can we do?

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

It is expected that this course will make students aware of the theoretical aspect of the state, itsorgans, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

Course Format

The course will be delivered through a combination of lectures, readings, discussions, and assignments.

TEXT BOOKS:

1. "Indian Polity" by M. Laxmikanth

TOTAL: 30 PERIODS

Course Code	Industrial Safety	L	T	P	C
MC4405		3	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques

Course Description

This course focuses on workplace safety and health, covering various safety terminologies, standards, regulations, safety activities, and hazard identification techniques. Students will learn about hazards, risks, control measures, safety standards, regulations, safety activities, and techniques for identifying and assessing workplace hazards.

Prerequisites

There are no specific prerequisites for this course, although a basic understanding of workplace safety concepts and regulations would be beneficial.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects-Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998-Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives-Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety-Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

Course Format

The course will be delivered through a combination of lectures, workshops, case studies, discussions, and practical exercises. Each session will focus on specific topics related to workplace safety, providing theoretical knowledge, practical insights, and hands-on training.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand key safety terminologies, including hazards, risks, control measures, and safety standards.
CO2: Identify and assess various workplace hazards, including chemical, physical, ergonomic, and environmental hazards
CO3: Interpret and comply with relevant safety regulations and standards, such as the Indian Factories Act and ISO 45001:2018.
CO4: Demonstrate knowledge of safety activities, including toolbox talks, safety committees, safety training, and emergency action plans
CO5: Analyze and mitigate workplace health and safety risks, such as noise hazards, musculoskeletal disorders, and electrical hazards.

TEXT BOOKS:

1. "Occupational Health and Safety Management: A Practical Approach" by Charles D. Reese

REFERENCES:

1. "Safety and Health for Engineers" by Roger L. Brauer
2. "Industrial Safety and Health Management" by C. Ray Asfahl and David W. Rieske.
3. "Introduction to Occupational Health and Safety" by Matthew Granger

YouTube Resources:

1. National Safety Council: Videos on workplace safety tips and best practices
2. OSHA: Occupational Safety and Health Administration's training videos

TOTAL: 30 PERIODS