VINAYAKA MISSION'S RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)

Faculty of Engineering and Technology

REGULATIONS 2021

Programme:

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

Full Time (4 Years)

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM

(Semester I to VIII)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO)

Graduating Students of Electrical and Electronics Engineering programme will be able to:

Sl. No.	Description
PSO 1	Apply science, mathematics and engineering through differential and integral calculus, complex variables to solve electrical engineering problems.
PSO 2	Demonstrate proficiency in use of software and hardware to be required to practice electrical engineering profession.
PSO 3	Provide socially acceptable technical solution with the knowledge of ethical and management principles for sustainable development.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

Sl. No.	Description
PEO1	To impart the graduates to promote basic science and mathematical foundation, as also the principles and technology advancements made in electrical and electronics engineering and allied fields.
PEO2	To induce the graduates to design Electrical, Electronics and Computing systems those are innovative and socially acceptable.
PEO3	To motivate the graduates to exhibit professionalism, ethics, communication skills, team work and Application oriented research.

VINAYAKA MISSION'S RESEARCH FOUNDATION
(DEEMED TO BE UNIVERSITY), SALEM

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM FOR REGULATION-2021

Credit Requirement for the Course Categories

Sl. No.	Category of Courses	Types of Courses		Suggested Breakup of Credits (min-max)
1.	A. Foundation Courses	Humanities and Social Sciences including Management Courses		9 – 12
2.		Basic Science Courses		18 – 25
3.		Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.		18 – 24
4.	B. Professional	Core Courses		48 – 54
5.	C. Elective Courses	Professional Electives		12
		Industry Designed / Industry Supported / Industry Offered/ Industry Sponsored Courses		6
		Open Electives	Innovation, Entrepreneurship, Skill Development etc.	6 – 9
			Emerging Areas like 3D Printing, Artificial Intelligence, Internet of Things etc.	6 – 9
6.	D. Courses for Presentation of technical Skills related to the specialization	Project Work		8
		Mini Project		3
		Seminar		1
		Internship in Industry or Elsewhere		3
7.	**E. Mandatory Courses	Yoga and Meditation, Gender Equity and Law, Essence of Indian Traditional Knowledge, Indian Constitution, NCC / NSS / RRC / YRC / Student Clubs / Unnat Bharat Abhiyan / Swachh Bharat , Sports and Games		Zero Credit Course (Minimum 2 Courses to be Completed other than Yoga and Meditation)
Minimum Credits to be earned				**160**

** The credits earned in category 'E' Courses will not be counted in CGPA calculation for awarding of the degree.

CURRICULUM

B.E - ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER
I TO VIII

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SEMESTER I TO VIII

A. Foundation Courses

Humanities and Social Sciences including Management Courses – Credits (9-12)

SL. NO	COURSE CODDE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	34121H01	TECHNICAL ENGLISH	ENG	FC-HS	3	0	0	3	NIL
2.	34121H04	BUSINESS ENGLISH	ENG	FC-HS	3	0	0	3	NIL
3.	34121H81	ENGLISH LANGUAGE LAB	ENG	FC-HS	0	0	4	2	NIL
4.	34121H02	TOTAL QUALITY MANAGEMENT	MANAG	FC-HS	3	0	0	3	NIL
5.	34121H82	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT LAB	ENG	FC-HS	0	0	2	1	NIL
6.	34121H83	UNIVERSAL HUMAN VALUES - UNDERSTANDING HARMONY	ENG	FC-HS	3	0	0	3	NIL

Basic Science Courses – Credits (18-25)

1.	34121B01	ENGINEERING MATHEMATICS	MATH	FC-BS	2	1	0	3	NIL
2.	34121B04	PHYSICAL SCIENCES	PHY & CHEM	FC-BS	4	0	0	4	NIL
3.	34121B07	DIFFERENTIAL EQUATIONS AND TRANSFORMS	MATH	FC-BS	2	1	0	3	ENGINEERING MATHEMATICS
4.	34121B05	SMART MATERIALS AND NANO TECHNOLOGY	PHY	FC-BS	3	0	0	3	PHYSICAL SCIENCES
5.	34121B16	PARTIAL DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA	MATH	FC-BS	2	1	0	3	DIFFERENTIAL EQUATIONS AND TRANSFORMS
6.	34121B31	NUMERICAL METHODS	MATH	FC-BS	2	1	0	3	DIFFERENTIAL EQUATIONS AND TRANSFORMS
7.	34121B25	MATHEMATICAL AND STATISTICAL TOOL FOR RESEARCH	MATH	FC-BS	2	1	0	3	NIL
8.	34121B30	NON-DESTRUCTIVE TESTING OF MATERIALS	PHY	FC-BS	3	0	0	3	NIL
9.	34121B19	ENVIRONMENTAL SCIENCES	CHEM	FC-BS	3	0	0	3	NIL
10.	34121B81	PHYSICAL SCIENCES LAB	PHY & CHEM	FC-BS	0	0	4	2	NIL

Engineering Science courses including Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc., Credits – (18-24)

1	35021E01	FOUNDATIONS OF COMPUTING AND PROGRAMMING (THEORY AND PRACTICALS)	CSE	FC-ES	2	0	2	3	NIL
2	34621E01	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	EEE & ECE	FC-ES	4	0	0	4	NIL

3	35021E02	PYTHON PROGRAMMING (THEORY AND PRACTICALS)	CSE	FC-ES	2	0	2	3	NIL
4	34421E01	BASICS OF CIVIL AND MECHANICAL ENGINEERING	CIVIL & MECH	FC-ES	4	0	0	4	NIL
5	34421E81	ENGINEERING GRAPHICS AND DESIGN	MECH	FC-ES	0	0	6	3	NIL
6	35021E03	PROGRAMMING FOR PROBLEM SOLVING	CSE	FC-ES	3	0	0	3	NIL
7	34621E81	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LAB	EEE & ECE	FC-ES	0	0	4	2	NIL
8	34421E84	ENGINEERING SKILLS PRACTICALS LAB	CIVIL & MECH	FC-ES	0	0	4	2	NIL

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SEMESTER I TO VIII

B. Professional Courses

Core Courses – Credits (48-54)

SL. NO	COURSE CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	34621C01	ELECTRIC CIRCUIT ANALYSIS (THEORY AND PRACTICALS)	EEE	CC	3	0	2	4	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
2.	34721C03	SEMICONDUCTOR DEVICES AND CIRCUITS	ECE	CC	3	0	0	3	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
3.	34621C02	ELECTRICAL MACHINES – I	EEE	CC	3	0	0	3	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
4.	34621C06	ELECTRICAL MACHINES – II	EEE	CC	3	0	0	3	ELECTRICAL MACHINES – I
5.	34621C03	ELECTROMAGNETIC THEORY	EEE	CC	3	0	0	3	ENGINEERING MATHEMATICS
6.	34621C04	MEASUREMENT AND INSTRUMENTATION (THEORY AND PRACTICALS)	EEE	CC	3	0	2	4	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
7.	34721C09	ANALOG AND DIGITAL CIRCUITS (THEORY AND PRACTICALS)	ECE	CC	3	0	2	4	SEMICONDUCTOR DEVICES AND CIRCUITS
8.	34621C12	POWER ELECTRONICS AND DRIVES (THEORY AND PRACTICALS)	EEE	CC	3	0	2	4	SEMICONDUCTOR DEVICES AND CIRCUITS
9.	34621C08	TRANSMISSION AND DISTRIBUTION	EEE	CC	3	0	0	3	ELECTROMAGNETIC THEORY
10.	34621C05	CONTROL SYSTEMS	EEE	CC	3	0	0	3	DIFFERENTIAL EQUATIONS AND TRANSFORMS
11.	34621C13	POWER SYSTEM ANALYSIS	EEE	CC	3	0	0	3	TRANSMISSION & DISTRIBUTION

12.	34721C18	MICROCONTROLLER BASED SYSTEM DESIGN AND EMBEDDED SYSTEM DESIGN (THEORY AND PRACTICALS)	ECE	CC	3	0	2	4	ANALOG AND DIGITAL CIRCUITS
13.	**34621C07**	POWER SYSTEM PROTECTION AND SWITCHGEAR	EEE	CC	3	0	0	3	ELECTRICAL MACHINES – I & ELECTRICAL MACHINES – II
14.	34721C82	SEMICONDUCTOR DEVICES AND CIRCUITS LAB	ECE	CC	0	0	4	2	NIL
15.	34621C81	ELECTRICAL MACHINES – I LAB	EEE	CC	0	0	4	2	NIL
16.	34621C82	ELECTRICAL MACHINES – II LAB	EEE	CC	0	0	4	2	NIL
17.	34621C83	CONTROL SYSTEMS LAB	EEE	CC	0	0	4	2	NIL
18.	34621C84	POWER SYSTEM SIMULATION LAB	EEE	CC	0	0	4	2	NIL

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SEMESTER I TO VIII

C. Elective Courses

Professional Elective - Credits(12)

SL. NO	COURSE CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.	34621P08	HIGH VOLTAGE ENGINEERING	EEE	EC-PS	3	0	0	3	NIL
2.	34621P13	POWER SYSTEM OPERATION AND CONTROL	EEE	EC-PS	3	0	0	3	NIL
3.	34621P11	POWER QUALITY AND FACTS	EEE	EC-PS	3	0	0	3	NIL
4.	34621P14	SPECIAL ELECTRICAL MACHINES	EEE	EC-PS	3	0	0	3	NIL
5.	34621P16	WIND ENERGY CONVERSION SYSTEMS	EEE	EC-PS	3	0	0	3	NIL
6.	34621P05	ELECTRIC VEHICLES	EEE	EC-PS	3	0	0	3	NIL
7.	34621P04	DISTRIBUTED GENERATION AND MICROGRIDS	EEE	EC-PS	3	0	0	3	NIL
8.	34621P10	POWER CONVERTERS ANALYSIS AND DESIGN	EEE	EC-PS	3	0	0	3	NIL
9.	34621P01	RENEWABLE ENERGY SOURCES	EEE	EC-PS	3	0	0	3	NIL
10.	34621P07	ENERGY CONVERSION AND STORAGE TECHNOLOGIES	EEE	EC-PS	3	0	0	3	NIL
11.	34621P12	POWER SYSTEM AND SMART GRID	EEE	EC-PS	3	0	0	3	NIL
12.	34621P03	DIGITAL SIGNAL PROTECTION FOR POWER SYSTEMS	EEE	EC-PS	3	0	0	3	NIL
13.	34621P02	DESIGN OF ELECTRICAL APPARATUS	EEE	EC-PS	3	0	0	3	NIL

14.	34621P09	HVDC TRANSMISSION SYSTEMS	EEE	EC-PS	3	0	0	3	NIL
15.	34621P06	ENERGY AUDIT AND CONSERVATION	EEE	EC-PS	3	0	0	3	NIL
16.		Design of Photovoltaic System	EEE	EC-PS	3	0	0	3	NIL

Industry Designed/ Industry Supported/ Industry Offered/ Industry Sponsored Courses – Credits (6)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING INDUSTRY**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	34121I07	BUSINESS INTELLIGENCE AND ITS APPLICATIONS	INFOSYS	EC-IE	3	0	0	3	NIL
2.	35021I01	LEARNING IT ESSENTIALS BY DOING	INFOSYS	EC-IE	3	0	0	3	NIL
3.	34121I18	MATH MODELLING AND CONTROL SYSTEMS (THEORY AND PRACTICALS)	REYNLAB	EC-IE	2	0	2	3	NIL
4.	34121I12	ELECTRIC AND HYBRID ELECTRIC VEHICLES (THEORY AND PRACTICALS)	REYNLAB	EC-IE	2	0	2	3	NIL

Open Electives – Electives from Innovation, Entrepreneurship, Skill Development etc. - Credits (6-9)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	34121O04	INNOVATION, PRODUCT DEVELOPMENT AND COMMERCIALIZATION	MANAG	OE-IE	3	0	0	3	NIL
2.	34121O06	NEW VENTURE PLANNING AND MANAGEMENT	MANAG	OE-IE	3	0	0	3	NIL
3.	34121O07	SOCIAL ENTREPRENEURSHIP	MANAG	OE-IE	3	0	0	3	NIL
4.	45121O01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	MANAG	OE-IE	3	0	0	3	NIL
5.	34121O02	INTELLECTUAL PROPERTY RIGHTS	MANAG	OE - IE	3	0	0	3	NIL
6.	34121O05	LIFE SKILLS	MANAG	OE-IE	3	0	0	3	NIL

Open Electives – Electives from other Technical and /or Emerging Courses - Credits (6-9)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	35321O03	PRINCIPLES OF BIOMEDICAL INSTRUMENTATION	BME	OE-EA	3	0	0	3	NIL
2.	35321O01	BIOSENSORS AND TRANSDUCERS	BME	OE-EA	3	0	0	3	NIL
3.	38121O02	INTRODUCTION TO BIOFUELS	BTE	OE-EA	3	0	0	3	NIL
4.	38121O01	FOOD AND NUTRITION TECHNOLOGY	BTE	OE-EA	3	0	0	3	NIL
5.	34221O01	DISASTER RISK MANAGEMENT	CIVIL	OE-EA	3	0	0	3	NIL
6.	34221O02	MUNICIPAL SOLID WASTE MANAGEMENT	CIVIL	OE-EA	3	0	0	3	NIL
7.	35021O02	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	CSE	OE-EA	3	0	0	3	NIL
8.	35021O03	INTRODUCTION TO INTERNET OF THINGS	CSE	OE-EA	3	0	0	3	NIL
9.	35021O01	CYBER SECURITY	CSE	OE-EA	3	0	0	3	NIL
10.	34721O01	DESIGN OF ELECTRONIC EQUIPMENT	ECE	OE-EA	3	0	0	3	NIL
11.	34721O02	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	ECE	OE-EA	3	0	0	3	NIL
12.	34421O01	3D PRINTING AND ITS APPLICATIONS	MECH	OE-EA	3	0	0	3	NIL
13.	34421O02	INDUSTRIAL ROBOTICS	MECH	OE-EA	3	0	0	3	NIL
14.	36921O01	BIOMOLECULES – STRUCTURE AND FUNCTION	PE	OE-EA	3	0	0	3	NIL
15.	36921O02	PHARMACOGENOMICS	PE	OE-EA	3	0	0	3	NIL

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SEMESTER I TO VIII									
D. Courses for Presentation of technical Skills related to the specialization									
Project work, Seminar and Internship in Industry or elsewhere Credits - (15)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	34621R01	PROJECT WORK	EEE	PI-P	0	0	16	8	NIL
2.	34621M81	MINI PROJECT	EEE	PI-M	0	0	6	3	NIL
3.	34621S81	SEMINAR	EEE	PI-S	0	0	2	1	NIL
4.	34621T81	INTERNSHIP	EEE	PI-IT	3 Weeks			3	NIL

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SEMESTER I TO VIII									
E.MANDATORY COURSES									
MANDATORY COURSES (NO CREDITS) (NOT INCLUDED FOR CGPA CALCULATIONS)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.	34121Z81	YOGA AND MEDITATION	PHED	AC	0	0	2	0	NIL
ANY TWO OF THE FOLLOWING COURSES									
2.	34121Z82	GENDER EQUITY AND LAW	LAW	AC	0	0	2	0	NIL
3.	34121Z83	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	GEN	AC	0	0	2	0	NIL
4.	34121Z84	INDIAN CONSTITUTION	LAW	AC	0	0	2	0	NIL
5.	34121Z85	NCC/NSS/RRC/YRC/STUDENT CLUBS/UNNAT BHARAT ABHIYAN/ SWACHH BHARAT	GEN	AC	0	0	2	0	NIL
6.	34121Z86	SPORTS AND GAMES	PHED	AC	0	0	2	0	NIL

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING – SEMESTER I TO VIII									
Professional Elective Courses relevant to chosen Specialization / Branch Credits - (12)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
SPECIALISATION – ELECTRIC VEHICLE									
1.	34621EV01	ARCHITECTURE OF ELECTRIC AND HYBRID ELECTRIC VEHICLE	EEE	EC-SE	3	0	0	3	NIL
2.	34621EV02	BATTERY MANAGEMENT SYSTEM	EEE	EC-SE	3	0	0	3	NIL
3.	34621EV03	MODERN DRIVES FOR ELECTRIC VEHICLE	EEE	EC-SE	3	0	0	3	NIL
4.	34621EV04	POWER CONVERTERS FOR ELECTRIC VEHICLE	EEE	EC-SE	3	0	0	3	NIL
5.	34621EV05	TESTING OF ELECTRIC AND HYBRID VEHICLE	EEE	EC-SE	3	0	0	3	NIL
6.	34621EV06	DESIGN OF HYBRID ELECTRIC VEHICLE	MECH	EC-SE	3	0	0	3	NIL
7.	34621EV07	CONTROL SYSTEMS FOR HYBRID ELECTRIC VEHICLE	EEE	EC-SE	3	0	0	3	NIL
8.	34621EV08	BRAKE SYSTEM OF EV AND HEV	EEE	EC-SE	3	0	0	3	NIL
9.	34621EV09	ENERGY STORAGE SIMULATION LAB	EEE	EC-SE	3	0	0	3	NIL
10.	34621EV10	ELECTRIC DRIVES LAB	EEE	EC-SE	0	0	4	2	NIL

SPECIALISATION – SOLAR AND ALTERNATE ENERGY									
1.	34621SAE01	NEW AND RENEWABLE ENERGY SOURCES AND ITS APPLICATIONS	EEE	EC-SE	3	0	0	3	NIL
2.	34621SAE02	SOLAR COLLECTORS AND THERMAL ENERGY CONVERSION	EEE	EC-SE	3	0	0	3	NIL
3.	34621SAE03	ENERGY CONSERVATION AND ENERGY EFFICIENCY	EEE	EC-SE	3	0	0	3	NIL
4.	34621SAE04	APPLICATIONS OF GREEN BUILDING TECHNOLOGIES	EEE	EC-SE	3	0	0	3	NIL
5.	34621SAE05	NUCLEAR REACTOR THEORY	EEE	EC-SE	3	0	0	3	NIL
6.	34621SAE06	CONVENTIONAL ENERGY TECHNOLOGIES	EEE	EC-SE	3	0	0	3	NIL
7.	34621SAE07	SOLAR ENERGY LAB	EEE	EC-SE	3	0	0	3	NIL
8.	34621SAE08	WIND ENERGY LAB	EEE	EC-SE	3	0	0	3	NIL
9.	34621SAE09	POWER ELECTRONICS SIMULATION LAB –I	EEE	EC-SE	0	0	4	2	NIL
10.	34621SAE10	POWER ELECTRONICS SIMULATION LAB -II	EEE	EC-SE	0	0	4	2	NIL

HONORS AND MINOR DEGREE PROGRAMMES (18-20)									
AUTOMOTIVE SYSTEMS									
1.		FUNDAMENTALS OF AUTOMOTIVE SYSTEMS	EEE		3	0	0	3	NIL
2.		VEHICULAR NETWORKS AND COMMUNICATION	EEE		3	0	0	3	NIL
3.		E-MOBILITY BUSINESS AND POLICIES	EEE		3	0	0	3	NIL
4.		AUTOMOTIVE ELECTRONICS	EEE		3	0	0	3	NIL
5.		AUTOMOTIVE CONTROL SYSTEMS	EEE		4	0	0	4	NIL
6.		VEHICLE DYNAMICS AND CONTROL	EEE		4	0	0	4	NIL
INDUSTRIAL AUTOMATION									
1.		SENSORS & ACTUATORS	EEE		3	0	0	3	NIL
2.		PLC & ITS APPLICATIONS	EEE		3	0	0	3	NIL
3.		INDUSTRIAL AUTOMATION & CONTROL	EEE		3	0	0	3	NIL

4.		DIGITAL TWIN FOR PROCESS INDUSTRY	EEE		3	0	0	3	NIL
5.		INDUSTRIAL INTERNET OF THINGS	EEE		3	0	0	3	NIL
6.		MICRO-MECHANAICAL SYSTEMS	EEE		3	0	0	3	NIL
7.		PROCESS CONTROL DESIGN	EEE		3	0	0	3	NIL

	TECHNICAL ENGLISH	Category	L	T	P	Credit
		FC - HS	3	0	0	3

PREAMBLE

Technical English is a life skill course necessary for all students of Engineering and Technology. It aims at developing communication skills in English, essential for understanding and expressing the ideas of different professional context. The outcome of the course is to help the students acquire the language skills of Listening, Speaking, Reading and Writing competency in English language and thereby making the students competent and employable in the globalised scenario.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To enable students to develop LSRW skills in English. (Listening, Speaking, Reading, and Writing.)
2	To make them become effective communicators
3	To ensure that learners use Electronic media materials for developing language
4	To aid the students with employability skills.
5	To develop the students communication skills in formal and informal situations

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Listen, remember and respond to others in different scenario	Remember
CO2. Understand and speak fluently and correctly with correct pronunciation in different situation.	Understand
CO3. To make the students experts in professional writing	Apply
CO4.. To make the students in proficient technical communicator	Apply
CO5 To make the students recognize the role of technical writing in their careers in business, technical and scientific field	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				**L**	**L**	**M**	**M**	**M**		**S**		**S**	**S**		**S**
CO2							**L**			**S**		**S**	**M**		**S**
CO3				**L**				**L**				**L**	**M**	**M**	
CO4	**L**					**M**		**L**	**M**	**S**	**L**	**S**	**S**	**M**	**S**
CO5	**M**		**L**	**S**								**S**	**M**		**S**

S- Strong; M-Medium; L-Low

SYLLABUS

SELF INTRODUCTION

Self introduction - Simulations using E Materials - Whatsapp, Face book, Hiker, Twitter- Effective Communication with Minimum Words - Interpretation of Images and Films - Identify the different Parts of Speech- Word formation with Prefixes and suffixes -Common Errors in English -Scientific Vocabulary (definition and meaning)– Technical Abbreviations and Acronyms -Listening Skills- Passive and Active listening, Listening to Native Speakers - Characteristics of a good listener.

STRESS

Articles - Phonetics (Vowels, Consonants and Diphthongs) - Pronunciation Guidelines -Listening to Indian speakers from different regions, intrusion of mother tongue - Homophones – Homonyms - Note taking and Note making - Difference between Spoken and Written English- Use of appropriate language - Listening and Responding to Video Lectures (Green India, environment, social talks, New Norms) - Extempore.

SPEAKING SKILLS

Tense forms- Verbal and Non verbal Communication - Describing objects - Process Description- Speaking Practice - Paragraph Writing on any given topic (My favourite place, games / Hobbies / School life, etc.) -Types of paragraphs - Telephone Etiquettes - Telephonic conversation with dialogue- Interpersonal Skills.

READING SKILLS

English as language of Opportunity and Employability- Impersonal Passive Voice - Conditional Sentences - Technical and Non technical Report Writing (Attend a technical seminar and submit a report) - News Letters and Editing - Skimming-Scanning - How to Improve Reading Speed - Designing Invitations and Poster Preparation – Technical Jargons

TECHNICAL WRITING

Sentence Pattern (SVOCA) - Statement of Comparison - Transcoding (Flow Chart, Bar Chart and Pie Chart) – Informal and Formal letters – Application letter- Resume Writing- Difference among Bio data, Resume and Curriculum Vitae.

TEXTBOOK

1. English for Engineers- Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCE BOOKS

1. 1. English for Effective Communication, Department of English, VMKV & AVIT, SCM Publishers, 2009.
2. Practical English Usage- Michael Swan (III edition), Oxford University Press
3. Grammar Builder- I, II, III, and Cambridge University Press.

4 Pickett and Laster. Technical English: Writing, Reading and Speaking, New York: Harper and Row Publications, 2002.

Course Designers:

S.No.	Name of the Faculty	Mail ID
1.	Dr. Jennifer G Joseph, Prof. and Head, H&S	jennifer@avit.ac.in
2	Dr.P.Saradha / Associate Professor - English	saradhap@vmkvec.edu.in

34121H02	BUSINESS ENGLISH	Category	L	T	P	Credit
		HSS	3	0	0	3

PREAMBLE

Language is one of the most valued possessions of men. It acts as a repository of wisdom. Among all other languages English, the international language plays a vital role as a propeller for the advancement of knowledge in different fields and as a telescope to view the dream of the future.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To impart and enhance corporate communication.
2	To enable learners to develop presentation skills
3	To build confidence in learners to use English in Business context
4	To make them experts in professional writing
5	To equip students with employability and job searching skills

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Communicate with a range of formal and informal context	Understand
CO2. demonstrate interaction skills and consider how own communication is adjusted in different scenario	Apply
CO3. Use strengthened oral and written skills in the business context	Apply
CO4. Create interest in a topic by exploring thoughts and ideas	Apply
CO5. Have better performance in the art of communication	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**M**		**L**		**L**	**S**	**S**		**M**	**S**		**S**	**S**		
CO2		**M**	**S**	**M**		**M**	**M**		**L**	**S**		**S**	**M**		
CO3	**L**	**M**				**M**		**L**		**S**	**L**	**M**		**M**	
CO4		**L**	**M**	**M**			**L**	**M**	**M**	**S**	**L**	**M**	**M**		**M**
CO5		**L**		**M**		**L**	**L**			**S**		**S**	**M**	**M**	**S**

S- Strong; M-Medium; L-Low

SYLLABUS

Basics of Language and Listening Skills: Subject and Verb Agreement (concord) - Preposition and Relative Pronoun - Cause and effect - Phrasal Verbs-Idioms and phrases-Listening Comprehension -Listening to Audio Files and Answering Questions-Framing Questions-Negotiation Skills-Presentation Skills and Debating Skills

STRESS: Stress (Word Stress and Sentence Stress) Intonation- Difference between British and American English Vocabulary-Indianism-Compound Words (including Technical Terminology) Jargons- Technical and Business

SPEAKING SKILLS AND READING SKILLS: Extempore**,** Listening to TED Talks and discussion on the topic heard, Speaking activities- pair and group designed by the faculty, Group Discussion-Types of Interviews, Watching Documentary Films and Responding to Questions, Reading Skills-Understanding Ideas and making Inferences–– FAQs –

E - Mail Netiquette - Sample E – mails , Critical Reading-Book Review-Finding Key Information and Shifting Facts from Opinions

CORPORATE COMMUNICATION: What is Corporate Communication? Types of Office communications - Recommendation-Instruction-Check List- Circulars-Inter Office Memo- Minutes of Meeting and Writing Agenda - Discourse Markers - Rearranging Jumbled Sentences

WRITING SKILLS Technical Articles – Written communication Project Proposals-Making Presentations on given Topics -Preparing Power Point Presentations-Business Letters (Calling for Quotation, Placing Orders and Complaint Letters) - Expansion of an Idea-Creative Writing.

TEXTBOOK

1. English for Effective Communication - Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCE BOOKS

1. Grammar Builder – I, II, III – Cambridge University Press.
2. Technical English – Writing, Reading and Speaking – Pickett and Lester, Harper and Row

Course Designers:

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. Jennifer G Joseph	Professor & Head	English	jennifer@avit.ac.in
2	Dr. P. Saradha	Associate Professor	English	saradhap@vmkvec.edu.in

	ENGLISH LANGUAGE LAB	Category	L	T	P	Credit
		FC - HS	0	0	4	2

PREAMBLE

English Language Laboratory provides technological support to students. It acts as a platform for learning, practicing and producing language skills through interactive lessons and communicative mode of teaching.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand communication nuisances in the corporate sector.
2	To understand the role of mother tongue in second language learning and to avoid interference of mother tongue.
3	To improve the oral skills of the students communicate effectively through different activities
4	To understand and apply the telephone etiquette
5	Case study to understand the practical aspects of communication

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Give best performance in group discussion and interview	Understand
CO2. Best performance in the art of conversation and public speaking.	Apply
CO3. Give better job opportunities in corporate companies	Apply
CO4. Better understanding of nuances of English language through audio-visual experience and group activities	Apply
CO5. Speaking skills with clarity and confidence which in turn enhances their employability skills	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		S	M	S		L			S	S	M				M
CO2	M								M	S		M	M		M
CO3	M									S		M			M
CO4	M									M			M		M
CO5	M			S						M			M		S

S- Strong; M-Medium; L-Low

SYLLABUS

MODULE I: Ice Breaker, Grouping, Listening- (Hearing and listening)- Active Listening- Passive Listening – Listening to songs, videos and understanding- (fill in the blanks) Telephone Conversation

MODULE II: Influence of mother tongue, videos, understanding nuances of English language (video) puzzle to solve, Activity.

MODULE III: Why is English important, Communication skills, TED (video) Communication in different scenario – a case study, ingredients of success, Activity – chart, speak the design, feedback on progress, Group

wise, Individual. Role Play

MODULE IV: Telephone Etiquette, Dining Etiquette, Meeting Etiquette, Corporate Etiquette, Business Etiquette.

MODULE V: Case study of Etiquette in different scenario.

Course Designers:

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1	Dr. Jennifer G Joseph,	Prof. and Head, H&S	English	jennifer@avit.ac.in
2	Dr.P.Saradha	Associate Professor	English	saradhap@vmkvec.edu.in

	TOTAL QUALITY MANAGEMENT	Category	L	T	P	Credit
		FC - HS	3	0	0	3

PREAMBLE:

Quality is the mantra for success or even for the survival of any organization in this competitive global market. Total Quality Management (TQM) is an enhancement to the traditional way of doing business. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach for providing quality of products and processes. It becomes essential to survive and grow in global markets, organizations will be required to develop customer focus and involve employees to continually improve Quality and keep sustainable growth.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Total Quality Management concepts.
2. To practice the TQM principles.
3. To apply the statistical process control
4. To analyze the various TQM tools
5. To adopt the quality systems.

COURSE OUTCOMES:

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

CO1: Understand the importance of quality and TQM at managerial level.	Understand
CO2: Practice the relevant quality improvement tools to implement TQM.	Apply
CO3: Analyse various TQM parameters with help of statistical tools.	Analysing
CO4: Assess various TQM Techniques.	Evaluate
CO5: Practice the Quality Management Systems in a different organization Environment.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	-	L	L	L	M	L	M	-	-	-
CO2	M	-	-	-	L	L	-	L	M	M	-	L	-	-	M
CO3	S	S	M	S	S	-	-	L	-	L	-	L	L	M	L
CO4	L	M	S	L	M	-	L	-	L	M	L	M	-	-	-
CO5	L	L	M	-	L	M	S	S	M	L	L	M	-	-	M

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION

Concept of Quality and Quality Management - Determinants of quality of product & service - Quality costs – Analysis Techniques for Quality Costs – TQM Principles and Barriers & Implementation –Leadership – Concepts- Role of Top Management- Quality Council – Quality statements: vision, mission, Policy - SMART Goal setting -- Strategic Planning.

TQM PRINCIPLES AND PHILOSOPHIES

Customer satisfaction – Perception of Quality- Customer Complaints - Service Quality- Customer Retention- Employee Involvement – Motivation- Empowerment – Teams - Recognition and Reward- Performance Appraisal - Continuous Process Improvement : Deming's Philosophy - Juran's Trilogy - PDSA Cycle- Taguchi Quality Loss Function - 5S principles and 8D methodology - Kaizen - Basic Concepts.

STATISTICAL PROCESS CONTROL (SPC) & PROCESS CAPABILITY

Statistical Fundamentals – Measures of central Tendency & Dispersion - Population and Sample- Normal Curve- Control Charts for variables and attributes - OC curve - Process capability- Concept of six sigma- The Seven tools of Quality - New seven Management tools.

TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT

Benchmarking – Reasons - Process- Quality Function Deployment (QFD) – House of Quality- QFD Process- Benefits- Total Productive Maintenance (TPM) – Concept- Improvement Needs- FMEA – Stages of FMEA - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

QUALITY SYSTEMS

Introduction to IS/ISO 9004:2000 – quality management systems – Elements- Implementation of Quality System - Documentation- Quality Auditing- ISO 14000 – Concept- Requirements and Benefits.

TEXT BOOKS:

1. Dale H.Besterfiled- et at. - Total Quality Management- PHI-1999. (Indian reprint 2002).
2. Feigenbaum.A.V. "Total Quality Management- McGraw-Hill- 1991.

REFERENCES:

1. James R.Evans & William M.Lidsay - The Management and Control of Quality- (5th Edition) - South-Western (Thomson Learning) - 2002 (ISBN 0-324-06680-5).
2. Oakland.J.S. "Total Quality Management Butterworth – Hcinemann Ltd - Oxford. 1989.
3. Narayana V and Sreenivasan - N.S. Quality Management – Concepts and Tasks- New Age International 1996.

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID

1	A. Mani	Associate Professor	Management Studies	mani@vmkvec.edu.in
2	Dr. V. Sheela Mary	Associate Professor	Management Studies	sheelamary@avit.ac.in

34121H82	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT	Category	L	T	P	Credit
		HSS	0	0	2	1

To develop students with good presentation and writing skills (Professionally & technically). Articulate and enunciate words and sentences clearly and effectively. Develop proper listening skills. Understand different writing techniques and styles based on the communication being used.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To develop communication and personality skills.
2	To improve Aptitude skills, train to improve self-learning / researching abilities, presentation skills & technical writing.
3	To improve students employability skills.
4	To develop professional with idealistic, practical and moral values.
5	To produce cover letters, resumes and job application strategies.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Improve communication and personality skills.	Apply
CO2. Demonstrate effective use of teamwork skills and presentation skills to complete given tasks.	Apply
CO3. Speak with clarity and confidence thereby enhancing employability skills of the students.	Apply
CO4. Have balanced value system that can be practiced for enhanced professional life.	Apply
CO5. Improve their vocabulary and use them in appropriate situation	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**M**	**M**	-	-	-	**M**	**M**	-	**M**	**S**	-	-			
CO2	**M**	-	-	-	-	-	-	-	**S**	**M**	-	-			
CO3	-	-	-	-	-	-	**M**	-	**S**	**S**	-	-			
CO4	-	-	-	-	-	-	-	-	-	-	-	-			
CO5	**S**	-	-	-	-	-	-	-	**M**	**S**	-	**M**			

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I: COMMUNICATION AND SELF DEVELOPMENT: Basic Concepts of Communication; Barriers in Communication; How to Overcome Barriers to Communication, Barriers and Filters in Listening Skill, Active and Passive listening, exposure to English language through various activities and maintaining a vocabulary dairy improving confidence in Language usage using activities,

UNIT – II: GRAMMAR & SYNTAX: Subject verb concord, tenses, Homophones, Homonyms, Spotting errors.

UNIT – III. READING AND WRITING SKILLS: Reading Comprehension; and suggesting title for given passage Back office job for organizing a conference / seminar (member of organizing committee and submit a report); Jumbled sentences, respond to real time advertisement and prepare a covering letter with CV.

UNIT IV. SPEAKING SKILLS AND ESSENCE OF SOFT SKILLS: Hard and soft Skills; Feedback Skills; Skills of Effective Speaking; Component of an effective Talk; how to make an effective oral presentation, Time management, Team work skills, Leadership skills, Adaptability and bettering oneself, Persuasion skills.

UNIT V TECHNICAL REPORT, RESEARCH CASE STUDY & REPORTING: Types and Structure of Reports; Collecting Data; Technical Proposals; Visual Aids; General Tips for Writing Reports. Research Case Study and reporting, how to make an effective power point presentation

TEXTBOOK

1. The Functional Aspects of Communication Skills, Prajapati Prasad and Rajendra K.Sharma, S. K Kataria& Sons, New Delhi, Rep''nt 2007

REFERENCES

1. Business Communication, Sinha K. K. S. Chand, New Delhi.
2. Business Communication, Asha Kaul, Prentice Hall of India
3. Business Correspondence and Report Writing A Practical Approach to Business and Technical Communication, Sharma, R.C.and Krishna Mohan, Tata Mc Graw – Hill.

Course Designers:

COURSE DESIGNERS

S.No.	Name of the Faculty	Mail ID
1.	Dr. Jennifer G Joseph, Prof. and Head	jennifer@avit.ac.in
2.	Dr. P.Saradha, Associate Professor	saradhap@vmkvec.edu.in

Course Code	Course Title	Category	L	T	P	C
	UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY	**FC - HS**	**3**	**0**	**0**	**3**

Course Objectives:

1. Development of a holistic perspective based on self- exploration

2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4. Development of commitment and courage to act.

UNIT I Introduction

Value Education, Definition, Concept and Need for Value Education-Content and Process of -basic guidelines for Value Education -Self exploration - Happiness and Prosperity as parts of Value Education.

UNIT II Understanding Harmony in the Human Being

Harmony in Myself-Understanding human being as a co-existence of the sentient 'I' and the material 'Body'-Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. -Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I'-Understanding the harmony of I with the Body-Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

UNIT III Understanding Harmony in the Family and Society

Harmony in Human-Human Relationship -meaning of Justice - Trust and Respect -Difference between intention and competence- respect and differentiation; the other salient values in relationship 4.Understanding the harmony in the society - Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals –Gratitude

UNIT IV Understanding Harmony in the Nature and Existence

Whole existence as Coexistence -.Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature-Holistic perception of harmony at all levels of existence.

UNIT V Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values -.Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order- Competence in professional ethics

Total Hours : 45 Hours

Text Book

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

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

COURSE DESIGNERS				
S.NO	**COURSE INSTRUCTOR**	**DESIGNATION**	**NAME OF THE INSTITUTION**	**MAIL ID**
1	Dr.S.P.Sangeetha	Vice Principal(Academics)	AVIT	sangeetha@avit.ac.in
2	Dr.Jennifer G Joseph	HoD-H&S	AVIT	Jennifer@avit.a.cin

	ENGINEERING MATHEMATICS	Category	L	T	P	Credit
		FC- BS	2	1	0	3

PREAMBLE

The driving force in Engineering Mathematics is the rapid growth of technology and the sciences. Matrices had been found to be of great utility in many branches of engineering applications such as theory of electric circuits, aerodynamics, and mechanics and so on. Many physical laws and relation can be expressed mathematically in the form of differential equations. Based on this we provide a course in matrices, calculus and differential equations. Vector calculus is a form of mathematics that is focused on the integration of vector fields. An Engineer should know the Transformations of the Integrals, as Transformation of Line Integral to surface and then to volume integrals.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To recall the advanced matrix knowledge to Engineering problems.
2	To equip themselves familiar with the functions of several variables.
3	To improve their ability in solving geometrical applications of differential calculus problems
4	To examine knowledge in multiple integrals.
5	To improve their ability in Vector calculus.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Apply the concept of orthogonal reduction to diagonalise the given matrix	Apply
CO2. Find the radius of curvature, circle of curvature and centre of curvature for a given curve.	Apply
CO3. Classify the maxima and minima for a given function with several variables, through by finding stationary points	Apply
CO4. Find double integral over general areas and triple integral over general volumes	Apply
CO5. Apply Gauss Divergence theorem for evaluating the surface integral.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	--	--	--	--	L	--	--	--	M	--	--	--
CO2	S	S	M	--	--	--	--	L	--	--	--	M	--	--	--
CO3	S	S	M	--	--	--	--	L	--	--	--	M	--	--	--
CO4	S	S	M	--	--	--	--	L	--	--	--	M	--	--	--
CO5	S	S	M	--	--	--	--	L	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

MATRICES:

Characteristic equation– Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof).

DIFFERENTIAL CALCULUS&PARTIAL DERIVATIVES :

Curvature – Cartesian and Parametric Co-ordinates – Centre and radius of curvature – Circle of curvature.

Partial Derivatives – Total Differentiation – Maxima and Minima -Constrained Maxima and Minima by Lagrangian Multiplier Method,

ORDINARY DIFFERENTIAL EQUATIONS:

Solutions of second and third order linear ordinary differential equation with constant coefficients – Method of variation of parameters -Simultaneous first order linear equations with constant coefficients.

MULTIPLE INTEGRALS:

Introduction of multiple integration by examples of Double and Triple integral-Evaluation of double and Triple Integration(in both Cartesian and polar coordinates)-Change of order of integration

VECTOR CALCULUS:

Scalar and vector point functions, Gradient, divergence, curl, Solenoidal and irrotational vectors, Vector identities (without proof),Normal and Directional derivatives, Solenoidal and irrotational field, Integration of vectors: Definition of Line, surface and volume integrals, Green's, Gauss divergence and Stoke's theorems (Statements only)

TEXT BOOKS:

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill Education Pvt, New Delhi (2019).
2. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi (2020).
3. Kreyszig E., "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore (2012).

REFERENCES:

1. Engineering Mathematics", Department of Mathematics, VMKVEC (Salem) & AVIT (Chennai), (2017).
2. Dr.A.Singaravelu, "Engineering Mathematics I & II", 23rd Edition, Meenakshi Agency, Chennai (2016).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
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	PHYSICAL SCIENCES - Part A: ENGINEERING PHYSICS	Category	L	T	P	Credit
		FC- BS	2	0	0	2

PREAMBLE

Engineering Physics is the study of advanced physics concepts and their applications in various technological and engineering domains. Understanding the concepts of laser, types of lasers, the propagation of light through fibers, applications of optical fibers in communication, production and applications of ultrasonics will help an engineer to analyze, design and to fabricate various conceptual based devices.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To recall the properties of laser and to explain principles of laser
2	To assess the applications of laser
3	To detail the principles of fiber optics
4	To study the applications of fiber optics
5	To explain various techniques used in Non-destructive testing

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the principles laser, fiber optics and ultrasonics	Understand
CO2. Understand the construction of laser, fiber optic and ultrasonic equipments	Understand
CO3. Demonstrate the working of laser, fiber optic and ultrasonic based components and devices	Apply
CO4. Interpret the potential applications of laser, fiber optics and ultrasonics in various fields	Apply
CO5. Differentiate the working modes of various types of laser, fiber optic and ultrasonic devices.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S		M									M	M		M
CO2	S		L									M	M		
CO3	S			M			M					M	M		
CO4	S	M		M	M	S	M					M	S		M
CO5	S	M	M									M	M		

S- Strong; M-Medium; L-Low

SYLLABUS

Unit: I **9 hours**

LASERS: Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram.

Unit: II **9 hours**

FIBRE OPTICS: Principle and propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – Applications: Fiber optic communication system – fiber optic displacement sensor and pressure sensor.

Unit: III **9 hours**

ULTRASONICS: Ultrasonic production: Magnetostriction and piezo electric methods – Determination of velocity of ultrasonic waves (acoustic grating) – Applications of ultrasonics

TEXT BOOKS

1. Engineering Physics, compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.

2. Palanisamy P. K., Engineering Physics, Scientific Publishers, 2011.

3. Avadhanulu M. N., Kshirsagar P. G., Arun Murthy T. V. S., A Textbook of Engineering Physics, S. Chand Publishing, 2018.

REFERENCE BOOKS

1. Beiser, Arthur, Concepts of Modern Physics, 5th Edition, McGraw-Hill, 2009.

2. Halliday.D, Resnick.R, Walker.J, Fundamentals of Physics, Wiley & sons, 2013.

3. Gaur R. K. and Gupta S. L., Engineering Physics, DhanpatRai publishers, New Delhi, 2012.

4. Srivastava S. K., Laser Systems and Applications 3rd Edition, New Age International (P) Ltd Publishers, 2019.

5. Ajoy Ghatak, Thyagarajan K., Introduction To Fiber Optics, Cambridge India, 2013.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in

	PHYSICAL SCIENCES PART-B - ENGINEERING CHEMISTRY (Common to all Branches)	Category	L	T	P	Credit
		FC- BS	2	0	0	2

PREAMBLE

The objective of this course is to better understand the basic concepts of chemistry and its applications in diverse engineering domains. It also imparts knowledge on the properties of water and its treatment methods, Electrochemistry, corrosion and batteries, properties of fuel and combustion. This course also provides an idea to select the material for various engineering applications and their characterization.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To Provide the knowledge on water treatment.
2	To explain about the importance of electrochemistry, mechanism of different corrosion and principle and working of batteries.
3	To explain different types of fuel, properties and its important features.

COURSE OUTCOMES

On the successful completion of the course, students will be able to understand

CO1.	Estimate the hardness of water Apply and Identify suitable water treatment methods.	Apply
CO2.	Describe terms involved in electrochemistry, the control methods of corrosion and working of energy storage devices.	Analyse
CO3.	Understand the quality of fuels from its properties and the important features of fuels	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	-	M	S	M	-	-	-	M	M	M	M
CO2	S	S	L	L	-	S	S	S	-	-	-	S	M	L	M
CO3	S	M	M	L	L	L	M	M	-	-	-	S	-	M	M

S- Strong; M-Medium; L-Low

Syllabus

UNIT – I: WATER TECHNOLOGY **9hrs**

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA. Boiler troubles - Treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning). External treatment – Ion exchange process, zeolite process – Domestic water treatment - desalination of brackish water – Reverse Osmosis and Electrodialysis.

UNIT – II: ELECTROCHEMISTRY, CORROSION AND BATTERIES **9hrs**

Electrochemistry: Electrode potential - Nernst equation – Electrodes (SHE, Calomel and Glass) - Galvanic cell- Electrochemical cell representation - EMF series and its significance. Corrosion – Definition causes and effects, Classification, Types of corrosion- dry corrosion, Wet corrosion, Factors influencing rate of corrosion, Corrosion control methods – Sacrificial anode method and impressed current cathodic method.

Batteries: Terminology- Daniel cell – Dry cell - Lead-acid accumulator- Nickel-Cadmium batteries, Lithium batteries: Li/SOCl2 cell - Li/I2 cell- Lithium ion batteries. Fuel cells: Hydrogen-oxygen fuel cell, Solid oxide fuel cell (SOFC)

UNIT – III FUELS AND COMBUSTION **9hrs**

Fuels: Introduction – classification of fuels – coal – analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – petroleum – manufacture of synthetic petrol (Bergius process). Knocking – octane number – cetane number – natural gas – compressed natural gas (CNG). Liquefied petroleum gases (LPG) – power alcohol and biodiesel. Combustion of fuels: Introduction – calorific value – higher and lower calorific values- theoretical calculation of calorific value – ignition temperature – spontaneous ignition temperature – explosive range – flue gas analysis (ORSAT Method).

TEXTBOOK

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. A text book of Engineering Chemistry by S.S. Dara, S.Chand & company Ltd., New Delhi
3. A text book of Engineering Chemistry by Shashi Chawla, Edition 2012 Dhanpatrai & Co., New Delhi.

REFERENCES

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007
4. Engineering Chemistry by Dr. A. Ravikrishnan, Sri Krishna Publications, Chennai.

Course Designers:

Name of the Faculty	Mail ID
Dr. A.R. Sasieekumar	sasieekhumar@vmkvec.edu.in
Dr. R. Nagalakshmi	nagalakshmi.chemistry@avit.ac.in

	DIFFERENTIAL EQUATIONS AND TRANSFORMS	Category	L	T	P	Credit
		FC- BS	2	1	0	3

PREAMBLE

A signal is said to be a continuous time signal if it is available at all instants of time. A real time naturally available signal is in the form of time domain. However, the analysis of a signal is far more convenient in the frequency domain. These are three important classes of transformation methods available for continuous time systems. They are Laplace Transform, Fourier series and Fourier Transform. Similarly, Z- transform plays an important role in analysis of linear discrete time signals. Transform techniques are very important tool in the analysis of signals. Also To expose the students to the basics of wavelet theory and to illustrate the use of wavelet processing in engineering fields.

PREREQUISITE

Engineering Mathematics

COURSE OBJECTIVES

1	Learn to use Fourier series to represent periodical physical phenomena in engineering analysis
2	To understand how the Fourier series is extended to aperiodic signals in the form Fourier transform
3	To understand the properties of Z-Transform and associating the knowledge of properties of ROC in response to different operations on discrete signals.
4	To learn Laplace transform and it Inverse methods to solve differential transforms and integral transforms
5	To understand the terminology that are used in the wavelet's literature

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Explain fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.	Apply
CO2. Demonstrate Fourier Transform as a tool for solving integral equations	Apply
CO3. Solve difference equations by using Z transform techniques.	Apply
CO4. Understand the concept of Laplace transform and inverse Laplace transform of various functions and its application to solve ordinary differential equations.	Apply
CO5. Understand how to use the modern signal processing tools using signal spaces, bases, operators and series expansions.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	M	--	--	--	L	--	--	--	M	--	--	--
CO2	S	M	S	M	--	--	--	L	--	--	--	M	--	--	--
CO3	S	M	S	M	--	--	--	L	--	--	--	M	--	--	--
CO4	S	M	S	M	--	--	--	L	--	--	--	M	--	--	--
CO5	S	M	S	M	--	--	--	L	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

Syllabus

FOURIER SERIES:
Dirichlet's conditions - General Fourier series - Half-range Sine and Cosine series - Parseval's identity - Harmonic Analysis.

FOURIER TRANSFORMS:
Fourier transform pairs - Fourier Sine and Cosine transforms – Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

Z – TRANSFORMS:
Z-Transform – Elementary Properties – Inverse Z-Transform – Convolution Theorem – Formation of Difference Equations – Solution of first and second order Difference Equations using Z-Transform.

LAPLACE TRANSFORMS:
Laplace transform – transform of elementary functions – basic properties – derivatives and integrals of transforms – transforms of derivatives and integrals – initial and final value theorems – Transform of periodic functions-Inverse Laplace transform – Convolution theorem – -Solution of linear ODE of second order with constant coefficients.

WAVELET TRANSFROMATION:
Classes of wavelets: Haar, Daubechies, bi-orthogonal. Continuous Wavelet Transform (CWT): CWT and its Properties, Discrete Wavelet Transform- Haar scaling function - Nested spaces - Wavelet function- Designing orthogonal wavelet systems: Daubechies – Coiflet - Symlet wavelet system coefficients- Signal decomposition using DWT.

TEXT BOOKS:

1. Grewal, B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi (2012).
2. K. P. Soman, K. I. Ramachandran, "Insight into Wavelets: From Theory to Practice", Third Edition, PHI (2004).

REFERENCES:

1. "Engineering mathematics I & II", by Department of Mathematics, VMKVEC (Salem) & AVIT (Chennai), (2017).
2. Dr. A. Singaravelu, "Transforms and Partial differential Equations", 18th Edition, Meenakshi Agency, Chennai (2013).
3. R. M. Rao and Ajit S. Bopardikar, "Wavelet Transform, Introduction to theory and Applications", Addison-Wesley (1998).

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. L. Tamilselvi	Professor	Mathematics	ltamilselvi@avit.ac.in
2	Dr. M. Vijayarakavan	Associate Professor	Mathematics	vijayarakavan@vmkvec.edu.in

	SMART MATERIALS AND NANOTECHNOLOGY	Category	L	T	P	C
	Total Contact Hours: 45	FC- BS	3	0	0	3
	Prerequisite: Physical Sciences					

Preamble:

This syllabus enables the students to learn the applications of smart materials and uses of various smart engineering devices. The syllabus also discusses about the nanomaterials, their unique properties and applications in various fields.

Course Objectives:

1	Gain the knowledge about the concepts of smart systems and various smart materials.
2	Realize about the smart sensor materials which are used for Industrial Applications.
3	Understand about the Industrial application oriented Smart materials' Actuators.
4	To learn the properties and classifications and importance of Nanomaterials
5	Understand the characteristic features of materials at nanoscale and their potential applications

COS	Course Outcomes: On the successful completion of the course, students will	
CO1	Learn the smart-properties of various functional materials	Learn
CO2	understand the applications of different smart materials as sensors	Understand
CO3	understand the applications of different smart materials as actuators	Understand
CO4	Gather knowledge on unique properties of nanomaterials	Learn
CO5	Use of Nanomaterials for industrial applications	Acquire
CO6	Gain knowledge about nanomaterials in health care industry	

Mapping with Programme Outcomes and Programme Specific Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	POS2	POS3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	S	S	S	M	-	-	-	-	-	-	S	-	-	-
CO3	S	M	S	S	-	-	-	-	-	-	-	S	-	-	-
CO4	S	S	S	S	M	-	-	-	-	-	-	S	-	-	-
CO5	S	S	S	S	-	-	-	-	-	-	-	S	-	-	-
CO6	S	M	M	S	M	-	-	-	-	-	-	S	-	-	-

S – strong, M- Medium, L - Low

Syllabus

UNIT: I 9 Hours

Overview of Smart Materials: Introduction to Smart materials –piezoelectric materials – piezoelectricity – magnetostriction materials – magnetostriction effect– shape memory alloys (SMA) – photoelastic materials – photoelasticity.

UNIT: II 9 Hours

Smart material based sensors: Introduction to sensing technology - electric and magnetosrictive sensors - SMA based sensors - Infrared sensors – stress analysis by photoelastic sensors- Industrial Applications of smart sensors: Accelerometer and Biological DNA sensors.

UNIT: III 9 Hours

Smart Materials For Actuators: Introduction to smart actuators - piezoelectric actuators - magnetostrictive actuators - SMA based actuators - polymeric and carbon nanotubes based low power actuators –Industrial Applications: robotic artificial muscles , materials for bone substitutes and tissue replacement implants - smart polymeric materials for skin engineering

UNIT: IV 9 Hours

Materials in Nanoscale: Historical development of nanomaterials - Unit and dimensions - Classifications of nanomaterials - quantum dots, nanowires, ultra-thin films, nanoparticles, multilayered materials. Length Scales involved and effect on properties: mechanical, electronic, optical, magnetic and thermal properties.

UNIT: V 9 Hours

Selected Applications of Nanomaterials: Medical diagnostics – nanomedicine – targeted drug delivery – Biosensors; Information storage – nanocomputer – molecular switch – single electron transistors; design and fabrication of MEMS and NEMS devices.

TEXT BOOKS

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2015.
2. Fundamental of Smart Materials, Editor: Mohsen Shahinpoor, RSC Publishers 2020
3. Charles P. Poole, Jr. and Frank J Ownes, "Introduction to Nanoscience and Nanotechnology", Wiley-Interscience Inc., Publication, 1st Edition, 2020.
4. Smart Material Systems And Mems Design And Development Methodologies by Vijay K Varadan, WILEY INDIA 2014.

REFERENCE BOOKS

1. Pillai S.O., Solid State Physics, 9th Edition, New Age International (P) Ltd., Publishers, 2020.
2. William D. Callister Jr., David G. Rethwisch., Materials Science and Engineering: An Introduction, 10th Edition, Wiley Publisher, 2018.
3. Nanotechnology, Second eition, M. A. Shah and K. A. Shah, Wiley Publishers 2019.
4. Fundamentals of Nanotechnology, Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep, CRC Press, 2009.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. B. DHANALAKSHMI	Asso. Professor	Physics	Dhanalakshmi.phy@avit.ac.in
2	Dr G. SURESH	Asso. Professor	Physics	suresh.physics@avit.ac.in
3	Dr. R. N. VISWANATH	Professor	Physics	rnviswanath@avit.ac.in

	PARTIAL DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA	Category	L	T	P	Credit
		FC- BS	2	1	0	3

PREAMBLE

Impart knowledge about the subject of a single variable and multivariable. The focus of the course will be the study of the application of partial differential equations. The course also gives the opportunity to the learner to understand linear algebra and its application to engineering.

PREREQUISITE

Differential Equations and Transforms

COURSE OBJECTIVES

1	Familiarize themselves with the functions of a variety of variables.
2	To familiar with applications of partial differential equations
3	To have the knowledge of vector space & subspaces
4	To have an idea of inner product spaces over the field of complex numbers
5	Understand linear transformation and its properties

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Form the partial differential equations and find its solutions	Apply
CO2. Apply the partial differential equations in a vibration of strings; heat-passing a rod and two-dimensional heat conduction problems.	Apply
CO3. Understand the concept of vector space & subspace and to find the dimension of a vector	Apply
CO4. Understand inner product space concepts and apply the concept in various linear system related problems.	Apply
CO5. Compute the linear transformations and find matrices of general linear transformations	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO2	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO3	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO4	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO5	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

PARTIAL DIFFERENTIAL EQUATIONS:
Formation - Solutions of standard types f(p,q) = 0 , Clairaut's form, f(z,p,q) = 0 , f(p,x) = g(q,y) of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients

APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS:
Method of separation of variables – Solutions of one-dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates

VECTOR SPACES:
Vectors in two-dimensional space and n dimensional space**,** subspaces and spanning sets properties of vector space, Linear combination of vectors, Linear independence and dependence of vectors, basis and dimension

INNER PRODUCT SPACES:
Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations -Least square approximation

LINEAR TRANSFORMATION:
Linear transformations, linear operators, Properties of Linear Transformation, Algebra of Linear transformation, Matrix Representation of linear transformation, Linear map Associated with Linear Transformation

TEXT BOOKS:

1. Grewal, B.S., "Higher Engineering Mathematics", 35th Edition, Khanna Publishers, Delhi (2012).
2. Kennath M. Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, Pearson India Publishing, New Delhi, (2015).

REFERENCES:

1. Dr.A. Singaravelu, "Linear Algebra and Partial Differential Equations", Meenakshi Agencies, Chennai (2019).
2. Kreyszig, E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons, (Asia) Pvt. Ltd., Singapore (2012).
3. Dr.Gunadhar Paria, "Linear Algebra", New Central Book Agency (P) Ltd (2012).

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.V.T.Lakshmi	Associate Professor	Mathematics	lakshmivt@vmkvec.edu.in
2	Ms. S.Sarala	Associate Professor	Mathematics	sarala@avit.ac.in

	NUMERICAL METHODS	Category	L	T	P	Credit
		FC- BS	2	1	0	3

PREAMBLE

This course aims at developing the ability to formulate an engineering problem in a mathematical form appropriate for subsequent computational treatment and to choose an appropriate numerical approach. An under graduate of Engineering student needs to know sufficient numerical methods and techniques for solving engineering problems such as static or steady state problems, vibration or stability problems and initial value or transient problems etc.

PREREQUISITE

1.Differential Equations and Transforms

COURSE OBJECTIVES

1	To familiar with numerical solution of equations
2	To be get exposed to finite differences and interpolation
3	To be thorough with the numerical Differentiation and integration
4	To find numerical solutions of ordinary differential equations
5	To find numerical solutions of partial differential equations

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Solve the system of linear algebraic equations and single non linear equations arising in the field of Engineering.	Apply
CO2. Apply methods to find intermediate numerical value & polynomial of numerical data.	Apply
CO3. Apply methods to find integration, derivatives of one and two variable functions.	Apply
CO4. Solve the initial value problems using single step and multistep methods.	Apply
CO5. Solve the boundary value problems using finite difference methods.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	L	--	--	--	--	M	--	--	--
CO2	S	S	M	L	--	--	L	--	--	--	--	M	--	--	--
CO3	S	S	M	L	--	--	L	--	--	--	--	M	--	--	--
CO4	S	S	M	M	--	--	L	--	--	--	--	M	--	--	--
CO5	S	S	M	M	--	--	L	--	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS

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.

INTERPOLATION AND APPROXIMATION: Interpolation with Newton's divided differences, Lagrange's polynomial, Newton forward and backward differences, central difference Formula (Stirling's and Bessel's).

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's (both 1/3rd and 3/8th) rules. Romberg's rule, Two and Three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's rule.

INITIAL VALUE PROBLEMS OF ODE: Single Step Methods - Taylor Series, Euler and Modified Euler, Runge-Kutta method of fourth order -first and second order differential equations. Multistep Methods - Milne and Adam's-Bash forth predictor and corrector methods.

BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS:

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

TEXT BOOKS:

1. S.K Gupta, "Numerical Methods for Engineers", New Age International Pvt. Ltd. Publishers (2015).
2. S.R.K. Iyengar, R.K. Jain, Mahinder Kumar Jain, "Numerical methods for Scientific and Engineering Computations", New Age International publishers , 6th Edition (2012).
3. T. Veerarajan, T.Ramachandran, "Numerical Methods with Programs in C and C++", Tata McGraw-Hill (2008).

REFERENCES:

1. Joe D. Hoffman , Steven Frankel, "Numerical Methods for Engineers and Scientists", 3rd Edition, Tata Mc-Graw Hill. (New York) (2015).
2. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", MC Graw Hill Higher Education (2010).

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. S. Gayathri	Assistant Professor	Mathematics	gayathri@avit.ac.in
2	Dr. M.Vijayarakavan	Associate Professor	Mathematics	vijayarakavan@vmkvec.edu.in

	MATHEMATICAL AND STATISTICAL TOOLS FOR RESEARCH	Category	L	T	P	Credit
		FC- BS	2	1	0	3

PREAMBLE: Optimization techniques helps in solving problems in different environments that need decisions like, replacement , Sequencing and Network problems . Probabilistic and statistical analysis is mostly used in varied applications in Engineering and Science. Statistical method introduces students to cognitive learning in statistics and develops skills on analyzing the data by using different tests

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To be thorough with linear programming problem and formulate a real world problem as a mathematical programming model
2	Mathematical models for analysis of real problems in Operations Research.
3	To acquire skills in handling techniques of PERT, CPM and sequencing model to perform operation among various alternatives.
4	To get the knowledge on concepts of random variables and distributions with respect to how they are applied to statistical data
5	To acquire knowledge of Testing of Hypothesis useful in making decision and test them by means of the measurements made on the sample.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1,Formulate the Linear programming problem. Conceptualize the feasible region. Solve the LPP with two variables using graphical method and by simplex method	Apply
CO2. Be able to solve simple problems of replacement and sequencing model	Apply
CO3. Able to Solve network problems using CPM, PERT techniques	Apply
CO4. Select an appropriate probability distribution to determine the probability function for solving engineering problem	Apply
CO5. Apply the concepts of large/small sample tests into real life problems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	M	L	--	--	M	--	--	--	M	--	--	--
CO2	S	S	L	M	L	--	--	M	--	--	--	M	--	--	--
CO3	S	S	L	M	L	--	--	M	--	--	--	M	--	--	--
CO4	S	S	M	M	L	--	--	M	--	--	--	M	--	--	--
CO5	S	S	M	M	L	--	--	M	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

LINEAR MODELS: Mathematical Formulation of Linear programming problems- applications & limitations – Graphical method - Simplex method – Big M method

SEQUENCING AND REPLACEMENT MODELS: Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing n jobs through m machines. Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy.

NETWORK MODELS: Basic terminologies, constructing a project network, network computations in CPM and PERT.

PROBABILITY AND RANDOM VARIABLES: Probability concepts - Random variables - Discrete and continuous random variables - Expectation - Variance - Standard Distributions: Binomial, Poisson, Normal, Uniform and Exponential

TESTING OF HYPOTHESIS: Sampling distributions – Statistical hypothesis – Testing of hypothesis for mean, variance, and proportions for large and Small Samples (Z, t and F test) - Chi-square Tests for Goodness of fit - independence of attribute - Analysis of Variance

TEXT BOOKS:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics", 11th extensively revised edition, S. Chand & Sons (2015).
2. Douglas C. Montgomery and George C.Runger, "Applied Statistics and Probability for Engineers", 6th Edition, Wiley (2013).
3. H.A.Taha, "Operations Research: An Introduction", 7th Edition, Prentice Hall of India (2002).

REFERENCES:

1. Miller, "Probability and Statistics for Engineers", Freund-Hall, Prentice India Ltd. (2009).
2. Sundarasen.V, Ganapathy Subramaniyam, K.S, Ganesan.K. "Resource Management Techniques", A.R. Publications, Chennai (2013).
3. Premkumar Gupta, D.S. Hira, "Operations Research", S.Chand & company New Delhi.

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.V.T.Lakshmi	Associate Professor	Mathematics	lakshmivt@vmkvec.edu.in
2	Ms. S.Sarala	Associate Professor	Mathematics	sarala@avit.ac.in

	NON-DESTRUCTIVE TESTING OF MATERIALS	Category	L	T	P	Credit
		FC- BS	3	0	0	3

PREAMBLE

Nondestructive testing is a wide group of analysis/techniques used in science and industries to evaluate the properties and qualities of a material without causing damage. The nondestructive testing is highly valuable and can save both money and time in product evaluation, troubleshooting, and research.

PREREQUISITE:

COURSE OBJECTIVES

1	To understand the principles of visual inspection
2	To know about the procedure followed in liquid penetrant method
3	To learn the magnetic particle testing
4	To know about in radiographic testing
5	To learn about ultrasonic testing

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Choose the NDT methods as per the conditions of the materials under study	Understand
CO2. Identify the defects by visual inspection methods	Apply
CO3. Locate the surface defects using LPT and Magnetic particle inspection	Apply
CO4. Identify the internal defects using X ray radiography and Ultrasonic flaw detector	Apply
CO5. Inspect the defects using various techniques	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S			M	M							M			
CO2	S			M	M							M		S	S
CO3	S	M	M	M	M							M		S	S
CO4	S	S	M	M	M							M		M	M
CO5	S	S	S	M	M							M		M	M

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT: I **9 hours**

OVERVIEW OF NDT & VISUAL INSPECTION: Inspection of materials for defects and characterization - Non-Destructive versus Destructive Tests - different NDT methods and selection criteria for inspection - Visual Testing: Principle and conditions - Equipments and accessories: borescope, flexible fiber optic borescope, endoscopes or endoprobes, video imagescope - confocal laser scanning microscopy - optical coherence tomography - laser thermography. Visual inspection applied to construction materials

UNIT: II **9 hours**

LIQUID PENETRANT TESTING: Liquid penetrant testing: Introduction - Principle and equipments - test procedure - cleaning methods - interpretation of test results - characteristics and types of penetrants - developers - safety precautions, advantages and limitations - High temperature penetrant testing - Low temperature penetrant testing - Industrial applications of LPT.

UNIT: III **9 hours**

MAGNETIC PARTICLE TESTING: Principle of magnetic particle testing - different methods to generate magnetic fields - magnetic particle testing equipment - magnetic particle testing procedures method of De-magnetization - advantages and limitations - codes and standard for MPI - magnetic particle test for welding, valves, crank shafts, etc.

UNIT: IV **9 hours**

RADIOGRAPHIC TESTING: X-ray radiography principle, equipment & methodology - Types of industrial radiation sources and application - Radiographic exposure factors and technique - Gama ray and X- ray equipment - Precautions against radiation hazards - applications of industrial radiography

UNIT: V **9 hours**

ULTRASONIC TESTING: Principle: Interaction of ultrasonic waves with matter - instrumentation - ultrasonic probes and types - ultrasonic testing methods and modes - data presentation: A-scan, B-scan and C-scan - advantages and limitations - determination of thickness of samples and defects in welded products.

TEXT BOOKS

1. Jean-Paul Balayssac and Vincent Garnier, "Non-destructive Test and Evaluation of Civil Engineering Structures", ISTE Press Ltd - Elsevier Inc., 2017.
2. Prasad J, Nair C G K, Non-destructive Testing and Evaluation of Materials, Tata McGraw Hill Education Private Limited, 2011(Second Edition)
3. Carles J Hellier, Handbook of Nondestructive Evaluation, McGraw-Hill, 2013

REFERENCE BOOKS:

1. Nathan Ida and Norbert Meyendorf, "Handbook of Advanced Nondestructive Evaluation", Springer Int. Publishing Agency, 2019.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu, "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
3. Evgency N. Barkanov and Ivan A. Parinov, "Non-destructive Testing and Repair of Pipelines, Springer Int. Publishing Agency, 2018.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. B. Dhanalakshmi	Asso.Prof.	Physics	Dhanalakshmi.phy@avit.ac.in
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3	Dr. R. N. Viswanath	Professor	Physics	rnviswanath@avit.ac.in

	ENVIRONMENTAL SCIENCES (Common to All Branches)	Category	L	T	P	Credit
		FC-BS	3	0	0	3

Environmental science is an interdisciplinary field that integrates physical, chemical, biological, and atmospheric sciences. Environmental studies deals with the human relations to the environment and societal problems and conserving the environment for the future. Environmental engineering focuses on the various issues of environment and its management for sustainable development by improving the environmental quality in every aspect.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To inculcate the knowledge of significance of environmental studies and conservation of the natural resources.
2	To acquire knowledge of ecosystem, biodiversity, it's threats and the need for conservation
3	To gain knowledge about environmental pollution, it's sources, effects and control measures
4	To familiarize the legal provisions and the national and international concern for the protection of environment
5	To be aware of the population on human health and environment, role of technology in monitoring human health and environment.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the importance of environment and alternate energy resources	Understand
CO2. Initiate the awareness and recognize the social responsibility in ecosystem and biodiversity conservation	Apply
CO3. To develop technologies to analyse the air, water and soil pollution and solve the problems	Apply
CO4. To evaluate the social issues and apply suitable environmental regulations for a sustainable development	Evaluate
CO5. To identify and analyse the urban problems, population on human health and environment	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	S	S	S	-	-	-	S	-	-	-
CO2	S	M	M	-	-	S	S	S	-	-	-	S	-	-	-
CO3	S	L	M	-	-	S	S	S	-	-	-	S	-	-	-
CO4	S	S	S	L	-	S	S	S	-	-	-	S	-	-	-
CO5	S	S	S	M	-	S	S	S	-	-	-	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT –I ENVIRONMENT AND NATURAL RESOURCES

Environment - Definition, scope & importance - Public awareness- Forest resources- Use and over-exploitation, deforestation, case studies- Water resources: Use and over-utilization of surface and ground water, dams-benefits and problems –Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, Agriculture- effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, Scope & role of engineers in conservation of natural resources.

UNIT –II ECOSYSTEMS AND BIO – DIVERSITY

Ecosystem - Definition, structure and function - Food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest and Aquatic ecosystems – pond and sea, Introduction to biodiversity, Levels of biodiversity: genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –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 conservation of biodiversity.

UNIT –III ENVIRONMENTAL POLLUTION

Pollution - Definition, causes, effects and control measures of Air, Water and Land pollution, Solid waste- solid waste Management,–Disaster management: Floods, earthquake, cyclone, landslides and tsunamis - Clean technology options, Low Carbon Life Style.

UNIT-IV SOCIAL ISSUES AND ENVIRONMENT

6 hrs

Sustainable Development- Water conservation – rain water harvesting, watershed management - Resettlement and rehabilitation of people , case studies –Climate change - Global warming - Acid rain - Ozone depletion- Environment Protection Act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act- Pollution Control Board-central and state pollution control boards.

UNIT-V HUMAN POPULATION AND ENVIRONMENT

Population – Population growth & Population Explosion –Family welfare programme - Environment & human health - Human rights – Value education –AIDS/HIV, Role of information technology in

environment and human health.

TEXT BOOK

1. Environmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna Publications, Chennai.
2. Erach Bharucha "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India
3. Benny Joseph “Environmental Science and Engineering”, Tata Mc Graw- Hill, New Delhi

REFERENCES:

1.Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.
2. Anubha Kaushik and C.P Kaushik “Perspectives of Environmental Studies”, New age international publishers.
3. Trivedi R.K. “Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviromedia.
4. Environmental Science and Engineering by Dr. J. Meenambal, MJP Publication, Chennai Gilbert M. Masters: Introduction to Environmental Engineering and Science , Pearson EducationPvtLtd., II Edition, ISBN 81-297-0277-0,2004.
5. Miller T.G.Jr. Environmental Science Wads worth Publishing. Co.
6. Townsend C. Harper J. and Michael Begon, Essentials of Ecology, Blackwell Science.

COURSE DESIGNERS

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	PHYSICAL SCIENCES LAB: PART A – REAL AND VIRTUAL LAB IN PHYSICS	Category	L	T	P	Credit
		FC- BS	0	0	2	1

PREAMBLE

In this laboratory, experiments are based on the calculation of physical parameters like young's modulus, rigidity modulus, viscosity of water, wavelength of spectral lines, thermal conductivity and band gap. Some of the experiments involve the determination of the dimension of objects like the size of a microparticle and thickness of a thin wire. In addition to the above real lab experiments, students gain hands-on experience in virtual laboratory.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To impart basic skills in taking reading with precision of physics experiments
2	To inculcate the habit of handling equipments appropriately
3	To gain the knowledge of practicing experiments through virtual laboratory.
4	To know the importance of units
5	To obtain results with accuracy

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Recognize the importance of units while performing the experiments, calculating the physical parameters and obtaining results	Understand
CO2. Operate the equipments with precision	Apply
CO3. Practice to handle the equipments in a systematic manner	Apply
CO4. Demonstrate the experiments through virtual laboratory	Apply
CO5. Calculate the result with accuracy	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S													
CO2	S	S	M	M	S				M			M	M		M
CO3	S														
CO4	S	S	M	M	S							S	M		M
CO5	S	S													

S- Strong; M-Medium; L-Low

SYLLABUS

1. Young's modulus of a bar - Non-uniform bending
2. Rigidity modulus of a wire - Torsional Pendulum
3. Viscosity of a liquid - Poiseuille's method
4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer
5. Particle size determination using Laser
6. Wavelength of spectral lines – grating – Spectrometer
7. Thickness of a wire - Air wedge Method

8. Thermal conductivity of a bad conductor - Lee's disc
9. Band gap determination of a thermistor - Post Office Box
10. Specific resistance of a wire – Potentiometer

LAB MANUAL

Physical Sciences Lab: Part A – Real And Virtual Lab In Physics Manual compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.

COURSE DESIGNERS

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2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in

	PHYSICAL SCIENCES PART B - ENGINEERING CHEMISTRY LAB (Common to All Branches)	Category	L	T	P	Credit
		FC- BS	0	0	2	1

Engineering Chemistry Lab experiments explains the basics and essentials of Engineering Chemistry. It also helps the students to understand the applications of Engineering Chemistry. The electrodes, Cell and batteries study gives clear basic application oriented knowledge about electrochemistry. Water technology study gives the idea about hardness and its disadvantages. Now-a-days the practical and handling of equipments are needed for our fast growing life style.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To impart basic skills in Chemistry so that the student will understand the engineering concept.
2	To inculcate the knowledge of water and electrochemistry.
3	To lay foundation for practical applications of chemistry in engineering aspects.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the basic skills for his/her future studies.	Understand
CO2 Analyze the water comprehensively.	Apply
CO3. Apply the practical knowledge in engineering aspects	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	L	M	M	S	-	-	-	M	-	-	-
CO2	S	M	M	-	L	M	M	L	-	-	-	M	-	-	-
CO3	S	S	M	-	L	M	M	M	-	-	-	M			

S- Strong; M-Medium; L-Low

1. Determination of Hardness by EDTA method
2. Estimation of Hydrochloric acid by conductometric method
3. Acid Base titration by pH method
4. Estimation of Ferrous ion by Potentiometric method
5. Determination of Dissolved oxygen by Winkler's method
6. Estimation of Sodium by Flame photometer
7. Estimation of Copper from Copper Ore Solution
8.Estimation of Iron by Spectrophotometer

TEXT BOOK:

1. Engineering Chemistry Lab Manual by VMU.

COURSE DESIGNERS

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	FOUNDATIONS OF COMPUTING AND PROGRAMMING(THEORY + PRACTICALS)	Category	L	T	P	Credit
		FC - ES	2	0	2	3

PREAMBLE

This course aims to provide the fundamental concepts of Computer operations like hardware and software installation, and emphasizing principles programming languages. Studying the fundamentals database languages, commands and internet basics.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To provide basic knowledge of hardware components of computers and classifications.
2	To introduce and demonstrate various Operating System functions and software. Software application packages.
3	To study Principles of programming and applications of programming.
4	To learn about various Database Management Systems languages and commands used.
5	To learn basics of Internet and Web services.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. To understand the Basic knowledge on computer hardware and its functions.	Understand
CO2. To get knowledge of Fundamentals of various Operating System functions and soft wares.	Understand
CO3.To Understand the principles of programming and categories of programming languages.	Apply
CO4.To demonstrates Database Management Systems languages and their classifications.	Apply
CO5.To understands and demonstrates the Internet Basics.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	S	M	-
CO2	S	M	M	-	M	-	-	-	-	-	-	M	S	M	M
CO3	S	S	S	-	M	-	-	-	-	-	-	-	S	-	M
CO4	S	S	S	-	S	-	-	-	-	-	-	-	S	M	M
CO5	S	M	M	-	M	-	-	-	-	-	-	S	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction to computers:

Characteristics of computers, Classification of Digital Computer Systems: Microcomputers, Minicomputers, Mainframes, Supercomputers. Anatomy of Computer: Introduction, Functions & Components of a Computer, Central Processing Unit, Microprocessor, Storage units, Input and output Devices. How CPU and memory works. Program execution with illustrative examples.

Lab Component- PC Assembly,

Operating System Fundamentals:

Operating Systems: Introduction, Functions of an operating System, Classification of Operating Systems, System programs, Application programs, Utilities, The Unix Operating System, Basic Unix commands, Booting,

Lab Component-, Basic unix commands

Introduction to Principles of programming

Introduction to Programming , Programming Domain : Scientific Application , Business Applications, Artificial Intelligence, Systems Programming , Web Software
Categories of Programming Languages: Machine Level Languages, Assembly Level Languages , High Level Languages ,Problem solving using Algorithms and Flowcharts

Introduction to Database Management Systems

Database, DBMS, Why Database -File system vs DBMS, Database applications, Database users, Introduction to SQL, Data types, Classification of SQL-DDL with constraints, DML, DCL, TCL
Lab Component
Create: Table and column level constraints- Primary key, Foreign key, Null/ Not null, Unique, Default. Check, Alter, Drop, Insert, Update, Delete, Truncate, Select: using WHERE, AND, OR, IN , NOT IN

Internet Basics

Introduction, Features of Internet, Internet application, Services of Internet, Internet Service Providers, and Domain Name System.
Web Basics Introduction to web, web browsers, http/https, URL, HTML,CSS

Lab Component -HTML & CSS, web Browsing, Emails, Searching

TEXT BOOKS:

1. J. Glenn Brookshear,"Computer Science: An Overview", Addision-Wesley, Twelfth Edition, 2014

REFERENCES:

1. "Concepts of programming language" Concepts of Programming Languages Eleventh Edition GLOBAL Edition Robert W. Sebesta.

Knuth D.E., "The Art of computer programming Vol 1: Fundamental Algorithms", 3rd
Edition, Addison Wesley, 1997.

2. Knuth D.E., "The Art of computer programming Vol 1: Fundamental Algorithms", 3rd Edition, Addison Wesley, 1997.

COURSE DESIGNERS				
S. No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
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	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING A. BASIC ELECTRICAL ENGINEERING	Category	L	T	P	Credit
		FC- ES	2	0	0	2

PREAMBLE

It is a preliminary course which highlights the basic concepts and outline of Electrical engineering. The concepts discussed herein are projected to deliver explanation on basic electrical engineering for beginners of all engineering graduates.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To explain the basic laws used in Electrical circuits and various types of measuring instruments.
2	To explain the different components and function of electrical dc and ac machines.
3	To understand the fundamentals of safety procedures, Earthing and Power system.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Explain theelectrical quantities and basic laws of electrical engineering.	Remember
CO2: Demonstrate Ohm's and Faraday's Law.	Apply
CO3: Describe the basic concepts of measuring instruments.	Understand
CO4: Explain the operation of electrical machineries and its applications.	Understand
CO5: Explain the electrical safety and protective devices.	Understand
CO6: Compare the various types electrical power generation systems by application of conventional and non-conventional sources.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	M	L	-	-	-	L	M	L	S	M	L
CO2	S	M	M	L	M	-	-	-	S	M	M	L	S	L	-
CO3	S	M	M	M	M	-	-	-	-	L	M	L	S	M	L
CO4	S	M	L	L	M	L	-	-	-	L	M	L	S	L	-
CO5	S	M	L	-	M	S	-	-	-	L	L	L	-	-	-
CO6	S	M	-	-	M	L	S	L	-	L	L	L	M	L	M

S- Strong; M-Medium; L-Low

SYLLABUS
ELECTRICAL CIRCUITS AND MEASUREMENTS

Electrical quantities - Charge, Electric potential, current, power and Energy, Passive components (RLC)- Fundamental laws of electric circuits-steady solution of DC circuits - Introduction to AC circuits- Sinusoidal steady state analysis-Power and Power factor – Single phase and Three phase balanced circuits - Classification of Instruments-Operating Principles of indicating instruments.

ELECTRICAL MACHINES

Faraday's Law, Construction, Principle of operation, Basic Equation and Applications of DC & AC Generators and Motors - Single Phase Transformer, Single phase and Three phase Induction Motor.

ELECTRICAL SAFETY AND INTRODUCTION TO POWER SYSTEM

Protection & Safety - Hazards of electricity - shock, burns, arc-blast, Thermal Radiation, explosions, fires, effects of electricity on the human body. Electrical safety practices, Protection devices.

Types of Generating stations, Transmission types & Distribution system (levels of voltage and power ratings)- Simple layout of generation, transmission and distribution of power.

TEXT BOOKS:

1. Metha.V.K, Rohit Metha, "Basic Electrical Engineering", Fifth Edition, Chand. S&Co, 2012.
2. Kothari.D.P and Nagrath.I. J, "Basic Electrical Engineering", Second Edition, Tata McGraw-Hill, 2009.
3. R.K.Rajput , "Basic Electrical and Electronics Engineering", Second Edition, Laxmi Publication, 2012.

REFERENCE BOOKS:

1. Smarajt Ghosh, "Fundamentals of Electrical &Electronics Engineering", Second Edition, PHI Learning, 2007.

COURSE DESIGNERS

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3	Ms. D. Saranya	Assistant Professor (Gr-II)	EEE/AVIT	dsaranya@avit.ac.in
4	Mr. S. Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING B. BASIC ELECTRONICS ENGINEERING	Category	L	T	P	Credit
		FC- ES	2	0	0	2

PREAMBLE

The course aims to impart fundamental knowledge on electronics components, digital logics and communication engineering concepts. The course begins with classification of various active and passive components, diodes and transistors. It enables the student to design small digital logics like multiplexer, de-multiplexer, encoder, decoder circuits, etc. It crafts the students to get expertise in modern communication systems.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To learn and identify various active and passive components and their working principles.
2	To understand the number conversion systems and working Principles of logic gates.
3	To learn the digital logic principles and realize adders, multiplexer, etc.,
4	To understand the application-oriented concepts in the Various communication systems.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Interpret working principle and application of various active and passive electronic components like resistors, capacitors, inductors, diodes and transistors.	Understand
CO2. Construct the rectifier, Clipper, Clamper, regulator circuits and explore their operations.	Apply
CO3. Execute number system conversions and compute several digital logic operations.	Apply
CO4. Design adders, Multiplexer, De-Multiplexer, Encoder, Decoder circuits for given data input.	Apply
CO5. Expose the working principles of modern technologies in developing application-oriented gadgets like the UHD, OLED, HDR and various communication systems.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	L	-	-	-	M	-	-
CO2	S	M	M	M	-	-	M	-	L	-	-	L	-	M	-
CO3	S	M	M	-	-	-	-	-	L	-	-	-	S	-	-
CO4	S	M	M	M	-	-	M	-	L	-	-	L	M	-	-
CO5	S	M	-	-	-	-	-	-	L	L	-	L	S	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

SEMICONDUCTOR DEVICES

Passive and Active Components - Resistors, Inductors, Capacitors- Intrinsic Semiconductor, Extrinsic Semiconductor, Energy band diagram- Conductor, insulator, semiconductor, Characteristics of PN Junction Diode - Zener Diode and its Characteristics - Half wave and Full wave Rectifiers, Voltage Regulation- Simple wave shaping circuits- Clipper, Clamper. Bipolar Junction Transistor, JFET, MOSFET & UJT.

DIGITAL FUNDAMENTALS

Number Systems – Binary, Octal, Decimal and Hexa-Decimal – Gray Code- Conversion from one to another – Logic Gates and its characteristics – AND, OR, NOT, XOR, Universal Gates – Adders, Multiplexer, De Multiplexer, Encoder, Decoder – Memories.

COMMUNICATION AND ADVANCED GADGETS

Modulation and Demodulation – AM, FM, PM ,PCM,DM– RADAR – Satellite Communication – Mobile Communication, Optical communication, Microwave communication. LED, HD, UHD, OLED, HDR & Beyond, Smart Phones – Block diagrams Only.

TEXT BOOKS:

1. R.K. Rajput, "Basic Electrical and Electronics Engineering", Laxmi Publications, Second Edition, 2012.
2. Dr.P.Selvam, Dr.R.Devarajan, Dr.A.Nagappan, Dr.T.Muthumanickam and Dr.T.Sheela,"Basic Electrical and Electronics Engineering", Department of EEE & ECE, Faculty of Engineering & Technology, VMRFDU, Anuradha Agencies, 2018.
3. Edward Hughes, "Electrical and Electronics Technology", Pearson Education Limited, Ninth Edition, 2005.

REFERENCES:

1. John Kennedy, "Electronics Communication System", Tata McGraw Hill, 2003.

COURSE DESIGNERS

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1	Dr.T.Sheela	Associate Professor	ECE	sheela@vmkvec.edu.in
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	PYTHON PROGRAMMING (THEORY + PRACTICALS)	CATEGORY	L	T	P	CREDIT
		FC- ES	2	0	2	3

PREAMBLE

The purpose of this course is to introduce Python, a remarkably powerful dynamic programming language to write code for different operating systems along with application domain. Python has evolved on more popular and powerful open source programming tool

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To provide basic knowledge on Python programming concepts.
2	To introduce different methods in list, string, tuple, dictionary and sets.
3	To compute different programs using python control statements.
4	To learn about different functions in python.
5	To compute the exception handling functions, file concepts and CSV and JSON.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Learn python statements, comments and indentation, tokens, input and output methods using various example programs.	Understand
CO2. Apply the different methods involved in List, String, Tuples and Dictionary.	Apply
CO3. Design solutions for complex programs using decision making and looping statements.	Apply.
CO4.Apply the function programs with all the concepts like lambda, decorators and generators.	Apply.
CO5. Compute the exception handling programs, file concept programs and understand the concepts of CSV and JSON.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO2	S	M	M	M	M	-	-	-	-	-	-	-	S	M	M
CO3	M	S	S	S	M	-	-	-	-	-	-	-	M	M	M
CO4	S	S	S	S	M	-	-	-	-	-	-	-	S	S	M
CO5	S	M	M	M	M	-	-	-	-	-	-	-	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1 INTRODUCTION

Introduction to python-Advantages of python programming-Tokens-Variables-Input/output methods-Data types-Operators

2 DATA STRUCTURES

Strings-Lists-Tuples-Dictionaries-Sets

3 CONTROL STATEMENTS

Flow Control-Selection control Structure-if-if-else-if-else-if-else-Nested if iterative control structures-while loop, for loop and range.

4 FUNCTIONS

Declaration-Types of Arguments-Fixed arguments, variable arguments, keyword arguments and keyword variable arguments-Recursions-Anonymous functions: lambda- Decorators and Generators.

5 EXCEPTION HANDLING

Exception Handling-Regular Expression-Calendars and clock files: File input/output operations-Dictionary operations-Reading and writing in structured files: CSV and JSON.

LIST OF EXPERIMENTS

1. Write a program to sum of series of N natural numbers
2. Write a program to calculate simple interest.
3. Write a program to generate Fibonacci series using for loop
4. Write a program to calculate factorial using while loop
5. Write a program to find the greatest of three numbers using if condition
6. Write a program for finding the roots of a given quadratic equation using conditional control statements
7. Write a program to find the greatest of three numbers using conditional operator
8. Write a program to compute matrix multiplication using the concept of arrays
9. Write a program to implement recursive function
10. Write a program to read and write data using file concepts

TEXT BOOKS:

1. Bill Lubanovic, "Introducing Python Modern Computing in Simple Packages", 1st Edition, O'Reilly Media, 2014.
2. Programming With Python Book ‘Himalaya Publishing House Pvt Ltd
3. “Dive Into Python” by Mark Pilgrim

REFERENCES:

1. Mark Lutz, “Learning Python”, 6th Edition, O'Reilly Media, 2014.
2. David Beazley, Brian K. Jones, "Python Cookbook", 3rd Edition, O'Reilly Media, 2015.
3. Mark Lutz, “Python Pocket Reference”, 6th Edition, O'Reilly Media, 2015.

COURSE DESIGNERS				
S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. K.Karthik	Assistant Professor	CSE	karthik@avit.ac.in
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	BASICS OF CIVIL AND MECHANICALENGINEERING PART-A BASICS OF CIVIL ENGINEERING (Common to All Branches)	Category	L	T	P	Credit
		FC-ES	2	0	0	2

PREAMBLE

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering.

PREREQUISITE-NIL

COURSEOBJECTIVES

1	To understand the basic concepts of surveying and apply in practical problems
2	To study in detail different types of construction materials.
3	To impart basic knowledge about building components.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.An ability to apply concepts of Surveying on practical applications.	Apply
CO2. Explain different types of buildings, building components, building materials and building construction.	Remember
CO3.Expalin the essentials of components of a building and application of load on it	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	-	S	L	-	M	M	L	L	-	L	M	M	M
CO2	S	M	L	-	M	S	-	-	-	-	-	-	M	-	-
CO3	S	M	L	S	M	S	-	-	M	-	-	-	-	S	-

S-Strong;M-Medium; L-Low

SYLLABUS

SURVEYING

Objects–types–classification–principles–measurementsofdistances–angles–levelling–determination of areas– illustrative examples.

CIVIL ENGINEERING MATERIALS

Bricks –stones–sand –cement –concrete mix design and Quantity computation–steel sections.

BUILDING COMPONENTS AND STRUCTURES:

FOUNDATIONS: Types, Safe Bearing capacity of Soil–Requirement of good foundations.
SUPERSTRUCTURE: Brick Masonry–Stone Masonry–Beams –Columns –Lintels–Roofing–Flooring–Plastering–Mechanics – Internal and External Forces –Load Transformation Mechanism in Structural Elements– Stress – Strain – Elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping–Water Supply–Sources and Quality of Water— Rain water harvesting—Introduction to highway and railway.

TEXTBOOKS:

1. Basic Civil and Mechanical Engineering,VMU,(2017).CompanyLtd.,NewDelhi,2009.
2. Basic Civil and Mechanical Engineering, M.Prabakaran, S.P.Sangeetha, Vemuri Lakshminarayana, Maruthi Publishers, 2017.
3. Reinforced Concrete Structures B.C.Punmia,Vol.1&2,-Laxmi Publications,Delhi,2004.

REFERENCES:

1. Ramamrutham S., "Basic Civil En Ltd., 2009.
2. Rangwala S.C and Dalal K.B, Bui ouse, 2022.

COURSE DESIGNERS				
S. No.	**Name of the Faculty**	**Designation**	**Dept/College**	**MailID**
1	S.Supriya	Assist.Professor	Civil/VMKVEC	jansupriyanair@gmail.com
2	Mrs.Pa.Suriya	Asst.Professor	Civil/AVIT	suriya@avit.ac.in

	BASICS OF MECHANICAL ENGINEERING	Category	L	T	P	Credit
		FC (ES)	2	0	0	2

Preamble

This course provides a preliminary knowledge of the applications of mechanical engineering in our day to day life.

Prerequisite-NIL

CourseObjective

1	To demonstrate the principles of casting and metal joining processes in manufacturing
2	Understand the importance and uses of IC Engines, working principles of IC Engines.
3	Comprehend the working and use of various power plants

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

CO1.	Illustrate the application of casting and metal joining processes in manufacturing	Apply
CO2.	Demonstrate the operation of automotive engines and important components	Apply
CO3.	Understanding the construction and the working principle of conventional and non-conventional power generation	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	L	M	-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	L	L	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	L	L	-	-	-	-	-	-	-	-	-	-

S-Strong; M-Medium; L-Low

SYLLABUS

BASIC MANUFACTURING PROCESSES

Casting process-Introduction, Principle, Advantages, casting defects Forging process-introduction, forging, rolling, drawing, extrusion Welding process- introduction, principle, types-Gas and arc welding

IC ENGINES

The Importance and uses of Engines-Definition, Classification-I C & E C Engines- two stroke engines - four stroke engines - various parts and functions of I C engines-working of two stroke petrol engine and diesel engine with line sketches - working of four stroke petrol and diesel engines with line sketches - Comparison between two stroke and four stroke engines -S I and C I engines.

POWER PLANT ENGINEERING

Classification of power plants- Working of power plant with line Sketches-Steam power plant-Hydro- electric power plant - Diesel power plant -Nuclear power plant- merits and demerits. Nonconventional energy power plants – solar- wind-tidal- geo thermal, with line sketches- merits & demerits of various non conventional power plants

Text Books

1	Power plant Engineering, by G.R Nagpal
2	Internal combustion Engines by Ganesan
3	Workshop technology vol1, by S K Hajra Choudhury

Reference Books

1	Production technology, by P.C Sharma
2	Thermal Engineering by R.S.Khurumi
3	Power plant Engineering, by R.K Bansal

Course Designers

Sl.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Emailid**
1	R.MAHESH	AP(G-II)	MECH/AVIT	mahesh@avit.ac.in

	ENGINEERING GRAPHICS AND DESIGN	Category	L	T	P	Credit
		FC- ES	0	0	6	3

Preamble

Engineering Graphics is referred as language of engineers. An engineer needs to understand the physical geometry of any object through its orthographic or pictorial projections. The knowledge on engineering graphics is essential in proposing new product through drawings and interpreting data from existing drawings. This course deals with orthographic and pictorial projections, sectional views and development of surfaces.

Prerequisite

NIL

Course Objective

1	To implement the orthographic projections of points, straight lines, plane surfaces and solids.
2	To construct the orthographic projections of sectioned solids and true shape of the sections.
3	To develop lateral surfaces of the uncut and cut solids.
4	To draw the pictorial projections (isometric and perspective) of simple solids.
5	To draw the orthographic views from the given pictorial view.

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

CO1.	Execute in the form of drawing of the orthographic projections of points, straight lines, plane surfaces and solids.	Apply
CO2.	Demonstrate in the form of drawing of the orthographic projections of sectioned solids and true shape of the sections.	Apply
CO3.	Develop lateral surfaces of the solid section and cut section of solids.	Apply
CO4.	Draw the pictorial projections (isometric and perspective) of simple solids.	Apply
CO5.	Draw the orthographic views from the given pictorial view.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	S	L								L		
CO2	S	S	L	S	L								L		
CO3	S	S	L	S	L								L		
CO4	S	M	L	S	S								L		
CO5	S	S	L	S	L								L		

S- Strong; M-Medium; L-Low

Syllabus

PLANE CURVES AND DIMENSIONING

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Dimensioning. Projection of points.

PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to any one reference plane by change of position method.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of above solids in simple vertical position by cutting planes inclined to any one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids like Prisms, pyramids, cylinders and cones.

ORTHOGRAPHIC VIEWS AND ISOMETRIC VIEWS – First angle projection – layout views – Representation of Three Dimensional objects -multiple views from pictorial views of objects.

Principles of isometric View – isometric scale – Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones.	
INTRODUCTION TO AUTO CAD Introduction to Auto CAD- Basic introduction and operational instructions of various commands in AutoCAD. Limit System- Tolerance, Limits, Deviation, Actual Deviation, Upper Deviation, Lower Deviation, Allowance. Preparation of manual parts drawing and assembled sectional views from orthographic part drawings,	
Text Books	
1	Natarajan K V, "Engineering Graphics", Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2	K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International Private Limited.
3	K.R.Gopalakrishna"Engineering Drawing" (Vol. I & II), Subhas Publications, 2014.
4	Bhatt-N.D.-"Machine Drawing"-Published by R.C.Patel- Chartstar Book Stall- Anand-India- 2003
Reference Books	
1	N.D. Bhat and V.M. Panchal, Engineering Graphics, Charotar Publishers 2013
2	E. Finkelstein, "AutoCAD 2007 Bible", Wiley Publishing Inc., 2007
3	R.K. Dhawan, "A text book of Engineering Drawing", S. Chand Publishers, Delhi,2010.
4	DhananjayA.Jolhe, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw Hill Publishing Company Limited, 2008.
5	G.S. Phull and H.S.Sandhu, "Engineering Graphics", Wiley Publications, 2014.

Course Designers

S.No	Faculty Name	Designation	Dept / College	Email id
1	Dr. S.Venkatesan	Professor	Mech / VMKVEC	venkatesan@vmkvec.edu.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute	Duriation
1.	Engineering Graphics and Design	Prof. Naresh Varma Datla, Prof. S. R. Kale	IIT Delhi	12 weeks
2.	Engineering Drawing	Robi, P.S.	IIT Guwahati	12 weeks
3.	Engineering Drawing and Computer Graphics	Prof. Rajaram Lakkaraju	IIT Kharagpur	12 weeks

	PROGRAMMING FOR PROBLEM SOLVING	Category	L	T	P	Credit
		FC- ES	3	0	0	3

PREAMBLE

The course is designed to introduce basic problem solving and program design skills that are used to create computer programs. It gives engineering students an introduction to programming and developing analytical skills to use in their subsequent course work and professional development. This course focuses on problem solving, algorithm development, top-down design, modular programming, debugging and testing using the programming constructs like flow-control, looping, iteration and recursion. It presents several techniques using computers to solve problems, including the use of program design strategies and tools, common algorithms used in computer program and elementary programming techniques.

PREREQUISITE–NIL

COURSEOBJECTIVES

1.	To gain basic knowledge about simple algorithms for arithmetic and logical problems.
2.	To learn how to write a program, syntax and logical errors.
3.	To understand how to decompose a problem into functions and synthesize a complete program.

COURSEOUTCOMES

On the successful completion of the course, students will be able to

CO1: Formulate simple algorithms for arithmetic and logical problems.	Understand
CO2: Test and execute the programs and correct syntax and logical errors	Apply
CO3: Implement conditional branching, iteration and recursion.	Apply
CO4: Decompose a problem into functions and synthesize a complete program.	Analze
CO5: Use arrays, pointers, strings and structures to formulate algorithms and programs	Apply

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12			
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	-	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S

S-Strong; M-Medium; L-Low

SYLLABUS

UNIT – I: INTRODUCTION

Computer system: components of a computer system-computing environments-computer languages, creating and running programs, Algorithms, flowcharts- Introduction to C language: basic structure of programs, process of compiling and running program, -tokens, keywords, identifiers, constants, strings, special symbols, variables, data types-I/O statements

UNIT – II: OPERATORS, EXPRESSIONS AND CONTROL STRUCTURES

Operators and expressions: Operators- arithmetic- relational and logical- assignment operators- increment and decrement operators,-bitwise and conditional operators-special operators- operator precedence and associativity- evaluation of expressions-type conversions in expressions- Control structures: Decision statements: if and switch statement- Loop control statements: while, for and do while loops- jump statements- break-continue-goto statements.

UNIT – III: ARRAYS AND FUNCTIONS

Arrays: One dimensional array-declaration and initialization of one dimensional arrays- two dimensional arrays-initialization and accessing- multidimensional arrays- Basic Algorithms: Searching- Basic Sorting Algorithms-Functions: User defined and built-in Functions- Parameter passing in functions-call by value-Passing arrays to functions-call by reference,-Recursion-Example programs, such as Finding Factorial, Fibonacci series

UNIT – IV: STRINGS AND POINTERS

Strings: Arrays of characters- variable length character strings-inputting character strings-character library functions-string handling functions- Pointers: Pointer basics- pointer arithmetic-pointers to pointers-generic pointers-array of Pointers- functions returning pointers,-Dynamic memory allocation

UNIT – V: STRUCTURES AND FILE HANDLING

Structures and unions: Structure definition- initialization- accessing structures,-nested structures,-arrays of structures-structures and functions- unions- typedef- enumerations.-File handling :command line arguments- File modes- basic file operations read,-write and append

TEXTBOOKS

1. Schaum's Outline of Programming with C by Byron Gottfried , McGraw-Hill

REFERENCES

1. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
2. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.

Course Designers:

S.No.	Name of the Faculty	Designation	Department	MailID
1.	Mrs.R.Shobana	Assistant Professor	CSE	shobana@avit.ac.in
2.	Mr.B.Sundaramurthy	Assistant Professor	CSE	sundaramurthy@vmkvec.edu.in

	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB A. BASIC ELECTRICAL ENGINEERING	Category	L	T	P	Credit
		FC- ES	0	0	2	1

PREAMBLE

It is a laboratory course which familiarizes the basic electrical wiring, measurement of electrical quantities and various types of earthing methods.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To learn the residential wiring and various types of electrical wiring.
2	To measure the various electrical quantities.
3	To know the necessity and types of earthing and measurement of earth resistance.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO 1: Implement the various types of electrical wiring.	Apply
CO 2: Measure the fundamental parameters of AC circuits.	Analyze
CO 3: Measure the earth resistance of various electrical machineries.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	--	S	--	--	--	--	--	--	L	M	L	--
CO2	S	M	S	S	--	--	--	--	M	--	--	M	M	L	--
CO3	L	S	L	--	S	--	--	--	--	L	--	L	M	L	--

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Types of wiring, Joints and Measurement of resistance to earth of an electrical equipment.

REFERENCES

1. Laboratory Reference Manual.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Devarajan	Professor	EEE/VMKVEC	devarajan@vmkvec.edu.in
2	Dr. G. Ramakrishnaprabu	Associate Professor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
3	Ms. D. Saranya	Assistant Professor (Gr-II)	EEE/AVIT	dsaranya@avit.ac.in
4	Mr. S. Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	ENGINEERING SKILLS PRACTICES LAB PART B - BASIC ELECTRONICS ENGINEERING	Category	L	T	P	Credit
		FC- ES	0	0	2	1

PREAMBLE

This course is to provide a practical knowledge in Basic Electronics Engineering. It starts with familiarization of electronic components and electronic equipments. It enables the students to construct and test simple electronic projects

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To familiarize the electronic components, basic electronic equipments and soldering techniques.
2	To study the characteristics of Diodes, BJT and FET.
3	To understand the principles of various digital logic gates.
4	To understand the concept of basic modulation techniques

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Familiarize with the fundamentals of soldering techniques.	Understand
CO2. Construct experiments for PN and Zener diode characteristics also determine diode forward and reverse resistance	Apply
CO3. Construct clipper and clamper circuit and verify their voltage levels	Apply
CO4. Construct and justify operation simple voltage regulator for given Zener diode	Apply
CO5. Verify the truth tables and characteristics of logic gates (AND, OR, NOT, NAND, NOR, XOR).	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	L	-	-	-	M	-	-
CO2	S	M	M	M	-	-	M	-	L	-	-	L	-	M	-
CO3	S	M	M	-	-	-	-	-	L	-	-	-	S	-	-
CO4	S	M	M	M	-	-	M	-	L	-	-	L	M	-	-
CO5	S	M	-	-	-	-	-	-	L	L	-	L	S	-	L

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Practicing of Soldering and Desoldering.
2. Characteristics of PN junction Diode and find the forward and reverse resistance

3.Construct and Study simple clipper and clamper circuits
4. Characteristics of Zener diode and determine the break down voltage and diode resistance
5.Construct and Study simple voltage regulator using zener diode
6. Verification of Logic Gates.
7. Find the characteristics of AND ,NOR,NOT gate
8. Construct and Study simple voltage regulator using zener diode.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.T.Sheela	Associate Professor	ECE	sheela@vmkvec.edu.in
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3	Mr.R.Karthikeyan	Assistant Professor (Gr-II)	ECE	rrmdkarthikeyan@avit.ac.in
4	Ms.R.Mohana Priya	Assistant Professor (Gr-II)	ECE	mohanapriya@avit.ac.in

	ENGINEERING SKILLS PRACTICE LAB PARTA- BASIC CIVIL ENGINEERING (Common toAll Branches)	Category	L	T	P	Credit
		FC-ES	0	0	2	1

PREAMBLE

EngineeringSkillsPracticeisahands-ontrainingpracticetoMechanical,CivilandMechatronicsEngineeringstudents.Itdealswithfitting,carpentry,sheetmetal and relatedexercises.Also,it willinducethehabit ofselectingright tools, planningthejobanditsexecution

PREREQUISITE

Nil

COURSEOBJECTIVES

1	Tounderstandthebasicconceptsofbuildingcomponents.
2	Toimpart basic knowledgeaboutPlumping and Carpentry works.

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswill beableto

CO1. Preparethedifferenttypesoffitting and plumbing lines.	Apply
CO2.Preparethedifferenttypesofjointsusingwoodenmaterial	Apply

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	L	L	L	L	L	L	L	L	-	S	-
CO2	S	S	S	L	L	L	L	L	L	L	L	L	L	-	M

S-Strong; M-Medium; L-Low

SYLLABUS

Buildings:

1. Studyofplumbingandcarpentrycomponentsofresidentialandindustrial buildings,Safetyaspects.

Plumbing and Carpentry Works:

2. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in householdfittings.
3. Preparationofplumbinglinesketchesforwatersupplyandsewageworks.
4. Hands on Exercise on Demonstrationofplumbingrequirementsofhigh-risebuildings.

CarpentryusingPowerToolsonly:

5. Study of the joints in roofs, doors, windows and furniture.
6. Hands-on-exercise:Woodwork,jointsbysawing,planningandcutting.

TEXTBOOK

1.BasiccivilengineeringLabManual byDepartment ofCivil Engineering, VMRF.

COURSEDESIGNERS

S.No	NameoftheFaculty	Designation	Nameofthe College	MailID
1	M.Senthilkumar	Asst.Professor	Civil/ VMKVEC	senthilkumar@vmkvec.edu.in
2	Dr.D.S.Vijayan	Asst.Professor	Civil/AVIT	vijayan@avit.ac.in

	ENGINEERING SKILLS PRACTICE LAB B. BASIC MECHANICAL ENGINEERING	Category	L	T	P	Credit
			0	0	2	1

Preamble
Workshop is a hands-on training practice to Mechanical Engineering students. It deals with fitting, carpentry, foundry and welding related exercises. Also, it will induce the habit of selecting right tools, planning the job and its execution.

Prerequisite –NIL

Course Objective

1	To perform the practice in different types of fitting processes.
2	To executive joints using wooden materials.
3	To apply in depth knowledge in metal joining processes.
4	To demonstrate the pattern using foundry processes

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

CO1.	Perform the different types of fitting using MS plate.	Apply
CO2.	Practice the different types of joints using wooden material	Apply
CO3.	Demonstrate the different types of joints in metal by Arc Welding	Apply
CO4.	Utilize the different types of green sand mould	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO1	S	-	L	-	-	-	-	-	M	-	-	-	L	-	-
CO2	S	-	L	-	-	-	-	-	M	-	-	-	L	-	-
CO3	S	-	-	-	-	-	-	-	-	-	-	-	L	-	-
CO4	S	-	L	-	-	-	-	-	M	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

Tee – Fitting
Vee – Fitting
Preparation of a mould for a single piece pattern
Preparation of a mould for a split piece pattern
Half- Lap Joint in Carpentry
Dove Tail Joint in Carpentry
Lap Joint – Welding
Butt Joint – Welding

Text Books				
1	**BASIC MECHANICAL ENGINEERING, LAB MANUAL**			
Reference Books				
1	K.Venugopal, Basic Mechanical Engineering, Anuradha Publications, Chennai			
2	NR. Banapurmath, Basic Mechanical Engineering, Vikas Publications, Noida			
Course Designers				
S.No	Faculty Name	Designation	Department / Name of the College	Email id
1	V K Krishnan	Associate Professor	Mech / VMKVEC	vkkrishnan@vmkvec.edu.in
2	S. Duraithilagar	Associate Professor	Mech / VMKVEC	sduraithilagar@vmkvec.edu.in

	ELECTRIC CIRCUIT ANALYSIS (THEORY & PRACTICALS)	Category	L	T	P	Credit
		CC	3	0	2	4

PREAMBLE

Electric circuit theory is the fundamental theory upon which all branches of electrical engineering are built. Many areas of electrical engineering, such as power, electric machines, control, electronics, communications, and instrumentation, are based on electric circuit theory. Therefore, the basic electric circuit theory course is the most important course for an electrical engineering student, and always an excellent starting point for a beginner in electrical engineering education. Circuit theory is also valuable to students specializing in other branches of the engineering because circuits are a good model for the study of energy systems in general, and because of the applied mathematics, physics, and topology involved.

PREREQUISITE – BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OBJECTIVES

1	To understand the basic circuit parameter and formulate the mathematical model of circuits using basic laws.
2	Gain knowledge to solve DC and AC circuits using network theorems.
3	To understand series and parallel resonance concepts and analysis of coupled circuits.
4	To study protection of balanced and unbalanced loads and measurement of power and power factor in three phase circuits.
5	To Apply the knowledge of Digital Communication circuits in various fields.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Describe the various circuit laws and sources	Remember
CO2. Apply Mesh, Nodal analysis to solve DC circuits	Apply
CO3. Analyze of AC and DC circuits using various network theorems	Analyze
CO4. Discuss the basic concepts of Resonance circuits and its components.	Understand
CO5. Explain Coupled circuits with help of Inductance	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	L	M	L	-	M	S	M	M	-	-	-
CO2	S	S	M	S	L	-	-	-	-	-	-	-	-	-	-
CO3	S	M	-	S	S	-	M	-	M	L	L	M	-	-	-
CO4	M	M	M	M	S	-	M	-	-	L	L	M	-	-	-
CO5	M	M	M	M	S	-	M	-	M	L	L	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS
THEORY
BASIC CIRCUIT CONCEPTS:
DC and AC circuits - R, L, and C elements phasor diagrams-impedance, admittance - real and reactive power-power factor. Formation of matrix equations and analysis of complex circuits using mesh- current and nodal - voltage methods.
NETWORK THEOREMS AND TRANSFORMATIONS:
Voltage – Current – Source transformation. Star - Delta transformation, Superposition theorem – Reciprocity theorem – Substitution theorem – Maximum Power Transfer theorem – Thevenin's theorem – Norton's theorem.
RESONANCE AND COUPLED CIRCUITS:
Series and parallel resonance – Bandwidth and Q factor. Inductively coupled circuits – self and mutual inductance - co-efficient of coupling - Dot convention.
TRANSIENT ANALYSIS:
Transient response – natural and forced response. Transients in RC, RL and RLC circuit with DC and sinusoidal excitation.
THREE PHASE POWER MEASUREMENT Analysis of three phase three wire and four wire circuits with star and delta connected balanced and unbalanced loads- phasor diagram of voltages and currents. Measurement of power and power factor in three phase circuits by using single, two and three watt meter methods.
PRACTICAL
Verification of the thevenin's, norton's, super position, reciprocity and maximum power transfer theorem. Tme domian analysis of RL and RC transient circuits. Series and Parallel resonance circuits. Three phase power measurement circuit by two wattmeter method.
Text Book
1. Dr.S. Arumugam, Premkumar, Circuit Theory - Khanna publishers,1991 2. Sudhakar, A. and Shyam Mohan S.P.,'Circuits and Network Analysis and Synthesis', Tata McGraw-Hill Publishing C.Ltd., New Delhi, 2006.
Reference Books

1. Prof.T.NageswaraRao,"Electric circuit analysis" A.R.Publications.
2. Hyatt, W.H. Jr and Kemmerly, J.E., 'Engineering Circuits Analusis', McGraw-Hill International Editions, 2002.
3. Edminister, J.A., 'Theory and Problems of Electric Circuits', Schaum's outline series McGraw Hill Book Company, 5 th Edition, 2011.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. B. Parvathi Sangeetha	Assistant Professor	EEE	parvathi.eee@avit.ac.in
2	Mr. P. Loganathan	AP	EEE/VMKVEC	loganathan@vmkvec.edu.in

	SEMICONDUCTOR DEVICES AND CIRCUITS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This is an introduction course to semiconductor devices. The course begins with a discussion on how electron energy bands are formed in semiconductors. It examines the principles and operations of essential semiconductor devices used in today's electronics: diodes, light emitters, bipolar junction transistors and MOSFETs. It includes analysis of small signal model and large signal model of the devices which is the prerequisite for next level courses. This subject helps the students to design, model and develop amplifier circuits, Oscillator circuits, Tuned amplifiers and many other real time application circuits.

PREREQUISITE

Basics of Electrical and Electronics Engineering

COURSE OBJECTIVES

1	To understand the small signal BJT/FET Models.
2	Identify the frequency response of BJT and FET.
3	Apply the basic concept and working of various types of feedback amplifiers and oscillators.
4	To understand the working different types of large signal amplifiers.
5	To learn about various types of tuned amplifiers

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Determine various factors for HWR, FWR and construct Clipper, Clamper and voltage regulator circuits	Apply
CO2.Determine the characteristics and parameters of BJT and FET in various configuration	Apply
CO3. Design the voltage divider bias for BJT, FET and justify stability factors.	Apply
CO4. Analyze various parameters of feedback amplifier (voltage series, voltage shunt, current series and current shunt) by using simulation tools.	Analyze
CO5.Analyze the efficiency of large signal amplifiers and bandwidth of tuned amplifier by using simulation tools.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	-	-	-	-	-	-	-	M	M	-	-
CO2	S	M	M	M	-	-	-	-	-	-	-	M	M	-	-
CO3	S	S	M	M	-	-	-	-	-	-	-	M	S	L	L
CO4	S	S	M	M	M	-	-	-	-	-	-	M	S	M	L
CO5	S	M	M	M	M	-	-	-	-	-	-	M	S	M	L
S- Strong; M-Medium; L-Low															

SYLLABUS

SEMICONDUCTOR DIODE AND ITS APPLICATIONS

PN Junction Diode –, Zener Diode- Characteristics -equivalent circuits, Diode current Equation, Light-Emitting Diodes, Half-Wave Rectification, Full-Wave Rectification, Bridge Rectifier, Voltage regulator- Line and Load regulation, Clipper, Clamper, Voltage-Multiplier Circuits,

TRANSISTORS & SPECIAL DEVICES

Transistor: Construction, Transistor Operation and characteristics- CE, CB, CC Configuration -Characteristics of JFETs, Transfer Characteristics, Depletion-Type MOSFET, Enhancement-Type MOSFET. Special Devices: SCR, Shockley Diode, Diac, Triac, Unijunction Transistor, Phototransistors, MISFETs, MESFET.

BIASING CIRCUITS & SMALL SIGNAL ANALYSIS

BJT Biasing : Fixed Bias Configurations, Emitter Bias Configuration, Voltage Divider Bias - AC /DC Load line-Operating Point -, Hybrid Equivalent model, stability factor, Small Signal Analysis of CE Amplifier.
FET Biasing : Fixed bias, Self bias and Voltage divider bias, FET amplifiers – small signal model and Configurations using multisim simulation tool.

FEEDBACK AMPLIFIERS

Concept of feedback – effects of negative feedback- Input impedance- output impedance, voltage gain, current gain, Types of feedback amplifier-Voltage and Current Series, Voltage and Current Shunt, Gain Bandwidth Product.

POWER AMPLIFIERS & TUNED AMPLIFIERS

Power Amplifier : Class A, Push –Pull Amplifier-Class B, Class C & D amplifiers, Amplifier Distortion, Amplifier Efficiency. Tuned amplifiers: Single tuned, Double tuned, Synchronous tuned amplifiers –Stability of Tuned Amplifiers using multisim simulation tool.

TEXT BOOKS:

1.Jacob Millman, Christos C Halkias, Satyabrata Jit, "Electron Devices and Circuits", Tata McGraw Hill,4thEdition, 2015.
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 11thEdition, 2013

REFERENCE BOOKS:

1. David A Bell, "Fundamentals of Electronic Devices and Circuits", Oxford University Press, 5th Edition,2008.
2. D.Roychoudhury and shailB.Jain, —Linear Integrated circuits‖, 4th edition, New Age International Pvt.Ltd, 2014.
3. Thomas L. Floyd, "Electronic Devices", 9th edition, Pearson Education, 2011.

COURSE DESIGNERS				
S.No	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1.	Mr.S.Selvaraju	Associate Professor	ECE	selvaraju@vmkvec.edu.in
2.	Dr.R.Ramani	Assistant Professor	ECE	ramani@vmkvec.edu.in

	ELECTRICAL MACHINES – I	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Electrical Machines – I is concerned with the constructions, analysis of characteristics, testing and applications of types of machines and transformers. This course aims to enable to work professionally in the Electrical Engineering Sector.

Prerequisite: Basics of electrical & electronics engineering.

COURSE OBJECTIVE

On the successful completion of the course, students will be able to

1	To understand the concepts of field energy, co energy, mechanical force and production of torque and EMF.
	To analyze the performance characteristics of different types of DC Generator.
3	To analyze the performance characteristics of different types of DC motors.
4	To understand different types of Transformers, construction, working principle and their performance.
5	To familiarize with the applications of DC machines and transformer.

COURSE OUT COMES

CO1: learn the concepts and laws of electromagnetic induction in rotating machines	Understand
CO2: study construction, characteristics and applications of DC generators.	Understand
CO3: Explain the construction, characteristics and application of DC Motors Understand	Analyse
CO4: Clarify the starter and speed control method of DC Motors Apply	Evaluate
CO5: Illustrate the construction and working of Single Phase and Three Phase Transformers Apply & to Analyze the testing of DC Machines & Transformer	Evaluate

MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO1	S	L	L	L	-	-	L	-	L	-	L	L	-	S	L	-
CO2	S	S	L	M	-	L	-	-	L	L	L	L	L	S	M	-
CO3	M	S	L	M	L	L	-	-	L	-	L	L	L	S	M	-
CO4	S	M	M	L	L	M	L	-	M	-	M	L	M	S	L	-
CO5	S	M	M	L	L	M	L	L	L	L	L	M	M	S	L	L

S-STRONG,M-MEDIUM,L-LOW

Syllabus

BASIC CONCEPTS IN ROTATING MACHINES

Energy in Magnetic Systems-Field Energy and Co Energy-Determination of Mechanical Force- Singly and multiply excited systems -Laws of Electromagnetic induction - Torque and EMF production in rotating machines.

DC GENERATOR

Introduction – electric generator- Constructional features- Principle of operation of DC generator - EMF equation-circuit model - methods of excitation - Losses in DC generator –power stages –condition for maximum efficiency - armature reaction – compensating winding, Commutation - Operating Characteristics of DC generators - Parallel operation of DC generators - Applications of DC generators.

DC MOTORS

Principle of operation of DC motors - Back EMF - Torque Equation-Types of DC motors- characteristics of DC motors - Starting of DC motors: review of mechanical starter, electronic soft starters for DC motor with energy saving. Speed control: Field control, Armature control, voltage control– efficiency- Applications.

TRANSFORMERS

Principle, construction and operation of single-phase transformers, equivalent circuit, phasordiagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer- construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers – construction principle, applications and comparison with two winding transformer, Magnetizing current effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current Phase conversion - Scott connection, three-phase to six- phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Cooling of transformers.

TESTING OF DC MACHINES &TRANSFORMERS

Losses and efficiency –Condition for maximum efficiency - Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test, Testing of transformer: polarity test, load test, Open circuit and short circuit test, Sumpner's test.

TOTAL : 45 PERIODS

TEXT / REFERENCES:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hil Education, 2013.
2. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.
3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004. 62 4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
5. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
6. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

COURSE DESIGNERS

S.No	Name of Faculty	Designation	Department	Mail.id
1	A.BALAMURUGAN	Associate .Professor	VMKVEC	balamurugan@vmkvec.edu.in
2				

	ELECTRICAL MACHINES – II	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

In a modern world the electric motor especially Alternating current motors and Special applications-oriented motors has played a leading role in the high productivity of modern industry, and it is therefore directly responsible for the high standard of living being enjoyed throughout the industrialized world. Hence the course provides the knowledge about the basic study and performance analyzing techniques of AC machines and Special electrical machines.

PREREQUISITE: Electrical Machines – I

COURSE OBJECTIVES

1	To determine the voltage regulation of an alternator from its working principles
2	To describe the synchronous motor operating principle and analyze the synchronous motor withdifferent excitations.
3	To explain the working principle of single phase and three phase induction motor and determine their applications from their characteristics.
4	To employ the different starting and speed control methods of three phase induction motor.
5	To describe the construction and principle of operation of single phase induction motor and various machines which is involved in special Applications.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Identify the parts and predetermine the performance of synchronous generator by varies types of voltage regulation methods.	Remember
CO2: Explain the principle operation and performance characteristics of synchronous motor.	Understand
CO3: Analyze the characteristics of three phase induction motor through its equivalent circuit and circle diagram.	Analyze
CO4: Apply suitable starting and speed control methods to enhance the performance of three phase induction motors.	Apply
CO5: Evaluate the performance of special machines and can able to choose the suitable starting methods of single phase induction motor.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	S	-	-	-	-	M	L	-
CO2	S	M	-	M	-	-	-	M	-	-	-	-	M	M	-
CO3	S	S	-	M	-	-	-	M	-	-	-	-	M	M	-
CO4	S	M	-	M	-	L	-	M	-	-	-	M	S	M	-
CO5	S	L	M	L	L	L	-	M	-	-	-	M	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

SYNCHRONOUS GENERATOR

Construction - Armature Winding - Winding Factors - EMF Equation - Armature Reaction - Voltage Regulation - Predetermination of Regulation by Synchronous Impedance, MMF and Potier Methods - Power Flow Equations - Parallel Operations - Synchronization and Synchronizing Power - Synchronizing to Infinite Busbar - Slip Test.

SYNCHRONOUS MOTOR

Construction - Specific loading - output equation - main dimensions(D&L), Principle of Operation - Methods of Starting - Phasor Diagrams - Power Flow Equations - Effect of Varying Field Current and Load - V and Inverted V Curves - Synchronous Condenser - Hunting and Suppression Techniques.

THREE PHASE INDUCTION MOTOR

Construction - Specific loading - output equation - main dimensions (D&L) - Types - Principle of Operation - Equivalent Circuit - Phasor Diagram - Power across Air-gap, Torque and Power Output - Slip -Torque Characteristics - No-Load and Blocked Rotor Tests - Circle Diagram - Cogging and Crawling - Braking - Induction Generators- Applications

STARTING AND SPEED CONTROL OF THREE PHASE NDUCTION MOTOR

Need and necessity of starting and starters - types of starters - stator resistance and reactance starters, rotor resistance starter, auto transformer and star-delta starters – Need of speed control – Types - change of voltage - change of number of poles - change of frequency - cascade connection - slip power recovery scheme.

SINGLE PHASE INDUCTION MOTOR AND SPECIAL MACHINES

Construction of Single Phase Induction Motor - Double revolving field theory - Equivalent Circuit - Load Characteristics - Starting Methods of Single Phase Induction Motor - Variable Reluctance Motor - Stepper Motor - Hysteresis Motor - AC Series Motor -Repulsion Motor - Linear Induction Motor - Universal Motor- Servo Motor - Permanent Magnet DC and AC motors – Applications

TEXT BOOKS

1. Nagarath.I.J. and Kothari.D.P., “Electric Machines”, T.M.H. Publishing CoLtd., New Delhi, 4th edition 2010.
2. M.G.Say, “Performance and Design of Alternating Current Machines”, 3rd Edition, CBS Publisher.
3. B. L. Theraja, A. K. Theraja, “A Text Book of Electrical Technology”, Volume II, S.Chand & Company Ltd, New Delhi, 2007.
3. Vincent Del Toro, ‘Basic Electric Machines’ Pearson India Education, 2016.

REFERENCES

1. Gupta., “Theory and Performance of Electrical Machines”, Kataria and Sons, 14th edition 2009.
2. A. E. Fitzgerald, Charles Kingsley, Jr.Stephen D. Umans, “Electric Machinery”, Sixth Edition, Tata McGraw Hill Publishing Company Ltd., 2002.
3. Raj put R.K, “Electric Machines”, Lakshmi publication, fifth edition, reprinted at 2011.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.G.Ramakrishnaprabu	Associate Professor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
2.	Dr.R.Sathish	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
3.	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	ELECTROMAGNETIC THEORY	Category	L	T	P	C
		CC	3	0	0	3

Preamble

To introduce the fundamentals of electromagnetic fields, waves and their applications in Engineering.

PREREQUISITE : Engineering Mathematics

COURSE OBJECTIVES

1	To convey the basic physical concepts that lie behind all electrical engineering, the interactions between charged particles, whether stationary or in motion.
2	To familiarize with the concepts of Magneto statics and their applications
3	To understand Faraday's laws, Maxwell's equations, induced EMF and their applications.
4	To learn the concept of Electromagnetic Fields, waves and wave propagation.
5	To understand the concepts of field modeling and computation.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	To determine the electric field intensity from the stationary charge distributions and to analyze the electric fields using electromagnetic laws with the associated boundary conditions.	Understand
CO 2	To analyse time varying electric and magnetic fields.	Remember
CO 3	Compare the electric and magnetic boundary conditions, calculate the capacitance and inductance	Remember
CO 4	Summarise the electric magnetic waves and wave propagation in different medium.	Apply
C0 5	Compute Field Modeling & Computation	Understand

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-	-	S	S	-	-	L	-	-	-	-	L
CO2	M	-	M	-	S	L	M	-	M	L	-	-	-	-	L
CO3	M	-	M	-	S	L	M	-	-	L	-	-	-	-	-
CO4	S	-	S	-	S	M	M	L	-	L	M	-	L	M	-
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	-	-

SYLLABUS

ELECTROSTATICS

Introduction– Sources and effects of electromagnetic fields - Difference between field theory and circuit theory - Charge - Coulomb's law - Continuous charge distribution - Electric field intensity - Electric flux - Gauss's law and its Applications - Potential - Laplace and Poisson's equations -Electrostatic energy –Capacitance- boundary value problems

MAGNETOSTATICS

Current Density - Magnetic field - Magnetic flux - Magnetic flux density - Biot-Savart's law -Ampere's law - Torque – Force – Scalar and Vector Magnetic potential - Boundary value problem – Energy Density

ELECROMAGNETIC FIELDS

Faraday's law - Lenz's law - Self inductance - Mutual inductance - Co-efficient of coupling - Dot rule for coupled circuits - Series, Parallel - Inductance of solenoid, Toroid, Maxwell's equations (boundary conditions) - Displacement current - Eddy current.

ELECTROMAGNETIC WAVES

Introduction - Derivation of Wave Equation, Uniform Plane Waves - Conducting media - Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect, Poynting theorem.

FIELD MODELLING AND COMPUTATION

Problem formulation - boundary conditions – solutions - analytical methods - variables separable methods - conformal transformation - method of images - numerical methods - finite difference method - finite element method - charge simulation method.

TEXTBOOK

1. John D. Kraus, "Electromagnetics with application" McGraw Hill, 5th edition,2011.
2. William Hayt, "Engineering Electromagnetics", McGraw Hill, New York, 7th edition, 2014.
3. Kraus and Fleish, Electromagnetics with Applications, McGraw Hill International Editions, Fifth Edition, 2008

REFERENCES

1. K. A. Gangadhar, P.M. Ramanathan, Electromagnetic Field Theory, Khanna Publishers,Sixteenth Edition, 2011.
2. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014
3. A.Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	S.Prakash	AP(Gr-II)	EEE/AVIT	sprakash@avit.ac.in
2	Dr. R. Sankarganesh	Associate Professor	EEE/VMKVEC	sankarganesh@vmkvec.edu

	MEASUREMENTS AND INSTRUMENTATION (THEORY AND PRACTICALS)	Category	L	T	P	C
		CC	3	0	2	4

Preamble

This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail and to develop skills in designing and conducting experiments related to applications of measuring instruments.

PREREQUISITE : Basics of Electrical and Electronics Engineering

COURSE OBJECTIVES

1	To introduce the fundamentals of electrical and electronic instruments
2	To understand the working principles of the electrical and electronic meters
3	To Understand the working principle of AC, DC bridges.
4	To train the students in the measurement of displacement, resistance, inductance, torque and angle

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Explain the functional elements, characteristics, standards and calibration of measuring instruments.	Apply
CO 2	Describe the working of various electrical and electronic meters	Understand
CO 3	Determine unknown values using bridges.	Understand
CO 4	Describe the operation of storage and display devices.	Understand
C0 5	Explain the working of various transducers, ADC and DAC.	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

CoS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	-	M	-	-	S	-	M	-	S	M	M
CO2	M	L	M	M	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	S	L	-	-	-	S	M	-	-	-	S	M	-
CO4	M	M	L	S	-	-	-	M	-	-	M	M	S	M	-
CO5	S	S	M	M	-	-	-	-	-	-	-	M	S	S	-

SYLLABUS

INTRODUCTION

Functional elements of an instrument - static and dynamic characteristics – errors in measurement - statistical evaluation of measurement data - standard and calibration

ELECTRICAL AND ELECTRONICS INSTRUMENTS

Principle and types analog and digital ammeters and voltmeters – single and three phase Wattmeters and Energy meter– instrument transformers – instruments for measurement of frequency and phase.

COMPARISON METHODS OF MEASUREMENTS

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic interference – Grounding techniques

STORAGE AND DISPLAY DEVICES

Magnetic disc and tape recorders – digital plotters and printers – CRT displays – digital CRO – LED, LCD and Dot matrix displays. Data Logger

TRANSDUCERS

Classification of transducers – selection of transducers – resistive, capacitive and inductive transducers – piezo electric transducers – optical and digital transducers- Elements of data acquisition system – A/D, D/A converters – Smart sensors.

PRACTICE

Experiment on Transducer & AC Bridges, Calibration of Current Transformer, Instrumentation amplifiers, Calibration of Single phase Energy meter.

TEXTBOOK

1. A.K. Sawhney, Puneet Sawhney, 'A Course In Electrical And Electronic Measurements And Instrumentation ', Dhanpat Rai and Co,2012.
2. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCES

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2017.
2. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
3. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
4. John P. Bentley, 'Principles of Measurement Systems', III Edition, Pearson Education, 2000.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	S. Jensie Anita			jensiepresley@avit.ac.in

2	Mr. P. Loganathan	AP	EEE/VMKVEC	loganathan@vmkvec.edu.in

	ANALOG AND DIGITAL CIRCUITS (Theory and Practicals)	Category	L	T	P	Credit
		CC	3	0	2	4

PREAMBLE

One of the most important reasons for the unprecedented growth of Digital Electronics and systems is the advent of integrated circuits(ICs).Developments in the IC technology have made it possible to fabricate complex digital circuits such as microprocessors, memories and FPGAs etc. This course provides various methods and techniques suitable for a variety of digital system design applications.

PREREQUISITE

Semiconductor Devices And Circuits

COURSE OBJECTIVES

1	To understand the small signal BJT/FET Models
2	To learn about various compound configurations of multivibrators
3	To impart the design knowledge of various combinational logic circuits and sequential circuits
4	To understand the basics of hardware descriptive language
5	To design the various sequential logic circuits

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Apply the basic concept and working of various types offeedback amplifiers and oscillators.	Apply
CO2. Design different multivibrators & compound Configurations Circuits.	Apply
CO3. Apply the principles of Boolean algebra to manipulate and minimize logicexpressions	Apply
CO4. Design various combinational logic circuits (adder, subtractor, multiplexer and coders, etc.,)	Analyze
CO5.Design various sequential circuits using flip flops (counters, shift registers, etc.,)	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	-	-	-	-	-	-	-	M	M	-	-
CO2	S	M	M	M	-	-	-	-	-	-	-	M	M	L	-
CO3	S	M	M	M	M	-	-	-	-	-	-	M	S	M	-
CO4	S	S	M	M	-	-	-	-	-	-	-	M	S	M	-
CO5	S	S	M	S	-	-	-	-	-	-	-	M	S	M	L
S- Strong; M-Medium; L-Low															

SYLLABUS

OSCILLATOR CIRCUITS

Concept of feedback – effects of negative feedback-Barkhausen Criterion – Oscillator Circuits: Oscillator Principles – LC oscillators – Hartley oscillator, Colpitts Oscillator, Clapp Oscillator, RC Phase shift oscillators, Sweep oscillator-Wein Bridge Oscillator-Crystal oscillators - Demonstration With Relevant Experiments

COMPOUND CONFIGURATIONS AND MULTIVIBRATORS

Introduction, Cascade Connection, Cascode Connection, Darlington Connection, Differential Amplifier Circuit, CMRR, Schmitt Trigger. Multivirators- Astable –bistable – Monostable-- Demonstration With Relevant Experiments

BOOLEAN ALGEBRA, LOGIC GATES & GATE –LEVEL MINIMIZATION:

Introduction, Boolean Algebra, basic theorem & properties of Boolean Algebra, Boolean functions, canonical & standard forms, logical operations, logic gates, Integrated circuits, Map method-upto four variable Kmaps, Product of Sums (POS) & Sum of Products (SOP) simplification, don't care conditions, NAND & NOR implementations, Exclusive-OR Function, Hardware Description Language(HDL)- - Demonstration With Relevant Experiments

COMBINATIONAL LOGIC

Introduction, Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adder,
Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Code Converters, Encoders, Decoders, Multiplexers-- Demonstration With Relevant Experiments

SYNCHRONOUS SEQUENTIAL LOGIC, REGISTER & COUNTERS

Sequential circuits, storage elements: latches, flip flops, Analysis of clocked sequential circuits, Moore and Mealy circuits ,state diagram, state reduction & Assignment, design procedure, shift registers, ripple counters, synchronous counters-- Demonstration With Relevant Experiments

Text Books:

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, "Electron Devices and Circuits", Tata McGraw Hill,4thEdition, 2015.
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 11thEdition, 2013
3. Morris Mano, "Digital Design (with an introduction to the verilog HDL)", Prentice-Hall of India.
4. John F. Wakerly, "Digital Design Principles & Practices", 4th edition, Prentice-Hall,2005.

Reference Books:

1.David A Bell, "Fundamentals of Electronic Devices and Circuits", Oxford University Press, 5th Edition,2008.
2. D.Roy choudhury and shail B.Jain, ―Linear Integrated circuits‖, 4th edition, New Age International Pvt.Ltd, 2014.
3. Thomas L. Floyd, "Electronic De , 2011. Stephen D. Brown, and Zvonko Vranesic, "Fundamentals of Digital Logi cGraw Hill, June, 2007.

4. William Kleitz, “Digital Electronics: A Practical Approach with VHDL”, Ninth Edition, Pearson, 2002.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mr.S.Selvaraju	Associate Professor	ECE	selvaraju@vmkvec.edu.in
2.	Dr.R.Ramani	Assistant Professor	ECE	ramani@vmkvec.edu.in

	POWER ELECTRONICSAND DRIVES (THEORY & PRACTICALS)	Category	L	T	P
		CC	3	0	2

PREAMBLE

Power electronics involves the study of electronic circuits intended to control the flow ofelectrical energy. It de processing and control of 'raw' electrical power from anelectrical source such as an AC mains supply, a bat photovoltaic array, or a windturbine into a form and quality suitable for a particular electrical load. It is an enablin with a very wide range of applications.Electric Drives, both ac and dc types, come in many shapes and arestandardized versions for general-purpose applications. Others are intended for specifictasks. In any case, moto selected to satisfy the dynamic requirements of themachines on which they are applied without exceeding temperature.To acquire the practical knowledge in power electronic devices and converters.

PREREQUISITE: SemiconductorDevices and Circuits

COURSEOBJECTIVES

1	Togetanoverviewofdifferenttypesofpowersemiconductordevices andtheirswitchingcharacteristics.
2	Tounderstandtheoperation,characteristics andperformanceparameters ofcontrolledrectifiers.
3	Tostudytheoperation,switchingtechniquesandbasics topologiesofDC-DCswitchingregulators.
4	TostudytheoperationofACvoltagecontroller and tolearn thedifferentmodulationtechniquesinverters.
5	Toemploythe solidstatespeedcontroltechniquesforDCdrivesforefficientcontrol.
6	Toemploysolidstatespeedcontroltechniquesfor ACdrivesforproficientandlosslesscontrol.
7	To Analyze the performance of semiconductor devices and converters through experiments.

COURSEOUTCOMES

Onthesuccessful completionofthecourse,studentswillbe ableto

CO1:Define semiconductorphysicstothepropertiesofrealpowersemiconductordevicesanddifferentiatefromlowpowerdevices.	Re
CO2: Implement rectifiers and inverters forthe given application	
CO3: Implement DC-DC converters andAC-AC converter for the givenapplication	
CO4: Interpret theconceptsofanelectricaldrivesystemandchoosea suitablemotordrive fordifferentapplications&Explain the basics and advantages ofelectric drives.	Ur
CO5: Appraise the conventional speed control methods of AC motors withstartingandbrakingmethods.	Ana
CO6:ValidatetheproficientcontrolofACandDCdrivesbyutilizethepowerelectronicsconcepts.	Eva
C07: Analyze the performance of semiconductor devices and converters by conducting suitable experiments.	A

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMME SPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO
CO1	S	M	S	M	S	L	M	-	L	L	S	M	L	S
CO2	S	S	S	M	M	L	M	-	L	M	S	M	M	S
CO3	S	S	S	M	M	L	M	-	L	L	S	M	M	S
CO4	S	S	S	S	S	M	M	-	M	L	S	M	L	M
CO5	S	S	S	M	S	M	M	-	L	M	S	M	L	S

CO6	S	S	S	S	S	M	M	-	M	M	S	M	L	S
C07	S	M	L	L	M	-	-	-	S	-	M	-	-	S
S-Strong;M-Medium;L-Low-														

SYLLABUS

POWERSEMI-CONDUCTOR DEVICES
Overviewofswitchingdevices - Principles of operation, Characteristics, Protection and Gate dri ofPowerDiode,PowerTransistor,MOSFET,IGBT,SCR andTRIAC - Design of filters.

RECTIFIERS& CHOPPERS
Singlephaseandthreephase rectifiers - Dualconverters.BasicPrinciplesofChoppers-Stepdownandstepupchopper– Timeratiocontrolandcurrentlimitcontrol–Buck,Boost,Buck-Boostconverters.

INVERTERS &AC-ACCONVERTERS
Singlephaseandthreephase[120º&180º mode] Voltage Sourceinverters–Current SourceInverters - Regeneration i - PWMtechniques–SinglephaseandthreephaseACvoltagecontrollers –singlephaseandthreephasecycloconv Cycloconverter Control Scheme.

ELECTRICALDRIVES
General electric drive system - Classification and TypesofElectricalDrives –Factorsinfluencingtheselection drives– Torque-speed characteristics of motors- heating andcoolingcurves–classesofduty–Selection of motor p simpleproblems.

SOLIDSTATEDRIVES
Advantagesofsolidstatedrives–Speed control methods of DCmotorsusingrectifiersandchoppers– Speed controlofinductionmotorbyStator Voltage control, Voltage / Frequency control -Slippowerrecoverysystems.

PRACTICE

CharacteristicsofSCR, MOSFET andIGBT. ConverterfedDC MotorDrive.InverterfedInductionMotorDri

TEXTBOOKS:
1. RashidM.H.,"PowerElectronicsCircuits,Devices andApplications",PrenticeHallIndia,3rdEdition,NewDelhi,200
2. G.K.Dubey“FundamentalElectricalDrives”secondedition2002,NarosaPublications,Second edition,2002.

REFERENCES:
1. Cyril.W.Lander,"PowerElectronics",McGraw HillInternational,ThirdEdition,1993.
2. P.S.Bimbra"PowerElectronics",KhannaPublishers,thirdEdition2003.
3. PhilipT.Krein, "ElementsofPowerElectronics"OxfordUniversityPress,2004Edition.
4. N.K.De.,P.K.Sen“ElectricDrives”,PrenticeHall,Firstedition1999.
5. Pillai,S.K.,“A FirstcourseonElectricalDrives”,WileyEasternLtd.,New Delhi, 1982

COURSEDESIGNERS

S.No.	Nameof theFaculty	Designation	Department	MailID
1	Dr. R. Sankarganesh	AssociateProfessor	EEE/VMKVEC	sankarganesh@vmkv
2	Mr.N.P.Gopinath	Assistant Professor(Gr-II)	EEE/AVIT	Gopinathnp@avit.ac.i

	TRANSMISSION & DISTRIBUTION	Category	L	T	P	C
		CC	3	0	0	3

Preamble

It is concerned the function of different components used in Transmission and Distribution levels of power systems and modeling of the components, enrich with the fair knowledge in the recent trends in power Transmission and

PREREQUISITE: ELECTRO MAGNETIC THEORY

COURSE OBJECTIVES

1	To study the structure of electric power system and to develop expressions for the computation of transmission
2	To obtain the equivalent circuits for the transmission lines based on distance and to determine the voltage regulation and efficiency.
3	To study different types of insulators and constructional features of HT & LT cables.
4	To study the classification and functions of major components of substations.
5	To understand the structure of AC and HVDC Transmission systems and its various operating voltages.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Explain the importance and the functioning of transmission line parameters.	Understand
CO 2	Model the transmission lines and analyse their performance	Analyze
CO 3	Explain the knowledge of line insulators and underground cables.	Understand
CO 4	Describe the components of substation and grounding.	Understand
C0 5	Compare the HVDC and AC systems and analyse the performance of AC distribution	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	--	S	L	M	--	--	-	--	L	S	S	--
CO2	S	M	S	--	S	L	-	--	--	-	--	L	S	S	L
CO3	--	M	M	--	-	L	M	--	--	-	--	M	L	--	L
CO4	--	M	-	--	-	M	-	--	--	-	--	L	--	--	M
CO5	S	M	M	--	-	M	M	--	--	-	--	L	--	--	M

TRANSMISSION LINE PARAMETERS

Structure of electrical power system: Parameters of single and three phase transmission lines with single and double circuits: Resistance, inductance and capacitance of solid, stranded and bundled conductors: Symmetrical and unsymmetrical spacing and transposition - Application of self and mutual GMD - Skin and Proximity effects - Interference with neighboring communication circuits, Simple diagrams of typical towers and conductors for 400, 220 and 110 kV operations

MODELLING AND PERFORMANCE OF TRANSMISSION LINES

Classification of lines: Short line, medium line and long line - equivalent circuits, attenuation constant and phase constant, surge impedance, transmission efficiency and voltage regulation - Sag tension calculation: Factors affecting sag, Support at same level, Effect of ice and wind, Total length of conductor, Equivalent span, Support at different levels - Ferranti effect, Phenomena of corona and its losses.

LINE INSULATORS AND UNDERGROUND

Purpose and requirement of insulators – material for insulators – types of insulators – failure and testing of insulators – voltage distribution over a string of suspension insulators – string efficiency – equalization of potential across each unit – Corona and it's effect (problems in voltage distribution over a string of insulators)
Underground cables :- Advantages of cables – classification of cables– belted cable – oil filled cables – advantages and

SUBSTATION , GROUNDING SYSTEM AND DISTRIBUTION SYSTEM

Bus-bar arrangements – substation bus schemes – single bus, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker- and - a half with two main buses, double bus-bar bypass isolators. Importance of earthing in a substation. Qualitative treatment to neutral grounding and earthing practices in substations. Feeders, distributors and service mains. DC distributor – 2 - wire and 3 - wire, radial and ring main distribution. AC distribution - single phase and three phase 4 -wire distribution.

AC TRANSMISSION & HVDC TRANSMISSION

Typical layout of AC power supply scheme – influence of voltage on conductor materials – limits of line voltage – Kelvin's law – It's limitations – OH lines –line supports – various types of supports with their applications,
High voltage DC transmission – HVDC projects in INDIA and abroad – advantages and disadvantages of HVDC transmission – basics of protection of HVDC system.

TEXTBOOK

1. B.R.Gupta, 'Power System Analysis and Design', S.Chand, New Delhi, 2005.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
3. Veerappan.N and Krishnamurthi .S.R,' Power Systems Switch Gear and Protection' ,S.Chand Edition 2009.
4. Ravindranath, B and Chander, N, 'Power System Protection and Switchgear', Wiley Eastern Ltd., 1977

REFERENCES

1. Luces M.Fualkenberry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2. HadiSaadat, 'Power System Analysis,' Tata McGraw Hill Publishing Company', 2003.
3. V.K.Mehta,Rohit Mehta,' Principles of power system',S.Chand & Company Ltd, New Delhi,2013.
4. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi.
5. Wadhwa, C.L., 'Electrical Power Systems', New Age International (P) Ltd., Publishers, 1995.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Jensie Anita S		E	jensiepresley@avit.ac.in

	CONTROL SYSTEMS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

This course shall introduce the analysis and regulation of the output behaviors of dynamical systems subject to input signals. The course focuses primarily on using Laplace and frequency-domain techniques. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems. At the end of this course, one should possess in-depth knowledge of concepts from classical control theory, understand the concept of transfer function and use it for obtaining system response, analyze dynamic systems for their stability and performance, and design controllers (such as Proportional-Integral-Derivative) based on stability and performance requirements.

PREREQUISITE

Differential Equations and Transforms

COURSE OBJECTIVES

1	Understand the feedback and feed-forward control; apply representations of control systems.
2	To find time response of given control system model, various controllers design and simulation using MATLAB.
3	To understand the frequency domain analysis, use of frequency response methods for open loop and closed loop control systems.
4	To analyze the stability of systems using various methods and to design compensators.
5	To develop and analyze the state space models.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1	Find Transfer function of systems.	Understand
CO2	Find the time response of given control system model and to design a controller.	Create
CO3	Find the frequency response of control system model using frequency response plots.	Analyze
CO4	Analyze the stability of the control system and design the suitable compensators.	Create
CO5	Apply state space techniques to model control systems.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	S	M	-	-	-	-	-	M	M	S	M	-
CO2	S	M	-	M	S	-	-	M	-	-	-	M	S	M	S
CO3	S	M	-	M	S	-	-	-	-	-	-	M	S	M	-
CO4	S	M	-	M	S	-	M	-	-	-	M	M	S	M	S
CO5	S	M	-	M	S	L	L	-	M	-	M	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO CONTROL SYSTEMS

Basic elements in control systems – classifications of control systems – Mechanical Translational and Mechanical Rotational Systems, Electrical analogy– Transfer function – Block diagram reduction techniques – Signal flow graphs.

TIME RESPONSE ANALYSIS

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Effects of P, PI, PID modes of feedback control. Design and Simulation of time domain analysis using MATLAB.

FREQUENCY DOMAIN ANALYSIS

Frequency response analysis, Frequency domain specifications, Correlation between time and frequency responses, Bode Plot, Polar Plot, Constant M and N circles, Nichols chart, Design and Simulation of frequency domain analysis using MATLAB.

STABILITY ANALYSIS AND COMPENSATOR DESIGN

Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, Guidelines for sketching root locus , Nyquist stability criterion. Cascade Lag compensation, cascade Lead compensation and cascade Lag-Lead compensation

STATE VARIABLE ANALYSIS, AND APPLICATION OF CONTROL SYSTEMS

Introduction to State variable analysis: Introduction, Concept of State, State variables & State model, Equivalence between transfer function and state variable representations, Digital control design using state feedback. Synchros – AC servomotors- DC Servo motors.

TEXT BOOKS

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond. "Basic Control System Technology", Viva low priced student edition, 1998.
4. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley, 1995 (MATLAB Reference).
5. M. Gopal, "Control Systems: Principles and Design", 3rd Edition, McGraw, Hill, 2008
6. Nise N.S , " Control Systems Engineering", 6th Edition , Wiley India , 2016.

REFERENCES

1. Benjamin C Kuo, "Automatic Control system", Prentice Hall of India Private Ltd., New Delhi, 2009.
2. R.C. Dorf and R.H. Bishop, "Modern Control Systems", 12th Edition, Prentice, Hall, 2010.
3. http://www.mathworks.com/access/helpdesk/help/toolbox/control/
4. Control Systems - N. K. Sinha, New Age International (P) Limited Publishers.
5. S.N.Sivanandam, S.N.Deepa, Control System Engineering using Mat Lab, 2nd Edition, Vikas Publishing, 2012.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	e-mail id
1	D.SARANYA	Assistant Professor (Gr-II)	EEE / AVIT	dsaranya@avit.ac.in
2	R. SATHISH	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in

	POWERSYSTEMANALYSIS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To understand the necessity and to become familiar with the modeling of power system and components and to apply different methods to analyse power system for the purpose of system planning and operation.

PREREQUISITE: Transmissions and Distributions

COURSEOBJECTIVES

1	To model the power system under steady state operating condition.
2	To study the power flow models and apply efficient numerical methods to solve the power flow problem
3	To model and analyse the power systems under abnormal(or)fault conditions.
4	To model & analyse the transient behavior of power system when it is subjected to a fault.
5	TothestudytheImportanceofstabilityanalysisinpowersystemplanningandoperation.

COURSEOUTCOMES

On the successful completion of the course, students will be able to

CO1:Describe the modeling of power system and components.	Understand
CO2:Solve an solution of Load flow problems.	Apply
CO3:Examine the various types of Symmetrical faults.	Analyze
CO4:Examine the various types of Unsymmetrical faults.	Analyze
CO5:Explain the importance of stability analysis in power system planning and operation.	Understand
CO6:Classification of types of stability.	Understand

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	--	S	L	--	--	--	--	L	--	S	S	M
CO2	S	S	M	--	S	--	--	--	L	--	S	M	S	S	M
CO3	S	S	S	--	S	M	M	--	M	--	S	--	S	S	M
CO4	S	S	S	--	S	M	S	--	S	--	S	--	S	S	M
CO5	S	S	L	--	S	--	--	--	--	--	S	S	--	M	--
CO6	S	L	L	L	S	--	--	--	--	--	S	M	S	M	--

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTION

Need for system planning and operational studies – basic components of a power system. Generator models - Transformer model- Transmission system model - load representation. Single line Diagram – per phase and per unit representation–change of base. Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix.

POWERFLOWANALYSIS

Importance of power flow analysis in planning and operation of power systems -statement of power flow problem - classification of buses- development of power flow model in complex variables form and polar variables form- iterative solution using Gauss-Seidel method -Q-limit check for voltage controlled buses – algorithm and flow chart-iterative solution using Newton-Raphson method – algorithm and flow chart.

FAULTANALYSIS–BALANCED FAULTS

Importance of short circuit analysis - assumptions in fault analysis-analysis using Thevenin's theorem-Z-bus building algorithm- fault analysis using Z-bus – algorithm and flow chart- computations of short circuit capacity, post fault voltage and currents.

FAULT ANALYSIS–UNBALANCEDFAULTS

Introduction to symmetrical components – sequence impedances – sequence circuits of synchronous machine-sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis - problem formulation – analysis using Z-bus impedance matrix–algorithm and flowchart.

STABILITYANALYSIS

Importance of stability analysis in power system planning and operation – classification of power system stability - angle and voltage stability- Single Machine Infinite Bus(SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time –solution of swing equation by modifiedEulermethodandRunge-Kuttasecondordermethod.Algorithmandflowchart.

TEXT BOOKS

1. HadiSaadat,'Power System Analysis',TataMcGrawHill PublishingCompany,NewDelhi,2002.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi,SecondEdition, 2003.

REFERENCES

1. P.Kundur,'PowerSystem StabilityandControl,TataMcGrawHill,Publications,1994.
2. JohnJ.Grainger andW.D.Stevenson Jr., 'Power System Analysis', McGrawHillInternationalBookCompany,1994.
3. I.J.Nagrath and D.P.Kothari, 'Modern Power System Analysis', TataMcGraw-HillPublishingCompany, NewDelhi,1990.
4. .K.NagasarkarandM.S.SukhijaOxfordUniversityPress,2007

COURSEDESIGNERS

S.No.	NameoftheFaculty	Designation	Department	MailID
1	Dr.V.MANJULA	AssistantProfessor	EEE/VMKVEC	manjula@vmkvec.edu.in
2	S.PRAKASH	Assistant Professor(Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	MICROCONTROLLER BASED SYSTEM DESIGN & EMBEDDED SYSTEM DESIGN (Theory & Practicals)	Category	L	T	P	Credit
		CC	3	0	2	4

PREAMBLE

Embedded systems course is continuous of the Microprocessor and Microcontrollers, is intended to Design, Implementation and Test of embedded applications. This includes system requirements specifications, architectural and detailed design, and implementation, focusing on real-time applications. Learning the concepts will be enforced by a Project to design and develop an embedded system based on a single-chip microcontroller and to know complete Operating Systems, RTOS

PREREQUISITE : Analog and Digital Circuits

COURSE OBJECTIVES

1	Explore the fundamentals of microcontroller based system design
2	Organize the Arm Processor Embedded Firmware
3	Acquire knowledge of I/O and RTOS role on microcontroller
4	Perform various tasks in designing the Embedded System Design in RTOS
5	Handle the development and debugging tools in Embedded Systems

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Explain fundamentals of microcontroller based system design	Understand
CO2. Discuss the Arm Processor Embedded Firmware	Understand
CO3. Illustrate the I/O and RTOS role on microcontroller	Analyze
CO4. Examine the tasks in designing the Embedded System Design in RTOS	Analyze
CO5. Develop and debug tools in Embedded Systems	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	M	-	-	-	-	-	-	-	S	M	-
CO2	S	S	M	-	M	-	-	-	M	-	-	M	S	M	-
CO3	S	S	M	-	M	-	-	-	M	-	-	M	S	M	-
CO4	S	S	M	-	M	-	-	-	M	-	-	M	S	M	-
CO5	S	S	M	-	M	-	-	-	M	-	-	M	S	M	-
S- Strong; M-Medium; L-Low															

Syllabus

REVIEW OF 8051&TYPICAL EMBEDDED SYSTEM

Introduction to Embedded System. Architecture, 8051- CPU Block diagram, MemoryOrganization, Program memory, Data Memory, Interrupts Peripherals: Timers, Serial Port,I/O Port Programming: Addressing Modes, Instruction Set, Programming Timing Analysis Casestudy with reference to 8-bit 8051 Microcontroller.

Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces & Experiments

ARM PROCESSOR ORGANIZATION&EMBEDDED FIRMWARE

ARM9 Microcontroller Architecture-Block Diagram, Features, Memory Mapping MemoryController (MC)-External Bus Interface (EBI)-External Memory Interface-Interrupt Controller-System Timer (ST- Real Time Clock (RTC) Parallel Input/output Controller (PIO)Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, RealTime Clock, Watchdog Timer, Embedded Firmware Design Approaches and DevelopmentLanguages.

RTOS BASED EMBEDDED SYSTEM DESIGN

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multi-tasking, Task Scheduling.

TASK COMMUNICATION

Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

DEVELOPMENT & DEBUGGING TOOLS FOR MICROCONTROLLER BASED EMBEDDED SYSTEMS

Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyser & Experiments

Text Books:

1. Intel Hand Book on “Embedded Microcontrollers”, 1st Edition
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, “The 8051Microcontroller and Embedded Systems using Assembly and C”, 2e, PHI
3. ARM Company Ltd. “ARM Architecture Reference Manual– ARM DDI 0100E”
4. David Seal “ARM Architecture Reference Manual”, 2001 Addison Wesley, England; Morgan Kaufmann Publishers
5. Andrew N Sloss, Dominic Symes, Chris Wright, “ARM System Developer's Guide -Designing and Optimizing System Software”, 2006, Elsevier
6. Ayala, Kenneth J “8051 Microcontroller - Architecture, Programming &Applications”, 1st Edition, Penram International Publishing

COURSE DESIGNERS				
S.No	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.T.Muthumanickam	Professor	ECE	muthumanickam@vmkvec.edu.in
2	Dr.T.Sheela	Associate Professor	ECE	sheela@vmkvec.edu.in

	POWER SYSTEM PROTECTION AND SWITCHGEAR	Category	L	T	P	Cred
		CC	3	0	0	3

PREAMBLE

The course aims to impart fundamental knowledge on various abnormal operating conditions in power system anddescribe the apparatus and system protection schemes, phenomena of current interruption and various switchgears.

PREREQUISITE – Electrical Machines-I and Electrical Machines-II

COURSE OBJECTIVES

1	To study about the Causesofabnormaloperatingconditions(faults,lightningand switchingsurges)of theapparatusandsystem.
2	To analyze the Characteristicsandfunctions ofrelays andprotection schemes.
3	To study about the Apparatusprotection,staticandnumericalrelays.
4	To realize the Functioningofcircuitbreaker.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: findthecausesofabnormaloperating conditionsof theapparatusand system.	Apply
CO2: understandandanalyzethe Electromagnetic and StaticRelays.	Analyze
CO3: recommendthesuitable protection scheme for electrical apparatus.	Apply
CO4: studyaboutthestatic and numericalrelays.	Understand
CO5: suggestsuitabilitycircuitbreaker.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	M	S	L	-	-	-	-	L	S	M	-
CO2	S	S	M	S	M	S	L	L	-	-	L	L	S	M	-
CO3	S	M	S	S	M	S	L	-	-	-	-	-	S	M	-
CO4	S	L	L	M	M	S	L	L	-	-	L	L	S	M	-
CO5	S	S	S	S	M	S	L	-	-	-	-	L	S	M	-

S-Strong; M-Medium; L-Low

SYLLABUS

PROTECTION SCHEMES

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.

ELECTROMAGNETIC RELAYS

Operating principles of relays – the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

APPARATUS PROTECTION

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

STATIC RELAYS AND NUMERICAL PROTECTION

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

CIRCUIT BREAKERS

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 – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TEXT BOOKS:

1. SunilS.Rao,‘Switchgearand Protection’, KhannaPublishers,NewDelhi,2008.
2. B.RabindranathandN.Chander,‘PowerSystemProtectionandSwitchgear’,NewAgeInternational(P)Ltd.,FirstEdition 2011.
3. ArunIngole,‘SwitchGear andProtection’PearsonEducation,2017.

REFERENCE BOOKS:

1. BadriRam,B.H.Vishwakarma,'PowerSystemProtectionandSwitchgear',NewAgeInternationalPvt LtdPublishers,SecondEdition2011.
2. Y.G.PaithankarandS.R.Bhide,'Fundamentalsofpowersystemprotection',SecondEdition,Prentice Hall ofIndiaPvt.Ltd.,NewDelhi,2010.
3. C.L.Wadhwa, 'ElectricalPowerSystems', 6thEdition, NewAgeInternational(P)Ltd.,2010
4. RavindraP.Singh,'SwitchgearandPowerSystemProtection',PHILearningPrivateLtd.,NewDelhi, 2009.
5. VKMetha,"PrinciplesofPowerSystems"S.Chand, 2005.
6. BhaveshBhalja,R.P.Maheshwari,NileshG.Chotani,'ProtectionandSwitchgear'OxfordUniversityPress ,2011.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Devarajan	Professor	EEE/VMKVEC	devarajan@vmkvec.edu.in
2	Mr. R. Sathish	Assistant Professor	EEE/VMKVEC	sathsih@vmkvec.edu.in
3	Ms. D. Saranya	Assistant Professor (Gr-II)	EEE/AVIT	dsaranya@avit.ac.in
4	Mr. S. Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	SEMICONDUCTOR DEVICES AND CIRCUITS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The goal of this lab is to supplement the theory course Semiconductor Devices & Circuits. Students will gain experience by examining the characteristics of various semiconductor devices such as Diodes, BJTs & FETs. To improve ability of students to design the analog circuits with which services for many practical applications.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To understand the characteristics of a Diodes
2	To obtain the characteristics and parameters of transistors BJT/FET.
3	To find the frequency response of feedback amplifiers.
4	To study the performance of waveform generator and wave shaping circuits.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Experiment the characteristics of BJT's & FET's with various configurations	Apply
CO2. Determine ripple factor for the half wave & full wave Rectifier circuits and test with simulation tools	Apply
CO3. Determine the frequency of Feedback amplifiers and test with simulation tools	Apply
CO4. Classify the waveforms of Wave shaping circuits & Feedback amplifiers circuits and test with simulation tools	Analyze
CO5.Determine the efficiency of Power & Tuned amplifiers	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	-	-	-	-	-	-	-	L	M	-	-
CO2	S	M	M	M	M-	-	-	-	L	-	L	L	M	-	-
CO3	S	S	M	M	M	-	-	-	L	-	L	L	S	L	L
CO4	S	S	M	M	M	-	-	-	L	-	L	L	S	M	L
CO5	S	M	M	M	-	-	-	-	L	-	-	L	S	M	L
S- Strong; M-Medium; L-Low															

SYLLABUS

LIST OF EXPERIMENTS

1. Plot the input and output characteristics of a BJT Configuration and to compute the h – parameters

a)Common Emitter, b) Common Base

2. Obtain the Drain characteristics and Transfer characteristics & find the Trans-conductance, Drain resistance and Amplification factor of JFET.
3. Simulation & Hardware realization of Half wave & Full wave Rectifier with, without Filter and determine the efficiency
4. Simulation & Hardware realization of Clipping & Clamping circuits for given reference Voltage levels.
5. Simulation & Hardware realization of Voltage Series Feedback amplifiers and its frequency analysis
6. Design and simulation of Power amplifiers and calculate the efficiency
7. Design and obtain frequency Response the characterization of Single Tuned amplifierCircuit.
8. Construct series voltage regulator and obtain load and line regulation characteristics
9. Construct shunt voltage regulator and obtain load and line regulation characteristics
10. Mini project.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mr.S.Selvaraju	Associate Professor	ECE	selvaraju@vmkvec.edu.in
2	Dr.R.Ramani	Assistant Professor	ECE	ramani@vmkvec.edu.in

	ELECTRICAL MACHINES-I LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To acquire knowledge on the working of various DC machines and Transformers.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To obtain the performance and characteristics of Electrical machines.
2	To gain knowledge about speed control techniques on DC Machines
3	To compute the efficiency and regulation of a single-phase transformer.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO 1: Study the performance characteristics of different types of DC machines. Apply	Understand
CO 2: Compute the efficiency and regulation of a single-phase transformer. Analyze	Understand
CO 3: Testing of Transformer for Modelling Evaluate	Understand
CO4: Testing of a DC Machine and to monitor the efficiency. Evaluate	Analyse
CO 5: Explain the Transformer connections	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	POS2	POS3
CO1	S	L	M	-	-	-	-	-	S	L	L	L	S	M	-
CO2	S	L	M	-		L	L	-	S	L	L	M	S	M	-
CO3	S	L	M	-	-	L	L	-	S	L	L	M	S	M	L
CO4	S	L	M	L	L	L	L	-	S	L	L	L	S	M	L
CO5	S	L	M	-	-	-	-	--	S	L	L	L	S	M	-

S-STRONG.M-MEDIUM,L-LOW

LIST OF EXPERIMENTS

1. Load test on DC shunt motor.
2. Load test on DC series motor.
3. Speed control of DC shunt motor.
4. Open circuit and load characteristics of DC generator (Self and Separately Excited).
5. Load test on dc compound generator.
6. Load test on single phase transformer.
7. Open circuit & Short circuit test on single phase transformer.
8. Swinburne's test.
9. Separation of Losses in single phase transformer.
10. Hopkinson's test.
11. Sumpner's test on 1-phase transformer.
12. Study of three phase transformer connections.
13. Study of DC Starters.

Reference Books

Laboratory Reference Manual

SNO	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	Mail.id
1	A.BALAMURUGAN	ASSOCIATE –PROFESOR	VMKVEC	balamurugan@vmkvec.edu.in
2				

	ELECTRICAL MACHINES – II LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

The course provides basic knowledge about the AC machines and to provide opportunity to identify and analyze the various performance factors in different load and no-load conditions

COURSE OBJECTIVES

1	To determine the voltage regulation of an alternator from test data and analyze the effect of various factors such as armature resistance, armature reactance, leakage reactance and power factor on regulation.
2	To formulate of two reaction model of salient pole synchronous machines from test data and predetermine the voltage regulation using quadrature axis and direct axis reactance.
3	To determine the performance of single phase and three phase induction motor from test data and analyze the effect of speed, power factor, line current and efficiency under different loading conditions.
4	To employ the different starting and speed control methods of three phase induction motor.
5	To study about construction and principle operation of Linear and Synchronous induction motor.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1:Predetermine the regulation of Alternator.	Remember
CO2: Analyze the Performance and plot the characteristics of Alternator at different load conditions.	Analyze
CO3:Determine the effect of excitation on armature current and power factor of synchronous motor.	Understand
CO4: Evaluate the performance of three phase induction motor through the load characteristics and circle diagram.	Evaluate
CO5: Apply the suitable speed control method for any specifical applications.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	M	-	-	-	-	L	-	L	L	-
CO2	S	M	L	-	L	M	-	-	-	-	M	-	L	M	-
CO3	S	M	L	S	L	M	-	-	-	-	M	-	L	M	-
CO4	S	L	M	S	L	M	-	-	-	-	L	-	L	M	-
CO5	S	M	S	-	-	-	-	-	-	-	L	-	-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

Sl No	LIST OF EXPERIMENTS
1	Regulation of 3-phase Alternator by EMF and MMF methods.
2	Regulation of 3-phase Alternator by ZPF and ASA method.
3	Slip test on 3-phase Alternator.
4	Load characteristics of 3-phase Alternator by bus bar loading
5	V and inverted V curve of Synchronous motors.
6	Load test on 3-phase Induction motor
7	Load test on 1-phase Induction motor.
8	No load and Blocked Rotor test on three phase induction motor.
9	Equivalent circuit and pre – determination of performance characteristics of single-phase Induction motor.
10	Separation of losses in three-phase induction motor.
11	Speed control of three phase induction motor
12	Study of Servo motor , PMDC & PMAC motor, Linear induction motor and Synchronous Induction motor.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.G.Ramakrishnaprabu	Associate Professor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
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3.	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	CONTROL SYSTEMS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

Control Systems simulation Lab consists of multiple workstations, each equipped with an oscilloscope, digital multi-meter, PID trainers, control system trainers and stand alone inverted-pendulum, ball and beam control, magnetic-levitation trainers. This lab also covers the industrial implementation of advanced control systems via different computer tools such as MATLAB and Simulink.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response
2	To assess the system performance using time domain analysis and methods for improving it
3	To assess the system performance using frequency domain analysis and techniques for improving the performance
4	To design various controllers and compensators to improve system performance

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1	How to improve the system performance by selecting a suitable controller and/or a compensator for a specific application	Understand
CO2	Apply various time domain and frequency domain techniques to assess the system performance	Apply
CO3	Apply various control strategies to different applications(example: Power systems, electrical drives etc)	Analyze
CO4	Test system controllability and observability using state space representation and applications of state space representation to various systems	Analyze and Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	M	S	-	-	-	M	L	-	L	S	M	S
CO2	S	S	L	M	S	-	-	L	M	L	M	-	S	M	-
CO3	S	S	S	M	S	-	L	-	M	L	-	M	S	M	S
CO4	S	S	-	M	S	L	-	-	M	L	-	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Transfer function of self and separately excited DC Generator.
2. Transfer function of Armature and Field controlled DC Motor.
3. Transfer function of AC Servomotor.

4. Frequency response of Lag, Lead & Lag – Lead networks.
5. Characteristics of Synchronous transmitter and Receiver.
6. Transfer function of Ward – Leonard method of speed control of DC motor.
7. Study of P, PI and PID Controllers (First Order).
8. Simulate DC Position Control system and obtain its step response
9. Analog and simulation of type – 0 and type – 1 systems
10. Stability analysis of Linear Systems
11. Simulation of first order systems using MATLAB/ SCILAB
12. Simulation of second order systems using MATLAB/ SCILAB

COURSE DESIGNERS

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1.	R. SATHISH	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
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	POWER SYSTEM SIMULATION LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To acquire software development skills and experience in the usage of standard packages necessary for analysis and simulation of power system required for its planning, operation and control.

PREREQUISITE:NIL

COURSEOBJECTIVES

1	To study the power system planning and operational studies.
2	To study the Formation of bus admittance and impedance matrices and network solutions.
3	To study the Power flow solution of small systems using simple method, Gauss-Seidel P.F. method.
4	To study the Economic Dispatch and State estimation.
5	To acquire experience in the usage of standard packages for the following analysis/simulation/control functions

COURSEOUTCOMES

On the successful completion of the course, students will be able to

CO1:Explainthepowersystemplanningandoperationalstudies	Understand
CO2:Explaintheprocedure of bus admittance and impedance matrices and network solutions.	Understand
CO3:Solve the Power flow problems using GS and NR method.	Analyze
CO4:Detect Symmetrical and Unsymmetrical fault.	Analyze
CO5:Describe the Economic dispatch and State estimation.	Understand
CO6:DesigntheElectromagnetictransientcircuits.	Create

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	-	-	-	-	-	-	-	S	S	M
CO2	S	S	S	-	S	-	-	-	M	M	-	-	S	S	M
CO3	S	S	S	-	-	-	-	-	-	-	-	-	S	S	M
CO4	-	S	-	-	S	-	-	-	M	M	-	-	S	S	M
CO5	S	S	S	-	-	-	-	-	-	-	S	-	S	S	M
CO6	S	-	S	-	S	-	-	-	-	-	-	-	S	S	M

S-Strong;M-Medium;L-Low

LISTOFEXPERIMENTS

1. Computation of Parameters and Modeling of Transmission Lines.
2. Formation of Network Matrices and Solution of Networks.
3. Power Flow Analysis Using Gauss-Seidel Method.
4. Power Flow Analysis Using Newton-Raphson Method.
5. Symmetric and unsymmetrical fault analysis.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
7. Load-Frequency Dynamics of Single and Two-Area Power Systems.
8. State estimation: Weighted least square estimation.
9. Economic Dispatch in Power Systems.
10. Electromagnetic Transients in Power Systems.

REFERENCEBOOKS

1. Laboratoryreferencemanual.

OURSEDESIGNERS

No.	NameoftheFaculty	Designation	Department	MailID
1	DR.V.MANJULA	AssistantProfessor	EEE/VMKVEC	manjula@vmkvec.edu.in
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	HIGH VOLTAGE ENGINEERING	Category	L	T	P	Credit
		EC –PS	3	0	0	3

PREAMBLE

The course provides to get a fair knowledge about the generation of high voltages and currents. An understanding of high voltage phenomena, and to present the basics of high voltage insulation design and techniques. The course comprehends the concept of solid, liquid and gaseous dielectrics. The itineraries produce the method on generation and measurement of high voltages and currents. It gains knowledge in testing of high voltage equipments and the basics of high voltage laboratory techniques.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understanding of high voltage technology and its applications, Insulation design in general and protection of OH lines
2	To Understand breakdown mechanisms in solids, liquids and gases
3	Analyze transient over voltages and design protection .
4	To analyze the stability of closed and open loop systems using various methods and to design compensators,
5	To Apply diagnostic tests to examine the quality of insulation and apply statistic approach to analyze testing data

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1	Identify the causes and effects of over voltages and protection of power system against over voltages.	Understand
CO2	Classify the different breakdown mechanisms in Gases, liquids and solids.	Analyze
CO3	Describe the principle of generation of high DC, AC and impulse voltages.	Understand
CO4	Explain the various measurement techniques of high voltages and high currents.	Analyze
CO5	Scrutinize the Measurement of High AC , DC and Impulse Voltages and Currents	Analyze
CO6	Testing of high voltage electrical power apparatus	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	M		S	S		L	L	M	L	M	S	S
CO2	M	S	M	M	L		M	L			S	M	S	L	L
CO3	L	L	S			L			M				M	L	
CO4	L							M		L	L	M			
CO5	S		M		L			M			M	M			M
CO6	S	L	L	L	S	L	L	S	M	M	S	S	S	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS AND INSULATION COORDINATION

High Voltage classification - Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – protection against over voltages - Principles of insulation co-ordination.

ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS

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.

GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS

Generation of High DC, AC, impulse voltages and currents – Tripping and control of impulse generators.

MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS

Measurement of High voltages and High currents – Digital techniques in high voltage measurement.

HIGH VOLTAGE TESTING OF ELECTRICAL POWER APPARATUS

Testing of Insulator - Bushings - Isolators, Circuit breakers – Cables – Transformers –Surge Arresters – Tan Delta measurement – Partial Discharge measurement – Radio interference measurement – Case Studies.

TEXT BOOKS

1. M. S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill,1995.
2. Kuffel,E and Zaengl, W.S, 'High Voltage Engineering Fundamentals', Pergamon Press, Oxford , Londan,1986
3. High voltage engineering, Farouk A M Rizk; Giao N Trinh, CRC Press, [2014] ©20 ©2014

REFERENCES

1. E. Kuffel, W. S. Zaengl and J.Kuffel, "High Voltage Engineering Fundamentals", 2nd Edition,

Butterworth – Heinmann Publisher, 2000.
2. L. L. Alston, 'High Voltage Technology', 1st Edition, Oxford University Press, 1968.
3. T.J.Gallagher and A.J Pearmain, "High Voltage Measurement, Testing and Design", 2nd Edition, Wiley, New York, 2007.
4. C.L Wadwa, "High Voltage Engineering", 3rd Edition, New Age International, New Delhi, 2012.
5. R.D. Begamudre, "High Voltage Engineering (Problems and Solution)", 1st Edition, New Age International, New Delhi, 2010.

COURSE DESIGNERS

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	POWERSYSTEMOPERATIONANDCONTROL	Category	L	T	P	Credit
		EC –PS	3	0	0	3

PREAMBLE

To become familiar with the preparatory work necessary form meeting the next day's power system operation and the various control actions to be implemented on the system to meet the minute-to-minute variation of system load.

PREREQUISITE:Nil

COURSEOBJECTIVES

1	Have an overview of system load variation, reserve requirements, operation and control of power system.
2	Give an insight into the role of speed governing mechanism in load frequency control, concept of control area, modeling and analysis of load frequency control loop.
3	Give knowledge of excitation systems and the methods of voltage control.
4	Study the economic dispatch of generated power.
5	Provide adequate knowledge of the functions of energy control center, SCADA system and the security control.

COURSEOUTCOMES

On the successful completion of the course, students will be able to

CO1:Define the load curves and load duration curve.	Understand
CO2:Apply real power control, reactive power control to different cases	Apply
CO3:Explain the techniques to control power flows, frequency and voltage.	Understand
CO4:Solve Economic dispatch, Unit commitment problems at different loads using Conventional and modern methods.	Apply
CO5:Define computer control of power system	Understand
CO6:Design the controllers to maintain power system reliability	Create

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	--	--	S	--	--	--	--	--	--	--	S	M	M
CO2	--	S	S	--	--	--	--	--	--	--	--	--	S	S	M
CO3	--	--	--	M	M	--	--	--	--	--	-	--	S	M	M
CO4	S	S	S	-	S	--	--	--	--	--	--	--	S	S	M
CO5	--	--	--	--	S	--	--	--	--	S	--	--	--	S	S
CO6	--	--	--	M	M	--	--	--	--	--	--	--	S	--	--

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTION

System load – variation - load characteristics - load curves and load-duration curve (daily, weekly and annual) - load factor - diversityfactor.Importanceofloadforecastingandsimpletechniquesofforecasting.Anoverviewofpowersystemoperationandcontrolandtheroleofcomputersintheimplementation.(Qualitativetreatmentwithblockdiagram).

REALPOWER-FREQUENCYCONTROL

Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single-area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two-area system – modeling – static analysis of uncontrolled case - tie line with frequency bias control of two-area system-state variable model.

REACTIVEPOWER–VOLTAGECONTROL

Basics of reactive power control. Excitation systems – modeling. Static and dynamic analysis - stability compensation - generation and absorption of reactive power. Relation between voltage, power and reactive power at a node - method of voltage control – tap changing transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

COMMITMENTANDECONOMICDISPATCH

Statement of economic dispatch problem – cost of generation – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ- iteration method. (No derivation of loss coefficients).Statement of Unit Commitment problem –constraints; spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods -Priority-list methods –forward dynamic programming approach. Numerical problems only in priority-list method using full-load average production cost.

COMPUTERCONTROLOFPOWERSYSTEMS

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions – system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology – state estimation - security analysis and control. Various operating states (Normal, alert, emergency, in-extremis and restorative). State transition diagram showing various state transitions and control strategies.

TEXT BOOKS

1. Allen.J.WoodandBruce F.Wollenberg,'PowerGeneration,OperationandControl',JohnWiley& Sons,Inc., 2003.
2. Chakrabarti&Halder,"PowerSystemAnalysis:OperationandControl",PrenticeHallofIndia,2004Edition.

REFERENCEBOOKS

1. D.P.KothariandI.J.Nagrath,'ModernPowerSystemAnalysis',ThirdEdition,TataMcGrawHillPublishingCompanyLimited,NewDelhi,2003.(For Chapters1,2&3)
2. L.L. Grigsby,'TheElectric PowerEngineering,HandBook',CRCPress& IEEE Press,2001.
3. HadiSaadat, "PowerSystemAnalysis",(Forthe chapters1,2,3and4)11thReprint2007.
4. P.Kundur,'Power SystemStabilityandControl' MCCrawHillPublisher,USA,1994.
5. Olle.I.Elgerd,'ElectricEnergySystemstheoryanintroduction'TataMcGrawHillPublishingCompanyLtd.New Delhi,SecondEdition2003.

COURSEDESIGNERS

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	POWER QUALITY AND FACTS	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE

This course imparts knowledge about various electrical power quality issues and emphasis the need for PQ monitoring and measurement. To develop the knowledge in the area of FACTS controller using different techniques.

PREREQUISITE: Nil

COURSEOBJECTIVES

1	Describe the various power quality issues.
2	Identify the root cause of power quality problems.
3	Interpret the need for PQ monitoring and measurement.
4	To Study about working principle, Different modes of operation and application soft thyristors controlled series capacitor.
5	To Study the different voltage source converters based FACTS controllers.

COURSEOUTCOMES

On the successful completion of the course, students will be able to

CO1: Explain the various power quality problems.	Understand
CO2: Discuss the root cause of power quality problems.	Understand
CO3: Discuss the need for PQ monitoring and measurement.	Understand
CO4: Design and modeling of various FACTS Controllers	Create
CO5: Predict the impact of FACTS controllers on AC transmission system.	Analyze

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	--	--	--	--	--	--	--	L	--	--	--	--
CO2	M	L	--	--	--	--	--	--	--	--	--	--	--	L	--
CO3	M	L	--	--	L	--	--	--	--	M	M	L	--	S	L
CO4	S	M	S	--	--	--	--	--	--	--	--	--	S	S	M
CO5	M	--	--	S	--	M	--	--	--	--	--	--	--	M	--

S-Strong;M-Medium;L-Low

SYLLABUS

Introduction

Power quality-Impact of PQ on end users, Need for PQ monitoring, Various PQ Problems

Voltage disturbances

Voltagedips,overvoltages,shortsupplyinterruptions,voltagefluctuations and flicker-sources, effects, measurement and mitigation

Transients

Transientsystemmodel,examplesoftransientmodelsandtheirresponse,powersystemtransientmodel,typesandcauses of transients, lightning, other switching transients.

Voltage and Current Unbalance

Symmetricalcomponentsofcurrentsandvoltages,sources,effects,measurementsandmitigation

Solving power quality problems using CPD

Power quality measuring equipment-Smartpowerqualityanalyzers,Introductiontocustompowerdevices(CPD)– STATCOM,DVR,UPQC.

THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC)ANDAPPLICATIONS

Operation of the TCSC – Different modes of operation – Modeling of TCSC – Variable reactance model – Modeling for Power Flow and stability studies. Applications: Improvement ofthesystemstabilitylimit–Enhancementofsystemdamping-SSRMitigation.

VOLTAGESOURCECONVERTERBASEDFACTS CONTROLLERS

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability – Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –ModelingofSSSCinloadflowandtransientstabilitystudies.Applications:SSRMitigation-UPFCand IPFC.

TEXT BOOKS

1.SankaranC,"PowerQuality",CRCPress specialIndianedition2009.

2.K.R.Padiyar,"FACTSControllersinPowerTransmissionandDistribution",NewAgeInternational(P) Limited, Publishers, New Delhi, January2016.

3.R.MohanMathur,Rajiv K. Varma," Thyristor– Based Facts Controllers for ElectricalTransmissionSystems",IEEEpressandJohnWiley&Sons,January2011.

REFERENCE BOOKS

1. Roger.C.Dugan,MarkF.Mcgranaghan &H.WayneBeaty," Electrical power system Quality" McGraw-HillNewyorkSecondedition2003.

2. Math H.J.Bollen, « Understanding Power Quality Problems : Voltage Sags and Interruptions », IEEE Press, NewYork, 2000.

3.EwaldFuchs MohammadMasoum,"PowerQualityinPowerSystemsandElectricalMachines"2nd Edition, AcademicPress,ISBN:9780128007822,2015.

4. NarainG.Hingorani, "UnderstandingFACTS– ConceptsandTechnologyofFlexibleACTransmissionSystems",StandardPublishersDistributors,NewDelhi,March2011.

COURSE DESIGNERS				
S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.V.MANJULA	Assistant Professor	EEE/VMKVEC	manjula@vmkvec.edu.in
2	S.PRAKASH	Assistant Professor(Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	SPECIAL ELECTRICAL MACHINES	Category	L	T	P	
		EC- PS	3	0	0	

PREAMBLE:

This courseaims to impart in students, a good understanding of fundamental p ofdifferent types of special machines. Thecourse includes constructional details, operating p motorcharacteristics,microprocessorbasedcontrollers andapplicationsofvarious typesofspecialmachines.

PREREQUISITE:Nil

COURSEOBJECTIVES

1	Tounderstandtheconstruction,principleofoperation,torqueequation,drivercircuits&applicationsof Synchronousreluctancemotors.
2	Tostudytheconstruction,principleofoperation,torqueequation,drivercircuits&applicationsof Steppermotors.
3	Tounderstandtheconstruction,principleofoperation,torqueequation,drivercircuits&applicationsof Switchedreluctancemotors.
4	Tostudytheconstruction,principleofoperation,torqueequation,drivercircuits&applicationsof Permanentmagnetsynchronousmotors.
5	Tounderstandtheconstruction,principleofoperation,torqueequation,drivercircuits&applicationsof PermanentmagnetbrushlessDCmotors.

COURSEOUTCOMES

On the successfulcompletionofthecourse,studentswillbeable to

CO1:InterpretthebasicconstructionandoperatingprincipleofSynchronousReluctanceMotor, SRM,Steppermotor,PMSM andPMBLDCMotor	Un
CO2:Predict themotorcharacteristics,powerinputandtorquedevelopmentinSynchronousReluctance Motor,SRM,Steppermotor,PMSM andPMBLDCMotor.	Un
CO3:Illustrate thedrivesystemsandcontrolschemesforSteppermotors,SRM,PMSMandPMBLDCMotor.	Ar
CO4:Determinethe suitablespecialpurposemotorforthe specific application	Ap
CO5:ExaminetheMicroprocessorbasedcontrolofSteppermotors,SRM,PMSMandPMBLDCMotor.	A
CO6: Summarize permanent magnet materials and magnetic characteristics.	Un

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO
CO1	M	L	-	-	-	-	-	-	-	-	M	-	-	-
CO2	M	L	-	L	-	-	-	-	-	-	M	-	-	L
CO3	S	M	M	M	M	-	L	-	M	L	S	-	-	S
CO4	S	M	M	L	-	-	-	-	-	-	M	L	-	M
CO5	M	L	-	M	S	-	L	-	M	-	S	L	-	S
C06	S	-	M	L	-	-	L	-	-	-	M	L	M	-

S-Strong;M-Medium;L-Low

SYLLABUS

SynchronousReluctanceMotors

Constructional features - Operating principles - Types - Axial and Radial flux motors - Reluctance torque-Torque equation-characteristics-Syncreldrivesystem-Phasordiagram-Applications.

Steppermotors

Constructional features - Principle of operation - Torque production in Variable Reluctance (VR) stepper motor - Hybrid motor - Multi stack configuration - Modes of excitations - Characteristics - Drive circuits - Closed loopcontrol-Microprocessorcontrolofsteppingmotors-Applications.

SwitchedReluctanceMotors

Constructional features - Principle of operation - Rotary andLinear SRMs - Torque equation- Modes ofoperation-Powerconvertercircuits-ClosedloopcontrolofSRMdrive-Microprocessorcontrolof SRMdrive -Sensorless controlofSRM drive-Characteristics-Applications.

PermanentMagnetBrushless DCMotors

Permanent magnet materials - Magnetic characteristics - Comparison between PMBLDC motor and Conventional DC motor - Constructionalfeatures-Principleofoperation– Classifications– Rotor position sensors - EMFandtorqueequations- - Controller for PMBLDC motor - - Mechanical and Electronic commutators - - Torque-speedcharacteristics-Magneticcircuitanalysis-SensorlesscontrolofBLDC motors-Applications.

PermanentMagnetSynchronous Motors

Evolution of Synchronous Motor - Constructionalfeatures- Principleof operation- EMFandTorqueequations-Armaturereaction EMF-Sinewavemotorwithpracticalwindings-Phasordiagram-Torque/speedcharacteristics - Power controllers - Comparison of Permanent magnet excitation and Electromagnetic excitation - Microprocessor based control ofPMSM -Applications.

TEXTBOOKS:

1. BimalK.Bose,"ModernPowerElectronics andACDrives",PrenticeHall,NewDelhi,2005.
2. Gopal K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House Pvt.Ltd.,New Delhi, Secondedition,2015.

REFERENCEBOOKS:

1. R.Krishnan,PermanentMagnetSynchronousandBrushlessDC MotorDrives,PrenticeHallofIndia,2009.
2. T.J.E.Miller,"BrushlessPermanentMagnetandReluctanceDCMotorDrives",ClarendonOxfordPress,1989.
3. T.Kenjo,"SteppingMotorsandtheirMicroprocessorControls",ClarendonOxfordPress,1994.
4. K.Venkataratnam,"SpecialElectricalMachines",UniversityPress(India)Pvt.Ltd.,2009.
5. E. G. Janardanan, "Special Electrical Machines", PHI Learning Private Limited, ISBN: 978-81-203-4880-6,Delhi,2014.

COURSEDESIGNERS

S.No.	NameoftheFaculty	Designation	Department	MailID
1	Dr. R.Sankarganesh	AssociateProfessor	EEE/VMKVEC	sankarganesh@vmkvec.edu.in
2	Dr.K.Boopathy	Professor	EEE/AVIT	boopathyk@avit.ac.in

	WIND ENERGY CONVERSION SYSTEMS	CATEGORY	L	T	P	C
		EC- PS	3	0	0	3

PREAMBLE

To understand and familiarize the principle ,concepts of wind energy conversion systems.

PREREQUUISITE :Nil

COURSE OBJECTIVE

1.	To understand the components, various theories and dynamics of wind energy conversion systems
2.	To study the various types of wind turbines.
3.	To study about the fixed speed systems in wind energy convention
4.	To study about the variable speed systems in wind energy convention
5.	To introduction the grid connected control and monitoring sytems.

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1: Realize the basics of wind energy conversion systems	Understand
CO2:Comprehend various types of wind turbines in energy conversion systems	Analysis
CO3:understand the operations of various types of electrical machineries used for fixed speed systems.	Analysis
CO4:Illustrate the generation of electrical power from Variable speed system.	Analysis
CO5:Acquire knowledge on grid connected wind farm and design a standalone wind energy conversion system.	Create

Mapping with programme outcomes and programme specific outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	M	S	S	M	-	-	L	-	M	-	M
CO2	S	S	-	-	M	S	S	M	-	-	L	-	L	-	L
CO3	S	S	L	-	S	S	S	M	-	-	M	-	M	L	L
CO4	S	M	L	M	S	S	M	M	-	-	M	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG ,M-MEDIUM,L-LOW

SYLLABUS

INTRODUCTION **9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

WIND TURBINES **9**

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

FIXED SPEED SYSTEMS **9**

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

VARIABLE SPEED SYSTEMS **9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

GRID CONNECTED CONTROL & MONITORING SYSTEMS **9**

Wind interconnection requirements, FACTS control & low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady state and dynamic performance of the power system including modeling issue- WECS in various

Total Hours = 45

REFERENCES

1. L.L.Freris “Wind Energy conversion Systems”, Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha,S.Banerjee,”Wind Electrical Sytems”,Oxford University Press,2010.
3. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
4. E.W.Golding “The generation of Electricity by wind power”, Redwood burn Ltd.,Trowbridge,1976.
5. N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
6. S.Heir “Grid Integration of WECS”, Wiley 1998.

COURSE DESIGNERS

S.No	Name of the faculty	Designation	Department	Mail-id
1	Mr.A.BALAMURUGAN	ASSOCIATE PROFESSOR	EEE	balamurugan@vmkvec.edu.in

	ELECTRIC VEHICLES	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE

This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric vehicles.

PREREQUISITE: Basic Electrical & Electronics Engineering.

COURSE OBJECTIVES

1	To understand the basic concepts and dynamics of electric vehicles.
2	To familiarize and design of battery backup.
3	To analyze the characteristics of different types of DC & AC Motors.
4	To understand different types of power transmission configuration, clutch and braking.
5	To study about hybrid electric vehicles.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Describe the basic concepts of electric vehicles.	Understand
CO2: Design the propulsion system for electric vehicles.	Evaluate
CO3: Explain the construction, characteristics and application of batteries.	Analyze
CO4: Elucidate performance characteristics of DC&AC electrical machines.	Analyze
CO5: Design the drive train model for electric vehicles.	Evaluate
CO6: Describe about the various types and configuration of hybrid electric vehicle.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	M	-	L	L	-	-	-	-	-	-	-
CO2	S	M	S	L	M	-	L	M	-	-	-	-	-	-	-
CO3	S	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CO4	S	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CO5	S	M	S	L	M	-	L	M	-	M	M	-	-	-	-
CO6	S	-	-	-	M	-	L	L	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

ELECTRIC VEHICLES

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

BATTERY

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

DC & AC ELECTRICAL MACHINES

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

ELECTRIC VEHICLE DRIVE TRAIN

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing. Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

HYBRID ELECTRIC VEHICLES

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.

TEXT BOOKS:

1. Iqbal Hussain, *"Electric & Hybrid Vehicles – Design Fundamentals"*, Second Edition, CRC Press,
2. James Larminie, "*Electric Vehicle Technology Explained*", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, *"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals*", CRC Press, 2010.
2. Sandeep Dhameja, *"Electric Vehicle Battery Systems",* Newnes, 2000 .http://nptel.ac.in/courses/108103009

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Devarajan	Professor	EEE	devarajan@vmkvec.edu.in
2	Mr. V.Rattankumar	Assistant Professor	EEE	rattankumar@avit.ac.in

	DISTRIBUTED GENERATION AND MICROGRIDS	Category	L	T	P	C
		EC- PS	3	0	0	3

Preamble

To introduce the fundamentals of Distributed Generation and Implementation in Microgrid.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To illustrate the concept of distributed generation
2	To analyze the impact of grid integration
3	To study concept of Microgrid and its configuration

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Study the need for DG's and various types	Understand
CO 2	Understand the concepts and impacts in Grid Intergration	Understand
CO 3	Understanding of the microgrid types and configurations	Understand
CO 4	Analyze the various types of control in micro grid in islanded and grid connected operation	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-		S	S	-		L	-	-	-	-	M
CO2	M	-	M	-	S	L	M	-	M	L	-	-	-	-	-
CO3	M	-	M	-	S	L	M	-		L	-	-	L	M	-
CO4	S	-	S	-	S	M	M	L	-	L	M	-	-	-	L
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	L	-

SYLLABUS

UNIT - I	INTRODUCTION	9

Conventional power generation: advantages and disadvantages, Energy crises, Nonconventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT - II	DISTRIBUTED GENERATIONS (DG)	9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

UNIT - III	IMPACT OF GRID INTEGRATION	9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT - IV	INTRODUCTION TO MICROGRID	9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

UNIT - V	CONTROL AND OPERATION OF MICROGRID	9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TEXTBOOK

1. "Voltage Source Converters in Power Systems: Modeling, Control and Applications", Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications.
2. "Power Switching Converters: Medium and High Power", Dorin Neacsu, CRC Press, Taylor & Francis, 2006.
3. "Solar Photo Voltaics", Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009

REFERENCES

1. "Wind Energy Explained, theory design and applications," J.F. Manwell, J.G. McGowan Wiley publication
2. "Biomass Regenerable Energy", D. D. Hall and R. P. Grover, John Wiley, New York, 1987.
3. "Renewable Energy Resources" John Twidell and Tony Weir, Tyalor and Francis Publications, Second edition

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	S.Prakash	AP(Gr-II)	EEE	sprakash@avit.ac.in
2				

	Power Converters Analysis and Design	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE

To Give an Introduction to The Recent Developments in The Power Electronics Converters. This Course Introduces the Advanced Power Converters Such as Isolated Dc-Dc Converter, Reactive Elements. It Also Deals with The Synchronous Rectifiers and Cascaded Boost Converters.

PRERQUISITE

Nil

COURSE OBJECTIVES

1	Acquire a basic understanding of various power converter modules used to build a power electronics system and acquire the ability to select and design suitable circuit.
2	To impart knowledge on the design of different components for Power converter Systems.
3	To learn the switching losses of various triggering techniques
4	To understand the designing concept of various types of chopper and rectifier
5	To impart knowledge on the design of closed-loop compensators for DC-DC Converter

COURSE OUTCOMES

On the successful completion of the course, students will be able to

1. Select Power Semiconductor Switches for Power Electronic converters and calculate Losses in the Switch.	Remember
2. Apply the need and working of an Isolated DC-DC Converter for real-time application.	Apply
3. Implement the Design Reactive components for Power Electronic Converters.	Analysis
4. Develop a Model the DC-DC Converter Using state Space Technique.	Implement
5. Modelling of Design compensator for DC-DC Converters.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	M	-	-	-	-	-	-	M	S	M	-
CO2	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO3	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO4	S	M	M	L	L	-	-	-	-	-	-	L	S	M	-
CO5	S	S	M	M	M	-	-	-	-	-	-	L	S	M	M

S- Strong; M-Medium; L-Low

Syllabus

TRIGGERING LOSS CALCULATION

Survey of devices: Diode, Thyristor, BJT, IGBT, MOSFET and TRIAC-Realization of Semiconductor switch for one quadrant operation, Current bidirectional operation, Voltage bidirectional operation,
four quadrant operation- Thermal Design of Power Switching Devices-Estimation of loss in switch: Conduction Loss Switching Loss –Blocking Loss- Transistor Switching with Clamped Inductive Load.

ISOLATED CHOPPER CONVERTER

Need for Isolated Converters-Operation and Derivation of Voltage equation: Forward Converter-Fly back converter Push pull converter-Half Bridge and Full Bridge Converter.

DESIGN OF REACTIVE ELEMENTS IN POWER ELECTRONIC SYSTEMS:
Introduction-Design of Inductor: Material Constraint-Design Relationships-Design Steps-Design of Transformer: Design Equations-Design Steps-Different Types of Capacitors for Power Electronics Applications-Related problems on design of Inductor and Transformer and Evaluation of loss in capacitor

DC-DC CONVERTER DYNAMICS
Small Signal Analysis of Converter-State Space Averaging Technique-Steps involved in state space averagingDerivation of Transfer function of Ideal buck, boost converter using state space averaging- Converter Non Idealities.

COMPENSATOR DESIGN AND CURRENT MODE CONTROL
Closed loop requirements-Compensator structure-Design of compensator-Introduction of Current Mode Control Block diagram of Current Mode Control-Advantages of Current Mode control

TEXT BOOKS:

1. Ned Mohan,Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.Inc,New York,2002.
2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, New Delhi, 2010.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.K.Boopathy	Associate Professor	EEE/AVIT	boopathyk@avit.ac.in
2	Dr. R. Devarajan	Professor	EEE/ VMKVEC	devarajan@vmkvec.edu.in
4				

	RENEWABLE ENERGY SOURCES	Category	L	T	P	C
		EC- PS	3	0	0	3

Preamble

To introduce the fundamentals of PV & WIND and other energy sources and utilizing the resources that least pollute the environment.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	Awareness about renewable Energy Sources and technologies.
2	Adequate inputs on a variety of issues in harnessing renewable
3	Recognize current and possible future role of renewable energy sources.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Develop awareness about renewable energy sources and technologies	Apply
CO 2	Recall to get adequate inputs on a variety of issues in harnessing renewable energy	Remember
CO 3	Match the various renewable energy resources and technologies and their applications	Remember
CO 4	Organize and understand basics about biomass energy	Apply
CO 5	Interview to acquire knowledge about solar energy	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-	-	S	S	-		L	-	-	-	-	-
CO2	M	-	M	-	S	L	M	-	M	L	-	-	-	-	-
CO3	M	-	M	-	S	L	M	-	-	L	-	-	-	-	-
CO4	S	-	S	-	S	M	M	L	-	L	M	-	-	-	-
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	-	-

SYLLABUS

RENEWABLE ENERGY SOURCES

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources.

WIND ENERGY

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Grid integration issues of WPPs.

SOLAR PV AND SOLAR SYSTEM

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, Applications.

BIO MASS ENERGY

Introduction-Bio mass resources –Energy from Bio mass: conversion processes- Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine.

OTHER ENERGY SOURCES

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell :Principle of working- various types – construction and applications. Energy Storage System-Hybrid Energy Systems.

TEXTBOOK

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.

REFERENCES

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011 Arvind Krishnan & Others – Climate Responsive Architecture, Tata Mcgraw – Hill New Delhi 2001.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015
4. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	K.S.Kavitha Kumari	Assistant Professor	EEE	kavitha.eee@avit.ac.in

2	R. SATHISH	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in

	ENERGY CONVERSION AND STORAGE TECHNOLOGIES	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE

The aim of the course is to understand the basics of energy conservation techniques, energy storages in industries and the associated economical benefits.

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To provide knowledge on the fundamentals of magnetic circuits, energy, force, and torque of single and multi excited systems.
2	To provide knowledge on the transformation of energy from solar and wind.
3	To impart knowledge on Thermal and Solar Photovoltaic systems
4	To understand the concept of Magnetic, Electric, and Chemical Energy Storage systems and their applications
5	To gain knowledge on energy storage in electric.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

1. Depict the choice and rating of electrical machinery for selected applications	Remember
2. Design and develop a suitable hydrogen storage system to be used along with a fuel cell system.	Apply
3. Implement the chemical energy storage process for real-time application	Implement
4. Analysis and design the battery rating for various application	Analysis
5. Select the best power rating and performance for energy storage application	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	S	M	-	M	-	-	-	-	-	-	M	S	M	-
CO2	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO3	M	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO4	S	M	M	L	L	-	-	-	-	-	-	L	S	M	-
CO5	M	S	M	M	M	-	-	-	-	-	-	L	S	M	M

S- Strong; M-Medium; L-Low

ELECTROMECHANICAL ENERGY ALTERATION

Review of magnetic circuits-Principles of Electromechanical Energy - Conversion, General expression of stored magnetic energy, co-energy and force/torque, example using single and doubly -excited system.

ANALYSIS OF WIND AND PV SYSTEMS

Stand alone operation: Fixed and variable speed wind energy conversion systems (WECS), solar system - Grid connection Issues -Grid integrated SCIG and PMSG based WECS-Grid Integrated solar system.

CHEMICAL ENERGY STORAGE SYSTEMS

Introduction about fuel cells – design and principles of operation of a fuel cell – classification of fuel cells, conversion efficiency of fuel cells. Types of electrodes, work output and emf of fuel cell,
Applications of fuel cells. Introduction about Hydrogen energy – hydrogen production – electrolysis, thermo chemical methods. Battery - Types of Batteries - Equivalent Electrical Circuit - Battery Charging - Charge Regulators - Battery Management

MAGNETIC AND ELECTRIC ENERGY STORAGE SYSTEMS

Superconducting Magnet Energy Storage (SMES) systems; capacitor and batteries: comparison and application; super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application

ADVANCED BATTERIES FOR EV APPLICATIONS

Ultracapacitors: Features- Basic Principles of Ultracapacitors - Performance of Ultracapacitors – Mathematical model, Fuel cells: Operating Principles – Characteristics - Polarization loss - fuel cells Technologies - Comparison of fuel cells, Hybridization of Energy Storage systems.

TEXTBOOK

1. S.P.Sukatme, 'Solar Energy – Principles of thermal collection and storage,' Second edition, McGraw Hill,2007.
2. Mukund R. Patel, 'Wind and Solar Power Systems: Design, Analysis, and Operation, Second Edition, CRC Press, 2009

REFERENCES

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.K.Boopathy	Associate Professor	EEE/AVIT	boopathyk@avit.ac.in
2	Dr. R. Sankarganesh.in	Associate Professor	EEE/VMKVEC	sankarganesh@vmkvec.edu

	POWER SYSTEM AND SMART GRID	Category	L	T	P	C
		EC- PS	3	0	0	3

Preamble

To enable the students acquire knowledge on power system planning and fault condition, smart grid, different options of architectural design, renewable energy sources and storage integration with smart grid.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To model the power system under steady state operating condition.
2	To model and carry out short circuit studies on power system.
3	To understand the basic concepts, components and architecture of smart grid

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Construct a power system model under steady state operating condition	Apply
CO 2	Experiment with the various fault and carry out short circuit studies on power system	Apply
CO 3	Define the smart grids components and architecture	Remember
CO 4	Find the various renewable energy sources to reduce pollution	Remember
C0 5	List the role of batteries and energy storages	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	M	M	L	-	-	M	M	L	-	L	-	-	-
CO2	L	S	L	M	S	-	-	M	M	L	-	-	-	M	-
CO3	S	-	S	S	S	-	-	M	M	L	-	M	-	-	-
CO4	S	S	M	-	S	-	-	M	M	L	-	-	-	-	L
CO5	S	-	S	M	S	M	-	S	M	L	-	-	-	-	-

SYLLABUS

POWER SYSTEM

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, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters.

FAULT ANALYSIS

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system

INTRODUCTION TO SMART GRID

Today's Gird Versus Smart Grid, Rationale for Smart Grid, Computational Intelligence, Power System Enhancement, Communication and Standards, Environment and Economics, Shareholders Roles and Function, Architecture, Functions of Components

DISTRIBUTED GENERATION

Solar Energy, PV Systems, Wind turbine Systems, Biomass, Small and Micro Hydro Power, Fuel Cell, Geothermal heat pumps.

ENERGY STORAGE

Batteries, Flow Batteries, Fuel Cell and hydrogen electrolytes, Flywheel, Super conduction magnetic energy storage systems, super capacitors, Simulation and case studies.

TEXTBOOK

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
2. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.

REFERENCES

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
2. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.
3. Qi Huang, Shi Jing "Innovative Testing and Measurement Solutions for Smart Grid", John Wiley & Sons Inc, 2015.

COURSE DESIGNERS

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	DIGITAL SIGNAL PROTECTION FOR POWER SYSTEMS	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE

The technology of power system protection has evolved a lot since the era of electromechanical and solid-recorded by Current Transformers (CT) and Voltage Transformers (VT), by using digital signal processing techniques. Thus, the requirement of learning this subject has changed significantly over a period of time and in fact, this subject addresses this need in a comprehensive manner.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	Study of numerical relays.
2	Developing mathematical approach towards protection
3	Study of algorithms for numerical protection.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Learn the importance of Digital Relays	Understand
CO2: Apply Mathematical approach towards protection	Apply
CO3: Learn to develop various Protection algorithms	Understand
CO4: Simulate protection for abnormalities in virtual environment	Analyze
CO5: Demonstrate primitive relays at contingency state	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	M	-	L	L	-	-	-	-	-	L	-
CO2	S	M	S	L	M	-	L	M	-	-	-	-	M	-	M
CO3	S	-	-	-	M	-	-	-	-	-	-	-	-	M	S
CO4	S	-	-	-	M	-	-	-	-	-	-	-	M	-	-
CO5	S	M	S	L	M	-	L	M	-	M	M	-	-	-	L
CO6	S	-	-	-	M	-	L	L	-	-	-	-	-	L	-

S- Strong; M-Medium; L-Low

SYLLABUS

Unit-1

DIGITAL RELAYS

Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection, Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection

Unit-2

SIGNAL PROCESSING

Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis

Unit-3

SIGNAL CONDITIONING

Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filtering concepts, The digital relay as a unit consisting of hardware and software

Unit-4

ALGORITHMS FOR RELAY OPERATIONS

Sinusoidal wave based algorithms, ample and first derivative (Mann and Morrison) algorithm. Fourier and Walsh based algorithms, Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares based algorithms. Differential equation based algorithms, Traveling Wave based Techniques.

Unit-5

DIGITAL PROTECTION OF POWER SYSTEMS

Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of Power Systems.

TEXT BOOKS:

1. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
2. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014

REFERENCE BOOKS:

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press,

2009

2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999

COURSE DESIGNERS

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	DESIGN OF ELECTRICAL APPARATUS	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE.

This course offers the preliminary instructions and techniques to design the main dimensions and other major part of the transformer and DC and AC rotating machines. The course also provides the students with an ability to understand the step by step procedure for the complete design of electrical machines.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To study mmf calculation and thermal rating of various types of electrical machines.
2	To design Armature and field systems for D.C. machines.
3	To design Core, yoke, windings and cooling systems of transformers.
4	Design of stator and rotor of induction machines and synchronous machines
5	To design stator and rotor of synchronous machines

COURSEOUTCOMES

On the successful completion of the course, students will be able to

CO1	Understand basics of design considerations for rotating and static electrical machines	Understand
CO2	Design armature and field of DC machines.	Create
CO3	Design sing and three phase transformer.	Create
CO4	Design stator and rotor of induction motor.	Create
CO5	Design and analyze synchronous machines.	Analyze

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	L	-	-	-	-	-	-	M	S	M	-
CO2	S	S	S	S	-	-	-	-	-	-	M	M	S	M	S
CO3	S	S	S	S	-	-	-	-	-	-	M	M	S	M	-
CO4	S	S	S	S	L	-	M	-	-	-	M	M	S	M	S
CO5	S	S	S	S	L	L	L	-	-	-	-	M	S	M	-

S-Strong;M-Medium;L-Low

SYLLABUS

ELECTRICAL MACHINES DESIGN

Major considerations in Electrical Machine Design-Concept of magnetic circuit – MMF calculation for various types of electrical machines -Flux leakage – Leakage in Armature-Design of lap winding and wave winding-thermal rating: continuous, short time and intermittent short time rating of electrical machines

DC MACHINES

Construction - Output Equations – Main Dimensions – Choice of specific loadings – Choice of number of poles – Armature design – Design of commutator and brushes – Losses and efficiency calculation

TRANSFORMERS

Construction details –Output rating of single and three phase transformers – Overall dimensions – design of core, Yoke 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– Losses and efficiency calculation

INDUCTION MOTORS

Construction details- Output equation of Induction motor – Main dimensions – choice of specific loadings — Length of air gap- Rules for selecting rotor slots of squirrel cage machine- Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram.

SYNCHRONOUS MACHINES

Constructional details-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 – Design of field winding – Design of turbo alternators

TEXTBOOKS

1. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.
2. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.

REFERENCES

1. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011.
2. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.

COURSEDESIGNERS

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	HVDC TRANSMISSION SYSTEMS	Category	L	T	P	Credit
		EC- PS	3	0	0	3

PREAMBLE:

This course aims to develop the skills in the area of HVDC power transmission with the analysis of HVDC converters, harmonics and design of filters. This course also helps the students to learn Reactive power control, Power factor improvements of the system, HVDC cables and simulation

PREREQUISITE : NIL

COURSE OBJECTIVES

1	Recognize the significance and necessity of HVDC system
2	Describe the power converters and harmonic filters used in HVDC system
3	Determine the requirement of appropriate control strategies and stability techniques used for HVDC system
4	Illustrate suitable controller for HVDC converter to obtain desired output
5	Identify the application of HVDC system with practical examples
6	Explain HVDC Cables and simulation of systems

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1	Explain the significance and necessity of HVDC system	Understand
CO2	Discuss the power converters and harmonic filters used in HVDC system	Understand
CO3	Explain the requirement of appropriate control strategies and stability techniques used for	Understand
CO4	Design suitable controller for HVDC converter to obtain desired output	Apply
CO5:	Explain the application of HVDC system with practical examples	Apply
CO6	Explain HVDC Cables and simulation of systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	L	-		-	-	-	-	-	-	-
CO2	L	L	-	M	-	L	-	M	-	M	L	M	-	M	-
CO3	S	M	-	-	-	M	M	-	-	-	M	M	-	M	-
CO4	S	S	M	-	M	L	L	S	-	S	S	-	L	S	-
CO5	M	M	L	M	S	S	M	L	-	S	S	-	-	S	L
CO6	M	L	-	-	S	L	-	S	-	S	S	S	-	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Development of HVDC technology-Significance of DC transmission-Overview and organization of HVDC systems-Review of the HVDC system reliability-HVDC characteristics and economic aspects

POWER CONVERSION AND HARMONICS

Power conversion - Thyristor, Phase converter, Phase full bridge converter, Pulse converter- Harmonics in HVDC and removal-Determination of resulting harmonic impedance-Active power filter

CONTROL OF HVDC CONVERTER AND SYSTEM

Converter control for an HVDC system-Commutation failure- HVDC control and design - HVDC control functions- Reactive power and voltage stability- Interactions between AC and DC systems

TRENDS FOR HVDC APPLICATIONS

Wind Farm Technology- Modern Voltage Source Converter (VSC)- 800 kV HVDC System- Practical examples of an HVDC system

HVDC CABLES AND SIMULATION OF HVDC SYSTEMS

Introduction of DC cables – Basic physical phenomenon arising in DC insulation – Practical dielectrics – Dielectric stress consideration – Economics of DC cables compared with AC cables. Introduction to system simulation – Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation

TEXT BOOK

1. Chan-Ki Kim, “HVDC Transmission Power Conversion Applications in Power Systems”, John Wiley & Sons Pvt. Ltd., 2009.
2. K.R.Padiyar, “HVDC Power Transmission Systems”, New Age International (P) Ltd., New Delhi, 2002.

REFERENCE BOOKS

1. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1993
2. J.Arrillaga, “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
3. Erich Uhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.
4. V.K.Sood, “HVDC and FACTS controllers – Applications of Static Converters in Power System”, Kluwer Academic Publishers, 2004.
5. Dragan Jovcic, Khaled Ahmed, “High Voltage Direct Current Transmission: Converters, Systems and DC Grids”, John Wiley & Sons, Ltd, ISBN:9781118846667, 2015.
6. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age Interantional (P) Ltd., New Delhi, 1990

COURSE DESIGNERS

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2	Mrs.P.Poornima	AP(Gr-II)	EEE/AVIT	poornima@avit.ac.in

	ENERGY AUDIT AND CONSERVATION	Category	L	T	P	C
		EC- PS	3	0	0	3

Preamble

In the modern world conservation of energy play a major role. As per the statistics 70% of the energy is lost in transmission and energy theft. Hence more emphasis is needed on energy conversation and for that energy audit has to be done. Energy audit gives the scope of various methods and tools to be followed for energy conservation.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To understand the basics of electrical energy and energy conservation
2	To analyze the electrical and thermal performance of an electrical system
3	To understand the financial impact of energy management
4	To apply the role of energy monitoring in energy management
5	To understand various aspects of energy audit.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO1	Apply the knowledge of the subject to calculate the efficiency of various thermal utilities.	Remember
CO2	Design suitable energy monitoring system to analyze and optimize the energy consumption in an organization.	Understand
CO3	Improve the thermal efficiency by designing suitable systems for heat recovery and co-generation	Apply
CO4	Use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure	Apply
CO5	Carry out the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization.	Evaluate

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO24	S	M	-	-	L	-	-	-	-	-	-	-	M	M	S
CO25	S	S	M	-	-	-	-	-	-	-	-	-	M	M	-

CO26	M	L	M	S	-	-	-	-	-	-	-	-	M	M	M
CO27	S	S	-	M	-	-	-	-	-	-	-	-	M	M	M
CO28	S	M	S	M	M	-	-	-	-	-	M	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Commercial and Non-commercial energy-Primary energy resources-Commercial energy production-Final energy consumption-Indian energy scenario-Sectoral energy consumption(domestic, industrial and other sectors)-Energy needs of growing economy- energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its impotance, energy strategy for the future, Energy Conservation Act 2001 and its features.

ELECTRIC AND THERMAL PERFORMANCE

Electricity basics - Direct Current and Alternative Currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer. calculation of heat loss - heat gain, estimation of annual heating & cooling loads, factors that influence thermal performance, analysis of existing buildings setting up an energy management programme and use management - electricity saving techniques

ENERGY MANAGEMENT AND FINANCIAL ANALYSIS

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows

MONITORING OF ENERGY

Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

ENERGY EFFICIENCY

Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines), heat exchangers ,lighting system, Motors belts and drives, refrigeration system. Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles

TEXTBOOK

1.W. F. Kenny, Energy Conservation In Process Industry.
2.Amlan Chakrabarti, Energy Engineering and Management, Prentice hall India 2011
3.CB Smith, Energy Management Principles , Pergamon Press, New York

REFERENCES

1.Hand outs New Delhi, Bureau of energy efficiency 2.W. C. Turner, John Wiley and sons, Energy Management Hand Book.

COURSE DESIGNERS

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1	V.RATTAN KUMAR	AP(II)	EEE	rattankumar@avit.ac.in

	Design of Photovoltaic System	Category	L	T	P	C
		EC(PS)	3	0	0	3

Preamble

It is a design oriented course aimed at photovoltaic system design. The course begins by discussing about the PV cell Electrical characteristics and interconnections.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To discuss about the PV cell electrical characteristics and interconnections.
2	To estimate the insolation and PV sizing of PV system design.
3	To explain about Maximum power point tracking in solar PV system.
4	To discuss the various PV applications related to peltier refrigeration, water pumping.
5	To explain about the grid connection system.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Describe the fundamental concepts of energy from the sun and solar PV.	Understand
CO 2	Design a solar PV system	Create
CO 3	Apply the MPPT algorithms for solar PV.	Apply
CO 4	Design a battery interface system for PV powered water pumping system.	Create
CO 5	Analyze the grid integration of solar PV with and without battery storage.	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	-	M	S	S	-		L	-	-	S	S	-
CO2	S	S	S	S	S	L	M	L	M	L	-	-	L	M	-
CO3	S	M	M	L	L	L	M	-	-	L	-	-	L	M	-
CO4	S	S	S	S	S	M	M	L	M	L	M	-	M	M	-

CO5	S	M	M	L	S	M	S	-	M	L	L	M	-	L	M

SYLLABUS

PV Cell
Historical Perspective, PV cell characteristics and equivalent circuit, model of PV cell, cell efficiency, effect of temperature, fill factor. Series and parallel connection of identical and non-identical cells, protecting cell in series and parallel, interconnecting modules.
Energy from sun
Insolation and irradiance, solar geometry, insolation and energy on horizontal plate, sunrise and sunset hour angles. Incident energy estimation: energy on a tilted flat plate, energy plots in octave, atmospheric effects, airmass, Sizing PV: sizing PV applications without batteries, Batteries, battery selection, PV system design.
Maximum Power Point tracking
MPPT concept, DC-DC converters, MPPT algorithms-Impedance control methods.
PV Battery Interfaces
Direct PV- Battery connection, charge controller, battery charger, batteries in series and parallel. Peltier Cooling: peltier device, peltier element, thermal aspects. PV and Water Pumping: water pumping principle, hydraulic energy and power, total dynamic head, centrifugal pumps, reciprocating pump.
PV grid Interface
Grid connection principles, PV to Grid Topologies, 3phase d-q controlled grid connection- AC to DC transformation, DC to AC transformation, complete 3 phase grid connection. SVPWM-discrete and analog implementation, application of integrated magnetics.
TEXTBOOK
1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011. 2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
REFERENCES
1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011 Arvind Krishnan & Others – Climate Responsive Architecture, Tata Mcgraw – Hill New Delhi 2001. 2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004. 3. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015 4. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI

Learning Private Limited, New Delhi, 2011.
5. Chenming, H. and White, R.M., Solar Cells from B to Advanced Systems, McGraw Hill Book Co, 1983.
6. Ruschenbach, HS, Solar Cell Array Design Hand Varmostrand, Reinhold, NY, 1980 Proceedings of IEEE Photovoltaics Specialists Conferences, Solar Energy Journal.

COURSE DESIGNERS

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	BUSINESS INTELLIGENCE AND ITS APPLICATIONS	Category	L	T	P	Credit
		EC- IE	3	0	0	3

PREAMBLE

Business Intelligence (BI) refers to the tools, technologies, applications and practices used to collect, integrate, analyze, and present an organization's raw data in order to create insightful and actionable business information in Data mining.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To Introduce students to various business intelligence concepts
2	To learn the concepts of data integration used to develop intelligent systems for decision support
3	To introduce visualization tool for prepare the enterprise reporting
4	To learn analytical components and technologies used to create dashboards and scorecards, data/text/Web mining methods
4	To gain new insights into organizational operations in implementation of systems for Business Intelligence (BI)

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Learn about the concepts of OLTP and OLAP for BI infrastructure development	Understand
CO2. Gained an understanding of how business professionals can use analytics techniques to formulate and solve relevant problems and how they use analytics to support decision making	Analyze
CO3. Apply Clustering, Association and Classification techniques for Data Integration	Apply
CO4. Assess BI tools to solve problems, issues, and trends using predictive analysis	Apply
CO5. Develop systems to measure, monitor and predict the enterprise variables and performance indicators for business decision-making process	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	-	-	-	-	-	-	M	**S**	M	M
CO2	S	M	L	-	M	-	-	-	-	-	-	M	**S**	M	M
CO3	S	M	L	-	M	-	-	-	-	-	-	M	**S**	M	M
CO4	S	M	L	-	M	-	-	-	-	-	-	M	**S**	M	M
CO5	S	M	L	-	M	-	-	-	-	-	-	M	**S**	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO BUSINESS INTELLLIGENCE

Introduction to OLTP AND OLAP – BI Definition and BI Concepts – Business Applications of BI - BI Framework- Role of Data Warehousing in BI –BI Infrastructure Components- BI Process – Developing Data Warehouse – Management Framework – Business driven approach –BI Technology — BI Roles & Responsibilities.

BASICS OF DATA INTEGRATION

Concepts of Data Integration need and advantages of using Data Integration – Introduction to common data integration approaches – Introduction to ETL using SSIS – Introduction to Data Quality – Data Profiling Concepts and Applications.

INTRODUCTION TO MULTIDIMENSIONAL DATA MODELING

Introduction to Data and Dimensional Modeling – Multi Dimensional Data Model – ER modeling Vs Multi Dimensional Model – Concepts of Dimensions - facts - cubes- attributes- hierarchies- star and snowflake schema – Introduction to Business Metrics and KPIs – Creating Cubes using SSAS.

BASICS OF ENTERPRISE REPORTING

Introduction to Enterprise Reporting - Concepts of dashboards - balanced scorecards – Introduction to SSRS Architecture– Enterprise Reporting using SSRS reporting service

BI ROAD AHEAD

BI and Mobility – BI and cloud computing – BI for ERP systems - Benefits of BI in ERP-NorthWind_Traders Data-Data Analyses through Excel-Kettle Tool – Conversion of data using Kettle Tool.

TEXT BOOKS

1.RN Prasad, Seema Acharya, ”Fundamentals Of Business Analytics” Wiley India,2011

REFERENCES

1.Soumendra Mohanty, “Data Warehousing Design, Development and Best Practices”, Tata McGraw-Hill, New Delhi, 2007.

2.David Loshin, “Business Intelligence”, Morgan Kaufmann Publishsers, San Francisco, Fifth edition, 2007.

3.Larissa Terpeluk Moss and Shaku Atre, “Business Intelligence Roadmap”, Pearson Education, 2007

COURSE DESIGNERS

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1.	Dr. K. Sasikala	Associate Professor	CSE	sasikalak@vmkvec.edu.in
2.	Mrs. S. Leelavathy	Assistant Professor(G-II)	CSE	leelavathy@avit.edu.in

	LEARNING IT ESSENTIALS BY DOING	Category	L	T	P	Credit
		EC- IE	3	0	0	3

PREAMBLE

The proposed elective course exposes the non-CS/IT students to IT Essentials. The core modules of this Elective includes programming , Database and web Technology amongst other related topics. This course refers to the basic tools and technologies for the right type of website development and enable student to create simple web applications

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To learn about the essentials of Information Technology
2	To get an idea about the scripting languages.
3	To get an idea about the internet protocols

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1 Understand the networking concept internet protocols, network routing	Understand
CO2. Understand the fundamentals of web applications and its modeling	Understand
CO3. Understand and learn the scripting languages with design of web applications	Understand
CO4. Analyze the process of mobile communication and network technologies	Analyze
CO5. Build simple interactive applications, database applications and multimedia applications.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	-	-	-	-	-	-	-	M	**S**	M	M
CO2	S	M	M	M	-	-	-	-	-	-	-	M	**S**	-	M
CO3	S	M	M	M	-	-	-	-	-	-	-	M	**S**	M	M
CO4	M	M	M	M	M	-	-	-	-	-	-	M	**S**	M	-
CO5	M	M	M	M	S	-	-	-	-	-	-	M	**-**	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Fundamentals of Computer architecture

introduction-organization of a small computer -Central Processing Unit - Execution cycle – Instruction categories – measure of CPU performance Memory – Input/output devices - BUS-addressing modes. System Software – Assemblers – Loaders and linkers – Compilers and interpreters

Operating system

Introduction – memory management schemes Process management Scheduling – threads.
Problem solving with algorithms- Programming styles – Coding Standards and Best practices - Introduction to C -Programming Testing and Debugging. Code reviews -System Development Methodologies – Software development Models -User interface Design – introduction – The process – Elements of UI design & reports.

RDBMS

Data processing – the database technology – data models-ER modeling concept –notations – Extended ER features -Logical database design - normalization -SQL – DDL statements – DML statements – DCL statements
Writing Simple queries – SQL Tuning techniques – Embedded SQL - OLTP

Objected oriented concepts

Object oriented programming -UML Class Diagrams– relationship – Inheritance – Abstract classes – polymorphism-Object Oriented Design methodology - Common Base class -Alice Tool – Application of OOC using Alice tool.

Client server computing

Internetworking – Computer Networks – Working with TCP/IP – IP address – Sub netting – DNS – VPN – proxy servers World Wide Web – Components of web application - browsers and Web Servers
URL – HTML – HTTP protocol – Web Applications - Application servers – Web Security.

REFERENCES

1. Andrew S. Tanenbaum, Structured Computer Organization, PHI, 3rd ed., 1991
2. Silberschatz and Galvin, Operating System Concepts, 4th ed., Addision-Wesley, 1995
3. Dromey R.G., How to solve it by Computers, PHI, 1994
4. Kernighan, Ritchie, ANSI C language PHI,1992
5. Wilbert O. Galitz, Essential Guide to User Interface Design, John Wiley, 1997
6. Alex Berson, Client server Architecture, Mc Grew Hill International, 1994
7. Rojer Pressman, Software Engineering-A Practitioners approach, McGraw Hill, 5th ed., 2001
8. Alfred V Aho, John E Hopcroft, Jeffrey D Ullman, Design and Analysis of Computer Algorithms, Addison Wesley Publishing Co., 1998
9. Henry F Korth, Abraham Silberschatz, Database System Concept, 2nd ed. McGraw-Hill International editions, 1991
10. Brad J Cox, Andrew J.Novobilski, Object – Oriented Programming – An evolutionary approach, Addison – Wesley, 1991

Course Designers:

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2.	Mr. K.Karthik	Assistant Professor	CSE	karthik@avit.ac.in

	MATH MODELLING & CONTROL SYSTEMS	Category	L	T	P	C
		EC-IE	2	0	2	3

Preamble

This course introduces Mathematical modeling implementation in control system .

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To present a clear exposition of the classical methods of control system modelling, and basic principles of frequency and time domain design techniques
2	To teach the practical control system design with realistic system specifications
3	Understand the concept of stability using various stability criteria

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Develop mathematical models of engineering systems	Understand
CO 2	Able to design control strategies for engineering systems	Understand
CO 3	Develop plant models for evaluating control strategies	Understand
CO 4	Develop MIL and HIL testing frameworks and analyse results	Analyze
C0 5	Gain proficiency in use tools like MATLAB/ Simulink	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	M	-	M	-	-	S	-	M	-	S	M	M
CO2	M	L	M	M	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	S	L	-	-	-	S	M	-	-	-	S	M	-
CO4	M	M	L	S	-	-	-	M	-	-	M	M	S	M	-
CO5	S	S	M	M	-	-	-	-	-	-	-	M	S	S	-

SYLLABUS

INTRODUCTION TO MATH MODELLING
Need for Math Modelling – Transfer Functions - Steps to Build Transfer Functions. Modelling: Electrical & Electronic systems, Electromechanical systems, Hydraulic systems, Thermal systems - Control Systems in simple terms - Natural behaviour of a system - Controlled behaviour of a system
BUILDING A SIMPLE CONTROL SYSTEM
Input and Response of a system - Identifying control inputs - Types of controllers - Types of Systems based on number of I/O - Types of Systems based on I/O relationship - Time-Variant & In-Variant systems LTI Systems Behaviour - Practical example for controlling system behaviour
SIGNALS & BUILDING A SIMPLE CONTROL SYSTEM
Introduction to Signals - Signal Processing - Signal Noise- Conditioners - First order system and its response - Second order system and its response - Solution to the differential equations - Introduction to frequency domain – Convolution - Impulse response
FREQUENCY ANALYSIS & FEEDBACK SYSTEM
Bode plot - Laplace transform - Initial value theorem - Final value theorem - Zeros and poles - Closed Loop Control System – Air-Fuel Control – SI Engines, Closed Loop Control System – Air – Fuel Control – CI Engines - Data Driven vs Mathematical Models, Data Extraction Methods – Testing vs Simulation
STABILITY ANALYSIS & CONTROLLER DESIGN
Routh stability criterion - Nyquist plot – Linearization - Pole placement - Root locus Observability - Robust control – LQR - Observer design and State-estimator - Cascade control
HIL TESTING
HIL Testing fundamentals, applications and use cases - Developing HIL testing frame-work for control strategy evaluation - Automating HIL Test Scripts – Pass / Fail Scenarios
TEXTBOOK
1. U Kiencke, L Nielsen, “Automotive Control Systems for Engine, Driveline, and Vehicle”, Springer 2. John B Heywood, “Internal Combustion Engine Fundamentals”, McGraw-Hill, Inc
REFERENCES
1. Graham C Goodwin “Control System Design” 2. John R Fanchi “Math Refresher for Scientists and Engineers” 3. William, B. Ribbens, Understanding Automotive electronics, ButterWorth Heinemann 1998. 4. Robert N. Brandy, Automotive computers and Digital Instrumentation, Prentice Hall Eaglewood Cliffs, New Jersey, 1988
COURSE DESIGNERS 

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1	S.Prakash	AP(Gr-IIP	EEE	sprakash@avit.ac.in
2	Mr. P. Loganathan	AP	EEE/ VMKVEC	loganathan@vmkvec.edu.in

	Electric & Hybrid Electric Vehicles	Category	L	T	P	Credit
		EC- IE	2	0	2	3

PREAMBLE

This course presents the fundamental ideas, principles, analysis and design of hybrid and electric vehicles. deeper into the various aspects of hybrid and electric drive train such as their configuration with Matlab program.

PREREQUISITE: *Nil*

COURSE OBJECTIVES

1	To Discuss different energy storage technologies used for hybrid electric vehicles and their control
2	To learn the design and select EV & HEV components based on design requirements.
3	To understand the model-based development using MATLAB Simulink
4	To learn designing and mathematical modelling of EHV and drives.
5	To learn Carry out model-based calibration based on emissions requirements.
6	To know about various Electrical propulsion system

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1 -Develop the electric propulsion unit and its control for application of electric vehicles.	Apply
CO2 - Analyze different power converter topology used for electric vehicle application.	Implement
CO3 – Use the energy on board effectively	Remember
CO4 - Create the simulate and observe the behavior of EV	Apply
CO5 - Understand various components that make up a EV / HEV vehicle.	Apply
CO6- Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO3
CO1	L	M	L	M	M	-	L	M	S	L	-	-	S		-
CO2	-	L	M	L	-	S	-	M	M	-	S	-	-	M	-
CO3	M	S	-	S	-	L	L	L	-	M	-	-	-	L	-
CO4	L	L	M	S	-	L		M	M	L	L	S	M	M	M
CO5	M	M	L	M	S	-	L	M	-	M		L	M	-	M
CO6	L	L	M	-	L		L	S	M	-	L		L	L	L

S- Strong; M-Medium; L-Low

SYLLABUS

1. *Introduction to Hybrid & Electric vehicles*

2. *Principles of Electric Machines*
3. *Power electronics and Motor control*
4. *Energy storage system and Fuel cell vehicles*
5. *Transmissions and Alternate storage systems*
6. *Energy Management and Model based development*
7. *Integration of Subsystems*

References

1. *Electric and Hybrid Vehicles: Design Fundamentals, Husain Iqbal.*
2. *Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Chris Mi and M. Abul Masrur.*
3. *Electric and Hybrid Vehicles, by Tom Denton*
4. *Electric Vehicle Technology Explained, 2ed (WSE), James Larminie*
5. *Introduction to Hybrid Vehicle System Modeling and Control, Wei Liu.*
6. *Hybrid, Electric, and Fuel-Cell Vehicles, Jack Erjavec.*

	INNOVATION, PRODUCT DEVELOPMENT AND COMMERCIALIZATION	Category	L	T	P	Credit
		OE-IE	3	0	0	3

PREAMBLE

commercialization of innovation and new products in fast-paced, high-tech markets and matching technological innovation to market opportunities.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To make students understand multiple-perspective approach in organization to capture knowledge and creativity to develop successful products and services for Volatile, Uncertain, Complex and Ambiguous (VUCA) world.
2	Inculcate a disruptive thought process to generate ideas for concurrent and futuristic problems of society in general and markets in particular which focus on commercialization
3	Improved understanding of organizational best practices to transform exciting technology into successful products and services
4	Critically assess and evaluate innovation policies and practices in organizations especially from a cultural and leadership point of view
5	Explain why innovation isessential to organizational strategy – especially in a global environment

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Understand the role of innovation in gaining and maintaining competitive advantage	Understand
CO2: Integrate the innovation basis and its role in decision making especially under uncertainty	Apply
CO3: Analyze business challenges involving innovation management	Apply
CO4: Having problem solving ability – solving social issues and business problems	Apply
CO5: Comprehend the different sources of innovation	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012
CO1	M	-	-	-	-	M	S	S	-	M	-	-
CO2	S	S	S	M	M	M	-	-	-	-	-	-
CO3	S	S	S	M	M	M	-	-	-	-	-	-
CO4	S	S	S	M	M	M	-	-	-	-	-	-
CO5	S	S	S	M	M	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Pre-launch, during launch and Post launch preparations;

SYLLABUS:

Introduction to Innovation Management - Innovation – What it is? Why it Matters? - Innovation as a Core Business Process – system thinking for innovation – Framework for System Thinking - system thinking tools

Creating New Products and Services - Product and Service Innovation – Exploiting Open Innovation and Collaboration –The Concept of Design Thinking and Its Role within NPD and Innovation – framework for design thinking

Capturing Innovation Outcome - New Venture – Benefits of Innovation, and Learning from Innovation – Building Innovative Organization and Developing Innovation Strategy - Globalization for Innovations, Innovating for Emerging Economies and Role of National Governments in Innovation

New Product Brand Development and Pricing Strategies - Importance of Brand decisions and Brand identity development; Pricing of a new product, Pre-test Marketing

The Product offer Selecting Market opportunity and Designing new market offers-Concept Generation and Evaluation, Developing and Testing Physical offers - Pre-launch, during launch and Post launch preparations;

Text Book:

1. Joe Tidd, John Bessant (2013), Managing Innovation: Integrating Technological, Market and Organizational Change, 5th edition, Wiley.

Reference Books:

1. Schilling, M (2013), Strategic management of technological innovation, 4th edition, McGraw Hill Irwin.
2. Allan Afuah (2003), Innovation Management: Strategies, Implementation and Profits, 2nd edition, Oxford University Press.
3. Michael G. Luchs, Scott Swan, Abbie Griffin (2015), Design Thinking: New Product Development Essentials from the PDMA, Wiley-Blackwell.
4. John Boardman, Brian Sauser (2013), Systemic Thinking: Building Maps for Worlds of Systems, 1st edition, Wiley.
5. Rich Jolly (2015), Systems Thinking for Business: Capitalize on Structures Hidden in Plain Sight, Systems Solutions Press

COURSE DESIGNERS:

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	NEW VENTURE PLANNING AND MANAGEMENT	Category	L	T	P	Credit
		OE- IE	3	0	0	3

PREAMBLE

Contemporary methods and best practices for the entrepreneur to plan, launch, and operate a new venture and creation of a business plan

PREREQUISITE - Not Required

COURSE OBJECTIVES

1	An opportunity for self-analysis, and how this relates to success in an entrepreneurial environment.
2	Information and understanding necessary to launch and grow an entrepreneurial venture.
3	A realistic preview of owning and operating an entrepreneurial venture.
4	An entrepreneur must understand the diversity, emotional involvement, and workload necessary to succeed.
5	The opportunity to develop a business plan.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Explain the concept of new venture planning, objectives and functions and its components.	Understand
CO2: Analyze the business plan issues and remuneration practices in startups business.	Apply
CO3: Explore an entrepreneurial idea to the point where you can intelligently and decide whether to "go for it" or not.	Apply
CO4: Compare and contrast the different forms entrepreneurial environment in terms of their key differences and similarities.	Apply
CO5: Explore the business plan and business model canvas for your idea.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012
CO1	M	-	-	-	-	M	S	S	-	M	-	-
CO2	S	S	S	M	M	M	-	-	-	-	-	-
CO3	S	S	S	M	M	M	-	-	-	-	-	-
CO4	S	S	S	M	M	M	-	-	-	-	-	-
CO5	S	S	S	M	M	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

STARTING NEW VENTURE: Opportunity identification - Search for new ideas - Sources of innovative

ideas - Techniques for generating ideas - Entrepreneurial imagination &creativity - The role of creative thinking - Developing your creativity - Impediments to creativity.

METHODS TO INITIATE VENTURES: Pathways to new venture - Creating new ventures - Acquiring an existing venture - Advantages of acquiring an established venture - Examination of key issues – Franchising - How a franchise works and franchise law - Evaluating franchising opportunity.

THE SEARCH FOR ENTREPRENEURIAL CAPITAL: The venture capital market - Criteria for evaluating new venture proposals - Evaluating venture capitalists - stage of venture capital financing - Alternate sources of financing for Indian entrepreneurs - Bank funding - State financial corporations - Business incubators and facilitators - Informal risk capital - Angel investors.

THE MARKETING ASPECTS OF NEW VENTURE: Developing a marketing plan - Customer analysis - Sales analysis - Competition analysis - Market research - Sales forecasting - Sales Evaluation - Pricing decisions.

BUSINESS PLAN PREPARATION FOR NEW VENTURE: Business plan concept - Pitfalls to avoid in business plan - Developing a well conceived business plan - Elements of a business plan - Harvest strategy - Form of business organization - Legal acts governing businesses in India .

Text Book:

1. The Successful Business Plan, Secrets & Strategies, Rhonda Abrams, Published by The Planning Shop Titan, Ron Chernow, Random House
2. Osterwalder, A. and Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Hoboken, NJ: John Wiley & Sons

Reference Books:

1. Blackwell, E. (2011). How to Prepare a Business Plan: Create Your Strategy; Forecast Your Finances; Produce That Persuasive Plan. Kogan Page Publishers.
2. Levi, D. (2014). Group Dynamics for Teams. Sage Publications, Inc. Thousand Oaks.
3. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
4. Business Model Generation by Osterwalder and Pigneur.

COURSE DESIGNERS:

S.No	Name of the faculty	Designation	Department	E-Mail Id
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	SOCIAL ENTREPRENEURSHIP	Category	L	T	P	Credit
		OE- IE	3	0	0	3

PREAMBLE

Social entrepreneurship involves the creativity, imagination and innovation often associated with entrepreneurship.

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To provide students with a working knowledge of the concepts, opportunities and challenges of social entrepreneurship..
2	To demonstrate the role of social entrepreneurship in creating innovative responses to critical social needs (e.g., hunger, poverty, inner city education, global warming, etc)..
3	To engage in a collaborative learning process to develop a better understanding of the context and domain of social entrepreneurship..
4	To help prepare you personally and professionally for meaningful employment by reflecting on the issues of social entrepreneurship.
5	Engage with a diverse group of social entrepreneurs

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Explain the concept social entrepreneurship and distinguish its elements from across a continuum of organizational structures from traditional nonprofits to social enterprises to traditional for profits	Understand
CO2: Analyze the operations of a human service organization using social entrepreneurial orientation and industry assessment and diagnostic tools.	Apply
CO3: Apply the Social Business Model Canvas and lean startup methods for planning, developing, testing, launching and evaluating social change ventures.	Apply
CO4: Compare funding options for social change ventures.	Apply
CO5: The outcomes of social entrepreneurship are focused on addressing persistent social problems particularly to those who are marginalized or poor.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012
CO1	M	-	-	-	-	M	S	S	-	M	-	-
CO2	S	S	S	M	M	M	-	-	-	-	-	-
CO3	S	S	S	M	M	M	-	-	-	-	-	-
CO4	S	S	S	M	M	M	-	-	-	-	-	-

CO5	S	S	S	M	M	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

Social entrepreneurship – dimensions of social entrepreneurship – social change theories – equilibrium and complexity – theory of social emergence

Social entrepreneurs – mindset, characteristics and competencies – developing a social venture sustainability model – feasibility study – planning – marketing challenges for social ventures

Microfinance– MFI (Micro Finance Institutions) in India – regulatory framework of MFI – Banks and MFIs – sustainability of MFI – Self Help Groups– successful MFI models

Angel Investors & Venture Capitalists – difference – valuation of firm – negotiating the funding agreement – pitching idea to the investor

Corporate entrepreneurship – behavioral aspects – identifying, evaluating and selecting the opportunity – venture– location – organization – control – developing business plan – funding the venture – implementing corporate venturing in organization.

Text Book:

1. Constant Beugré, Social Entrepreneurship: Managing the Creation of Social Value, Routledge, 2016.

2. Björn Bjerke, Mathias Karlsson, Social Entrepreneurship: To Act as If and Make a Difference, Edward Elgar Publishing, 2013.

Reference Books:

1. Wei-Skillern, J., Austin, J., Leonard, H., & Stevenson, H. (2007). Entrepreneurship in the Social Sector (ESS). Sage Publications.
2. Janus, K. K. (2017). Social startup success. New York, NY: Lifelong Books.
3. Dancin, T. M., Dancin, P. A., & Tracey, P. (2011). Social entrepreneurship: A critique and future directions.
4. Alex Nicholls, Social Entrepreneurship: New Models of Sustainable Social Change, OUP Oxford, 2008.
5. David Bornstein, Susan Davis, Social Entrepreneurship: What Everyone Needs to Know, Oxford University Press, 2010.

COURSE DESIGNERS:

S.No	Name of the faculty	Designation	Department	E-Mail Id
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17MBHS01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	Category	L	T	P	Credit
		OE- IE	3	0	0	3

PREAMBLE:

A startup means company initiated by individual innovator or entrepreneurs to search for a repeatable and scalable business model. More specifically, a startup is a newly emerged business venture that aims to develop a viable business model to meet a marketplace needs or wants in an optimum manner.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1. To understand the basics of Startups Management and components.
2. To analyze the startups fund management practices
3. To practice the various kinds of stocks and employment considerations in startups.
4. To apply the importance of intellectual property rights and its procedures.
5. To explore the entrepreneurial mindset and culture.

COURSE OUTCOMES:

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

CO1: Explain the concept of engineering startups, objectives and functions and its components.	Understand
CO2: Analyze the startups funding issues and remuneration practices in startups business.	Analyse
CO3: Analyze the various kinds of stocks and employment opportunities and consideration in startups business.	Analyse
CO4: Compare and contrast the various forms of intellectual property protection and practice.	Analyse
CO5: Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.	Evaluates

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	M	M	S	-	M	-	M	-	L	L
CO2	S	S	M	M	M	L	-	-	-	-	-	M	L	L	-
CO3	S	S	S	M	M	M	-	-	-	-	-	M	L	-	M
CO4	S	S	S	M	M	M	-	-	-	-	-	M	-	M	L
CO5	S	S	-	M	M	M	-	-	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS:

Elements of a successful Start up: Startup Process – Create Management Team and Board of Directors – Evaluate market and Target Customers – Define your product or service – preparation of business plan -

specific problems and challenge in startup.

Funding Issues and Remuneration Practices: Funding Issues: Investment Criteria – Looking for seed cash – Seed, Startup, and subsequent Funding Rounds – Milestone Funding - Remuneration Practices for your Start –up : Salaries – Equity Ownership – Other compensation – Employment Contracts

Stock Ownership & startup Employment Considerations: Stock ownership: Risk- Reward Scale – Ownership Interest over time – Common and preferred stock – Authorized and outstanding shares – Acquiring stock – Restricted Stock Grants – Future Tax Liability on Restricted Shares - Compensation and startup Employment Considerations : Entrepreneurs Need Insurance – Do Fringe benefits – outsourcing your benefits work – Life Insurance – Health Insurance – Disability Insurance

Protecting Intellectual Property: Protecting your intellectual property: Copyrights - patents–Trade secrets – Trademarks - The Legal Form of your Startup: Corporation – Partnership – Limited Liability Company – Sole Proprietorship - – Making the startup decision: commitment – Leaving a current employer - stay fit.

Startup Capital Requirements and Legal Environment:

Identifying Startup capital Resource requirements - estimating Startup cash requirements - Develop financial assumptions- Constructing a Process Map - Positioning the venture in the value chain - Launch strategy to reduce risks- Startup financing metrics - The Legal Environment- Approval for New Ventures- Taxes or duties payable for new ventures..

Text Book:

1. James A. Swanson & Michael L. Baird, "Engineering your start-up: A Guide for the High-Tech Entrepreneur" 2nd ed, Professional Publications.inc
2. Donald F Kuratko, " Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

Reference Books:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
3. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. G. Murugesan	Professor	Management Studies	murugesan@vmkvec.edu.in
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	INTELLECTUALPROPERTY RIGHTS	Category	L	T	P	Credit
		OE-IE	3	0	0	3

PREAMBLE: The course is designed to introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1. To introduce fundamental aspects of Intellectual property Rights
2. To disseminate knowledge on patents and copyrights
3. To disseminate knowledge on trademarks, Design and Geographical Indication (GI),
4. To disseminate knowledge onPlant Variet, Layout Design Protection and create awareness about current trends in IPR
5. To disseminate knowledge onLegislation of IPRs and Alternate Dispute Resolution

COURSE OUTCOMES:

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

CO1: Understand the important of intellectual property rights	Understand
CO2: Apply for the patents	Apply
CO3: Understand and apply for the copyrights	Understand
CO4: Understand the important of trademarks	Apply
CO5: Appreciate the importance of IPR and its related issues	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	-	-	L	S	L	-	L	-	L	L	M	-
CO2	L	S	S	M	M	L	-	-	-	-	-	L	M	L	-
CO3	L	S	L	M	M	L	-	-	-	-	-	L	M	L	-
CO4	L	S	S	S	M	L	-	-	-	-	-	L	L	L	-
CO5	L	S	S	M	-	L	-	-	-	-	-	L	M	L	-

S- Strong; M-Medium; L-Low

SYLLABUS:

Unit 1 - Overview of Intellectual Property

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in

abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994.

Unit 2 - Patents & Copyright

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

Copyright - Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

Unit 3 – Trademarks, Design and Geographical Indication (GI)

Trademarks: Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

Design: Meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection

Geographical Indication (GI): Meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection

Unit 4 - Plant Varieties, Layout Design and Indian National Intelectual Property Policy

Plant Variety Protection: Plant variety protection: meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection.

Layout Design Protection: Layout Design protection: meaning – Procedure for registration, effect of registration and term of protection.

Indian National Intelectual Property Policy: India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies

UNIT – V: Legislation of IPRs and Alternate Dispute Resolution

Legislation of IPRs: The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act,

Geographical Indication Act, Bayh- Dole Act - Patent Ownership and Transfer, Patent Infringement, International Patent Law

Alternate Dispute Resolution: Alternate Dispute Resolution and Arbitration – ADR Initiatives –Reason for Choosing ADR – Advantages and Disadvantages of ADR – Assessment of ADR's – Litigation – Arbitration - Effective Mechanism for Business Issues.

Text Books:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference Book:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

COURSE DESIGNERS:

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1	P. S. Balaganapathy	Associate Professor	Management	dydirectormanagementstudies@avit.ac.in
2	A. Mani	Associate Professor	Management	mani@vmkvec.edu.in

	PRINCIPLES OF BIOMEDICAL INSTRUMENTATION	Category	L	T	P	
		OE-EA	3	0	0	

PREAMBLE

Toenablethestudentstodevelopknowledgeofprinciples,designandapplicationsof theBiomedical Instruments.

PREREQUISITE–NIL

COURSEOBJECTIVES

1	Toknowaboutbioelectricsignals,electrodesanditstypes.
2	ToknowthevariousBiopotentialrecording methods.
3	Tostudyaboutpatientmonitoringconceptandvarious Physiologicalmeasurementsmethods.
4	Tostudytheprincipleofoperationbloodflowmeter,bloodcellscounter.
5	Tostudyaboutbiochemicalmeasurementsanddetailstheconceptofbiotelemetryandpatientsafety.

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1. Explainthedifferent Biosignalor biopotential.	Understand
CO2. Discusstheworkingprinciplesofdiagnosticandtherapeuticequipments.	Understand
CO3. ExaminethevariousinstrumentslikeasECG,EMG,EEG,X-ray machine.	Apply
CO4. Illustratemedicalinstrumentsbasedonprinciplesandapplicationusedin hospital.	Analyze
CO5. Analyzeandcalibratefundamentalbiomedicalinstrumentationusedin hospital.	Analyze

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	--	--	-	--	--	--	--	--	--	--	L	M	--
CO2	M	--	--	--	--	--	--	--	L	--	--	L	M	--
CO3	S	S	M	S	M	--	--	--	M	--	--	M	M	M
CO4	S	M	M	M	L	--	--	L	S	L	--	S	M	S
CO5	S	S	M	M	L	M	--	L	S	L	--	S	M	S

S-Strong;M-Medium;L-Low

SYLLABUS

BIOELECTRICSIGNALSANDELECTRODES

Basicmedicalinstrumentationsystem,OriginofBioelectricPotential,Recordingelectrodes–ElectrodeTissueinterface, Electrolyte – skin interface, Polarization, Skin contact impedance, motion artifacts. Electrodes – Silver – silver electrodes, electrodes for ECG, electrodes for EEG, electrodes for EMG, Electrical conductivity of electrode jel creams, Microelectrodes.

BIOAMPLIFIERANDBIOMEDICAL RECORDERS

Bioamplifier, Need for Bioamplifier, Differential amplifier, Instrumentation amplifier, Chopper amplifier, I Amplifier, ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform.

PATIENTMONITORINGSYSTEMANDNONELECTRICALPARAMETERS MEASUREMENTS

System concepts of patient monitoring system, Bedside patient monitoring system, central monitors, Blood

measurement,Measurementoftemperature,Respirationratemeasurement,cardiacoutputmeasurement,Measuremento rate, Plethysmography technique.

BLOODFLOWMETERS, BLOODCELL COUNTERS

Electromagnetic blood flow meter, ultrasonic blood flow meter, Laser Doppler blood flow meter, Types of bloc Methods of cell counting, coulter counters, automatic recognition and differential counting.

BIO-CHEMICALMEASUREMENTSANDBIOTELEMETRYANDPATIENTSAFETY

Ph, Pc02, p02, Phco3 and electrophoresis, colorimeter, spectrophotometer, flame photometer, auto-a Biotelemetry-wireless telemetry, single channel telemetry, multichannel telemetry, multi patient telemetry.

TEXT BOOKS:

1. KhandpurR.S,**"Hand-bookofBiomedicalInstrumentation"**,TataMcGrawHill,2nd Edition,2003.
2. LeslieCromwell,FredWeibellJ,ErichPfeiffer.A,**"BiomedicalInstrumentationandMeasurements"**, Prentic India, 2nd Edition, 1997.

REFERENCES:

1. JohnG.Webster,**"MedicalInstrumentationapplicationanddesign"**,JohnWiley,3rd Edition, 1997.

Carr,JosephJ,Brown,John.M,**"IntroductiontoBiomedicalequipmenttechnology"**,JohnWileyandsons, New York Edition, 1997.

COURSEDESIGNERS

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		Category	L	T	P	Credit

	BIOSENSORSANDTRANSDUCERS	OE-EA	3	0	0	3

PREAMBLE

The course is designed to make the student acquire conceptual knowledge of the transducers and biological components used for the detection of an analyte. The relation between sensor concepts and biological concepts is highlighted. The principles of biosensors that are currently deployed in the clinical side are introduced.

PREREQUISITE–Nil

COURSEOBJECTIVES

1	Tousethebasicconceptsoftransducers,electrodes andits classification.
2	Todiscussthevarious typesof electrodes.
3	Todeterminetherecordingofbiological components.
4	Toemploytheknowledgeinelectrochemicalandopticalbiosensors.
5	Tooutlinethevariousbiologicalcomponentsusing biosensors.

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1. Describetheworkingprinciples of transducers.	Understand
CO2. Explainthevarious typesof electrodes.	Understand
CO3. UtilizevariousFETsensorsforrecordingofbiologicalcomponents.	Apply
CO4. Distinguishvariousbiosensorslikeelectrochemicalandopticalbiosensors.	Analyze
CO5. Analyzethebiologicalcomponentsusingbiosensorsinvarious applications.	Analyze

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO2	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO3	S	M	L	S	--	S	M	M	M	--	--	M	M	M	M
CO4	S	S	L	S	--	S	M	M	S	--	--	M	M	M	S
CO5	S	S	L	S	--	S	M	M	S	--	--	S	M	M	S

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTION: General measurement system, Transducers and its classification, Resistance transducers, capacitive transducer, Inductive transducer.

TRANSDUCERS:
Temperaturetransducers,piezoelectrictransducers,Piezoresistivetransducers,photoelectrictransducers.

BIOPOTENTIAL ELECTRODES:
Half cell potential, Types of Electrodes –Micro electrodes, Depth and needle electrodes, Surface electrodes, Chemicalelectrodes, Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

BIOSENSORS:
Biologicalelements,Immobilizationofbiologicalcomponents,ChemicalBiosensor-ISFET,IMFET,electrochemical sensor,

chemical fibro sensors.

APPLICATIONSOFBIOSENSORS:
Bananatrode,bloodglucosesensors,noninvasivebloodgasmonitoring,UREASEbiosensor,Fermentationprocess control, Environmental monitoring, Medical applications.

TEXT BOOKS:

1. H.S.Kalsi,**"ElectronicInstrumentation&Measurement"**,TataMcGrawHILL,1995.
2. BrainREggins,**"Biosensors:AnIntroduction",**JohnWileyPublication,1997.
3. Shakthichatterjee,**"BiomedicalInstrumentation"**,CengageLearning,2013.
4. JohnGWebster, **"MedicalInstrumentation:Applicationanddesign"**,JohnWileyPublications,2001.

REFERENCES:

1. K.Sawhney,**"AcourseinElectronicMeasurementsandInstruments"**,DhapatRai&sons,1991.
2. JohnPBentley,**"PrinciplesofMeasurementSystems"**,3rdEdition,PearsonEducationAsia,(2000Indianreprint).

GeddesandBaker,**"PrinciplesofAppliedBiomedicalInstrumentation"**,3rdEdition,JohnWileyPublications, 2008.

COURSEDESIGNERS

S.No.	Nameofthe Faculty	Designation	Department	Mail ID
1	Dr.L.K.Hema	Professor&Head	BME	hemalk@avit.ac.in
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3	Mr.V.Prabhakaran	AssistantProfessor(Gr-II)	BME	Prabhakaran.bme@avit.
4	Mrs.S.Vaishnodevi	AssistantProfessor	BME	vaishnodevi@vmkvec.e

		Category	L	T	P	Credit
	INTRODUCTION TO BIOFUELS	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

This course will provide an overview of existing energy utilization, production and infrastructure. We will also cover the consequences of our energy choices on the environment. The topics covered will include the chemistry of biofuels, the biology of important feedstocks, the biochemical, genetic and molecular approaches being developed to advance the next generation of biofuels and the economical and global impacts of biofuel production.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the different types and differences between existing energy resources.
2	To understand the improcurement, utilization and their impacts on society and environment
3	To gain knowledge about the existing different biofuels and the methods of production from different sources
4	To introduce the techonologies involved in the production, characterization of biofuels
5	To impacrt the knowledge and applications of biofuel in various sectors and their beneficial aspects to the society.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Understand the existing and emerging biomass to energy technologies	Remember
CO2. Understand the concept of 1st generation, 2nd generation and advance biofuels	Understand
CO3. Appraise the techno-economic analyses of biofuel conversion technologies	Understand
CO4. To articulate the concept of a biorefinery system and be able to develop major unit operations of an integrated biorefinery	Apply
CO5. Illustrate the environmental implications	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	L	-	M	-	S	L	-	-	-	-	S	-	L
CO2	-	S	S	-	M	-	L	-	-	-	-	-	-	S	L
CO3	S	M	-	M	-	M	-	L	L	-	-	-	S	-	L
CO4	-	S	M	-	M	L	L	-	-	-	-	-	-	S	M
CO5	-	-	-	-	-	-	-	S	M	-	-	-	-	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF BIOFUELS

Generation of biofuels – Development of biological conversion technologies – Integration of biofuels into biorefineries – Energy security and supply – Environmental sustainability of biofuels – Economic sustainability of biofuels.

BIODIESEL

Biodiesel – Microorganisms and raw materials used for microbial Oil production – Treatment of the feedstocks prior to production of the Biodiesel – Current technologies of biodiesel production – Purification of biodiesel; Industrial production of biodiesel – Biodiesel production from single cell oil.

BIOETHANOL

Bioethanol – Properties – Feedstocks – Process technology – Pilot plant for ethanol production from lignocellulosic feedstock – Environmental aspects of ethanol as a biofuel.

BIOMETHANE AND BIOHYDROGEN

Biomethanol – Principles, materials and feedstocks – Process technologies and techniques – Advantages and limitations – Biological hydrogen production methods – Fermentative hydrogen production – Hydrogen economy – Advantages and limitations.

OTHER BIOFUELS

Biobutanol production – Principles, materials and feedstocks – Process technologies – Biopropanol – Bioglycerol – Production of bio-oils via catalytic pyrolysis – Life-Cycle environmental impacts of biofuels and Co-products.

TEXT BOOKS:

1. Luque, R., Campelo, J.and Clark, J. Handbook of biofuels production, Woodhead Publishing Limited 2011 2. Gupta, V, K. and Tuohy, M, G. Biofuel Technologies, Springer, 2013 3. Moheimani, N. R., Boer, M, P, M, K, Parisa A. and Bahri, Biofuel and Biorefinery Technologies, Volume 2, Springer, 2015

REFERENCES:

1.Eckert, C, A. and Trinh, C, T. Biotechnology for Biofuel Production and Optimization, Elsevier, 2016 2. Bernardes, M, A, D, S. Biofuel production – recent developments and prospects, InTech,2011

COURSE DESIGNERS

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	FOOD AND NUTRITION TECHNOLOGY	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The course aims to enable the students to understand the physicochemical, nutritional, microbiological and sensory aspects, To familiarize the students about the processing and preservation techniques. To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Understand the tradition food processing techniques and the basics concept of food biochemistry
2	Demonstrate the product development technique, quality and contaminant check
3	To articulate their technical knowledge for industrial purpose
4	Describe national food laws and standards
5	Laws and qualities of standard for food products

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1: Recall the processing techniques practiced in olden days and the biological process	Remember
CO2. Illustrate the methods for animal product development, quality control and also screen the contaminant	Understand
CO3.Transfer the techniques in scaling up for industrial needs	Apply
CO4. Interpret and Troubleshoot instruments to maintain accuracy	Apply
CO5. Develop standards for food additives	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	M	S	M	L	-	-	-	-	-	-	-	M	L	-
CO4	M	S	S	M	L	-	-	-	-	-	-	-	S	S	-
CO5	-	S	S	M	M	-	-	-	-	-	-	M	L	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO FOOD BIOTECHNOLOGY

Introduction, History and scope of food Biotechnology, development and prospects of biotechnology in animal products, ancient and traditional food processing techniques; Biochemical and metabolic pathways of biological systems used in food production.

METHODS IN FOOD BIOTECHNOLOGY: Role of biotechnology in productivity of livestock, Modern biotechnological methods and processes in animal product development, chemical and physical factors required for growing microbial cultures in nutritive substrate; Meat species identification, Quality control, Screening products for contaminants

BIOTECHNOLOGY METHODS IN FOOD PROCESSING:

Use of biotechnology in the production of food additives, use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, Basic principles of the industrial use of bio-reactions for production of biomass-upstream and downstream processing application of microorganisms as starter cultures in meat industry, microbial production of food ingredients; Biosensors and novel tools and their application in food science.

HURDLE TECHNOLOGY:

Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology

FOOD SAFETY & SECURITY:

Consumer concerns about risks and values, biotechnology & food safety, Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; Future and applications of food biotechnology in India.

TEXT BOOKS:

1. Potter, Norman. M. Food Science, 5th Ed. Springer US

2. Manay, S.; Shadakshara Swamy, M., (2004). Foods: Facts and Principles, 4 th Ed. New Age Publishers.

3. B. Srilakshmi., (2002) Food Science, New Age Publishers.

REFERENCES:

1. Meyer, (2004). Food Chemistry. New Age

2. Deman JM. (1990) Principles of Food Chemistry. 2 nd Ed. Van Nostrand Reinhold, NY

3. Ramaswamy H and Marcott M. Food Processing Principles and Applications. CRC Press

COURSE DESIGNERS

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	DISASTERRISK MANAGEMENT	Category	L	T	P	Credit
		OE – EA	3	0	0	3

PREAMBLE

PREREQUISITE

NIL

COURSEOBJECTIVES

1	Tostudyabout theDisasterManagementCycles
2	ToStudyabouttheDisasterCommunityandplanning
3	ToUnderstandtheChallengesposedbyDisasterstothecommunity
4	Tostudyaboutcopingconceptsforbothnaturaland manmadedisasters
5	Tostudyaboutstrengtheningtechniquesforstructuralandnonstructuralmeasures

COURSE OUTCOMES

Onthesuccessfulcompletionofthe course,studentswillbeable to

CO1. UnderstandingDisasters,man-madeHazardsandVulnerabilities	UnderstandandApply
CO2. Understandingdisaster managementmechanism	Apply
CO3 Togainknowledgeabout organizationsinvolvedindisastercommunity	Apply
CO4. Tobuildskillstorespondtodisasters	Apply
CO5. Understandingcapacitybuildingconcepts andplanningofdisastermanagements	UnderstandandApply

MAPPING WITHPROGRAMMEOUTCOMES ANDPROGRAMMESPECIFICOUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	L	L	M	L	L	M	L	M	M	L	L	M
CO2	M	M	L	L	M	L	S	L	L	M	M	S	S	L	L	S
CO3	S	M	L	L	M	L	M	L	L	M	S	S	M	L	L	S
CO4	M	M	L	L	M	L	M	L	L	S	S	S	S	L	L	M
CO5	S	S	L	L	S	L	S	L	L	S	M	M	S	L	L	S

S-Strong;M-Medium;L-Low

SYLLABUS

UNITIINTRODUCTION

Overview of Disaster Management – Distinguishing between an emergency and a Disaster situation.Disaster Management Cycle – Disaster management Act and Policy in India; Organisational structurefordisastermanagementinIndia;Preparationofstateanddistrictdisastermanagementplans-PhaseI: Mitigation, and strategies; hazard Identification and vulnerability analysis. Disaster Mitigation andInfrastructure,impactofdisastersondevelopmentprogrammes,vulnerabilitiescausedbydevelopment, developingadraftcountry-leveldisasteranddevelopmentpolicyPhaseII:Preparedness, Disaster Risk Reduction(DRR), Emergency Operation Plan (EOP) Phases III and IV:Response and recovery, Response aims, Response Activities, Modern and traditional responses todisasters,DisasterRecovery,andPlan

UNITII DISASTERPLANNING

DisasterPlanning-DisasterResponsePersonnelandduties,CommunityMitigationGoals,Pre-DisasterMitigationPlan,PersonnelTraining,VolunteerAssistance,School-basedProgrammes,HazardousMaterials,Waysofstoringandsafelyhandlinghazardousmaterials,CopingwithExposure

.

UNITIIIDISASTERCOMMUNITY

Disaster Community-Community-based Initiatives in Disaster management, need for Community-Based Approach, categories of involved organizations: Government, Nongovernment organizations(NGOs), Regional AndInternational Organizations, Panchayaths, Community Workers, NationalAnd Local Disaster Managers, Policy Makers, Grass-Roots Workers, Methods Of Dissemination OfInformation, Community-Based Action Plan, Advantages/Disadvantages Of The Community BasedApproach

UNITIV COPINGWITHDISASTER

Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - IndustrialSafetyPlan;Safetynormsand survivalkits-Massmediaand disastermanagement

UNITV CAPACITYBUILDING

Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity forReducing Risk - Counter-Disaster Resources and their utility in Disaster Management - LegislativeSupportatthestate andnationallevels

TEXTBOOKS:

1. ManualonDisaster Management, NationalDisasterManagement,AgencyGovtofIndia.
2. Ayaz,."DisasterManagement:ThroughtheNewMillennium",AnmolPublications.(2009)
3. Dave,P.K.."Emergency MedicalServicesandDisasterManagement:AHolisticApproach",NewDelhi:JaypeeBrothersMedicalPublishers(P)Ltd.,2009
4. Disaster ManagementbyMrinaliniPandeyWiley2014.
5. Goel,S. L.,"DisasterManagement",NewDelhi:Deep&DeepPublicationPvt. Ltd.,2008

REFERENCEBOOKS:

1. Narayan,B."DisasterManagement",NewDelhi:A.P.H.PublishingCorporation,2009
2. Kumar,N.. "DisasterManagement".NewDelhi:AlfaPublications.,2009
3. Ghosh,G.K.,"DisasterManagement",New Delhi:A.P.HPublishingCorporation.

S.No	NameoftheFaculty	Designation	Nameofthe College	MailID
1	MrsJ.Srija	AssistantProfessor-I	AVIT	srija.civil@avit.ac.in

		Category	L	T	P	Credit
	MUNICIPAL SOLID WASTE MANAGEMENT	**OE-EA**	**3**	**0**	**0**	**3**

Preamble

Structure is an arrangement and organization of interrelated elements in a material object or system, or the object or system so organized. Material structures include man-made objects such as buildings and machines and natural objects such as biological organisms, minerals and chemicals.

Prerequisite

Nil

Course Objectives

1.	The on-site/off-site processing of the same and the disposal methods.
2.	The student is expected to know about the various effects and disposal options for the municipal solid waste.
3.	The collection and supply of water
4.	The offsite processing involved in site

Course Outcomes

On the successful completion of the course, students will be able to

CO1. To know about the types of waste & Sources	Analyze
CO2 . To Study the on site Storage & Processing	Apply
CO3. To study about the collection & transfer the waste	Apply
CO4. To Study the process of off site processing	Apply
CO5. To know about the solid waste disposal	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**L**	-	-	-	-	-	-	-	-	-		-	**S**
CO2	**S**	**M**	**L**	**S**	-	-	-	-	-	-	-	-		**M**	**S**
CO3	**S**	**M**	**M**	**S**	-	-	-	-	-	-	-	-		**M**	**S**
CO4	**S**	**M**	**M**	**M**	-	-	-	-	-	-	-	-		**M**	**S**
CO5	**S**	**M**	**M**	-	-	-	-	-	-	-	-	**L**		-	**S**

S- Strong; M-Medium; L-Low

Syllabus

SOURCES AND TYPES OF MUNICIPAL SOLID WASTES

Sources and types of solid wastes-major legislation-monitoring responsibilities-Effects of disposal of solid wastes - Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization– public health effects. Principle of solid waste management – social & economic aspects; Public awareness; Role of NGOs; Legislation.

ON-SITE STORAGE & PROCESSING

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

COLLECTION AND TRANSFER

Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, Anaerobic digestion, RDF and Incineration and co-generation of energy using waste, Pyrolysis of solid Waste operation & maintenance; options under Indian conditions.

OFF-SITE PROCESSING

Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions-cradle to grave management concept, Prevailing laws of hazardous waste management- Risk assessment.

DISPOSAL

Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment.

Text Books

1. George Tchobanoglous et.al., “Integrated Solid Waste Management”, McGraw-HillPublishers, 2002.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, “Waste Management”,Springer, 1994.
3. Charles A. Wentz; "Hazardous Waste Management", McGraw-Hill Publication, Latest publication, (1992).

Reference Books

1. R.E.Landreth and P.A.Rebers, “Municipal Solid Wastes – problems and Solutions”, Lewis Publishers, 1997, Bhide A.D. and Sundaresan, B.B., “Solid Waste Management in Developing Countries”,INSDOC, 1993.

2. Handbook of Solid Waste Management by Frank Kreith, George Tchobanoglous, McGraw Hill Publication, (2002), Bagchi, A., Design, Construction, and Monitoring of Landfills, (2nd Ed). Wiley Interscience, ISBN: 0-471-30681-9, Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development.

3. Government of India, New Delhi, (2000).

4. NPTEL – Municipal Soild Waste Management by Prof. Ajay Kalamdhad – IIT Guwahati.

INTRODUCTION
What is AI? – AI Problems – What is an AI technique – Defining the problem as a state space search – Production system - Production system – Characteristics – Problem Characteristics?
HEURISTIC SEARCH TECHNIQUES
Generate and test – Hill Climbing – Best first Search – Problem Reduction – Constraints satisfaction – Means end analysis.
KNOWLEDGE REPRESENTATION
Propositional Logic-First Order Predicate Logic-Prolog Programming-Unification-Forward Chaining- Backward Chaining-Ontological Engineering-Categories and Objects-Events-Mental Events and Mental Objects.
REPRESENTING KNOWLEDGE USING RULES
Procedural versus – Declarative Knowledge – logic Programming – Forward versus Backward Reasoning – Matching
GAME PLAYING
The Minimax search procedure – Adding Alpha Beta cut offs – Addition Refinements – Waiting for Quiescence – Secondary Searches – Using Book moves.
TEXT BOOKS
1. S. Russell and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education, 2015 Bratko, I., Prolog Programming For Artificial Intelligence (International Computer Science Series), Addison-Wesley Educational Publishers Inc; 4th Edition, 2011..
REFERENCES
1. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: A Logical Approach", Oxford University Press, 2004. 2. G. Luger, "Artificial Intelligence: Structures and Strategies For Complex Problem Solving", Fourth Edition, Pearson Education, 2002. 3. J. Nilsson, "Artificial Intelligence: A New Synthesis", Elsevier Publishers, 1998.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.M.Nitya	Professor	CSE	nithya@vmkvec.edu.in
2	Dr.M.Jayachandran	Professor	CSE	jayachandran@avit.ac.in

		Category	L	T	P	Credit
	INTRODUCTION TO INTERNET OF THINGS	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

Introduction to IoT for statistical data manipulation and analysis. It was inspired by and is most compatible with the statistical language.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To learn Introduction to IoT.
2	To Study methodology of IoT.
3	To Develop IoT applications using Arduino and Intel Edition.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: To Understand the basics in Introduction to IoT in terms of constructs, control statements, string functions	Understand
CO2: To Understand the use of Introduction to IoT fundamentals.	Understand & Apply
CO3: Learn to apply Introduction to IoT for Communicating Sequential Process	Understand & Apply
CO4: Able to appreciate and apply the Introduction to IoT from a statistical perspective	Understand & Apply
CO5 To learn Introduction to IoT Challenges	Understand & Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	L	S	S	M	S	L	S	-	**S**	M	S
CO2												M	M	M	S
CO3	M	S	M	M	M	S	S	M	S	M	M	-	M	-	S
CO4												M	M	S	M
CO5	S	S	S	S	M	S	S	S	S	M	S	S	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I –INTRODUCTION to IoT

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

.

UNIT II- IoT & M2M

Machine to Machine, Difference between IoT and M2M, Software define Network

UNIT III – Network & Communication aspects

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

UNIT IV – Domain specific applications of IoT

Design challenges, Development challenges, Security challenges, Other challenges

UNIT V – Reflection, Low-Level Programming

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

TEXT BOOKS

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

REFERENCES

1. Macro Schewartz, “Internet of Things with the Arduino Yun” Packet Publishing, 2014.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.M.Jayachandran	Professor	CSE	jayachandran@avit.ac.in
2	Dr.M.Nitya	Professor	CSE	nithya@vmkvec.edu.in

	CYBER SECURITY	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

To understand the need for Cyber Security in real time and to study techniques involved in it.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	To understand the fundamentals of Cyber Security and issues
2.	To study various cyber crimes and legal remedies
3.	To apply various privacy and security
4.	To study E-Commerce and digital payments
5.	To study the basic security aspects related to Computer and Mobiles

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Able to understand the concept of Cyber security and issues and challenges associated with it.	Understand
CO2: Able to understand the cyber crimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures	Apply
CO3: Able to appreciate various privacy and security concerns on online Social media and understand the reporting procedure of inappropriate content, underlying legal aspects and best practices for the use of Social media platforms.	Apply
CO4: Able to understand the basic concepts related to E-Commerce and digital payments.	Apply
CO5: Able to understand the basic security aspects related to Computer and Mobiles.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	M	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M		-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	S	-	-	-	-	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO CYBER SECURITY 9 hours
Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.
CYBER CRIME AND CYBER LAW 9 hours
Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies.
SOCIAL MEDIA OVERVIEW AND SECURITY 9 hours
Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.
E - C O M M E R C E AND DIGITAL PAYMENTS 9 hours
Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payament Settlement Act,2007.
DIGITAL DEVICES S E C U R I T Y , TOOLS AND TECHNOLOGIES FOR CYBER SECURITY 9 hours
End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.
REFERENCES
1. Cyber Crime Impact in the New Millennium, by R. C Mishra, Auther Press. Edition 2010. 2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011) 3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson, 13th November, 2001) 4. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd. 5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers. 6. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd. 7. Fundamentals of Network Security by E. Maiwald, McGraw Hill

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Jaichandran	Assistant professor G-II	CSE	rjaichandran@avit.ac.in

2	Mr. B. Sundharamurthy	Assistant Professor	CSE	sundharamurthy@vmkvec.edu.in

	DESIGN OF ELECTRONIC EQUIPMENT	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The objective of this course is to sensitise a registrant to various aspects of an electronics product. Specifically on non-Electrical aspects like mechanical design and detailing. Starting from a need translated into specifications, leading to design and prototyping and ending up in a manufacturable physical prototype.

PREREQUISITE – BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OBJECTIVES

1	*To understand the various Concept of Industrial Design process.*
2	*To apply the basic Concept of electronic Product designs methodology.*
3	*To classify the Concept of Ergonomics & aesthetics in product design.*
4	*To understand the Knowledge regarding the design of product packaging and working environment.*
5	*To understand the Knowledge of different industrial standard and value analysis.*

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Visualize the concept for product design with respect to ergonomics and aesthetics.	*Remember*
CO2. Analyze, design and implement control panels of electronic equipment	*Apply*
CO3. Apply creativity in the design of system by formulating architecture with proper placement of components.	*Apply*
CO4. Apply the concept of visual communication techniques in product design.	*Apply*
CO5. Apply the process of value analysis in existing product.	*Apply*

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	*PO1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	*M*	*L*	-	-	*S*	-	-	*L*	*M*	*L*	-	-	*S*	-	-
CO2	*M*	*L*	-	*M*	*S*	-	-	*L*	*M*	*L*	-	-	*S*	-	-
CO3	*M*	*L*	-	*M*	*S*	-	-	*L*	*M*	*L*	-	*L*	*S*	-	*M*
CO4	*S*	*M*	*L*	-	*S*	-	-	*L*	*M*	*L*	-	*L*	*S*	*M*	*M*
CO5	*S*	*M*	*L*	-	*S*	-	-	*M*	*L*	*L*	-	*L*	*S*	*M*	*M*

S- Strong; M-Medium; L-Low

SYLLABUS

MODULE 1: INTRODUCTION

Introduction to industrial design, Role of industrial design in the domain of industry, Generic product development process, ID process, Product innovations, tools and methods.

MODULE 2: PRODUCT PROTOTYPES

Management of ID process, Product architecture, Structure: standard and non-standard structures. Product prototypes.

MODULE 3: PRODUCT DESIGN AND PLANNING

Electronic product design and devel ...*ies, brainstorming documentation.*

Product planning: Defining the task ...*sting and Pricing of Industrial design,*

MODULE 4: ERGONOMICS

Ergonomics: Ergonomics of electronic equipment, Ergonomics of control panel design. Use of ergonomics at work places and plant layout. Aesthetics: Elements of aesthetics, aesthetics of control panel design.

MODULE 5: CASE STUDIES

Value engineering, Product quality and design management. Industrial standards, Graphics and packaging

TEXTBOOKS:

1. Carl T. Ulrich, Steven. D. Eppinger," "Product Design and Development", McGraw Hill Companies.

REFERENCE BOOKS:

1. Ernest J Mccormick ,"Human factors in Engineering and Design" -, McGraw-Hill Co.

2. Yammiyavar P," Control Panel Design and Ergonomics", CEDT/IISc Publication.

3. Murrell K, Chapman," Ergonomics: Man in his Working Environment", &Hall. London. Flurschiem C H, "Industrial Design and Engineering Design ", Council, London and Springer Verlag, 1983

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	*Mr.Rajat Kumar Dwibedi*	*Assistant Professor*	*ECE*	*rajatkumar.ece@avit.ac.in*
2	*Dr. L.K.Hema*	*Prof.&Head/ECE*	*ECE*	*hodece@avit.ac.in*
3	*Mr.G.Murali*	*Assistant Professor*	*ECE*	*muralig@vmkvec.edu.in*

	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

Industry 4.0 and Industrial Internet of Things is the pioneer of today's modern technology. To match the engineering skills with the industry skills this subject will induce and impart the knowledge among the young professionals.

PREREQUISITE

Basic knowledge of computer and internet

COURSE OBJECTIVES

1	*Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.*
2	*Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation.*
3	*Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems.*
4	*IIoT links the automation system with enterprise, planning and product lifecycle.*
5	*Real case studies*

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Apply & Analyzing the transformation of industrial process by various techniques.	*Analyze*
CO2. Evaluate the transformation technologies are considered to be the different drivers.	*Apply*
CO3. Existing industrial systems will adopt the applications of IIoT.	*Apply*
CO4. Intensive contributions over automation system with enterprise, planning and product life cycle	*Analyze*
CO5. Analyze of various Real time case studies.	*Analyze*

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	S	S	M	-	M	-	-	-	-	-	-	M	S	M	-
CO2	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO3	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO4	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO5	S	S	S	S	M	-	-	-	-	-	-	M	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO INDUSTRY 4.0 ANDINDUSTRIAL INTERNET OF THINGS*Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II.Industry 4.0: Globalization, The Fourth Revolution, LEAN Production Systems, Cyber Physical Systems and Next Generation Sensors, Collaborative Platformand Product Lifecycle Management*

INDUSTRIAL INTERNET OF THINGS& IT'S LAYERS

Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation. IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II.

IIoT COMMUNICATION

Communication-Part I, Industrial IoT- Layers: IIoT Communication, IIoT Networking-Part I, Part II, Part III. Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT

IIoT BIG DATA & SDN APPLICATIONS

Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, and Industrial IoT-Application Domains. Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

APPLICATIONS & REAL TIME CASE STUDIES

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies - Virtual reality lab, Manufacturing industries – part one, Manufacturing industries – part two, Milk processing and packaging industries, Steel technology lab, Student projects – part one, Student projects – part two

TEXT BOOKS:

1. *Anandarup Misra, Sudip | Roy, Chandana | Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0, CRC press, 2003.*

REFERENCE BOOKS:

1. *Gilchrist, Alasdair, "Introduction to IoT", Apress, 2016*
2. *Gilchrist, Alasdair "IIoT Reference Architecture", Apress, 2016*

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	*Dr. L.K.Hema*	*Professor &Head*	*ECE*	*hodece@avit.ac.in*
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	3D PRINTING AND ITS APPLICATIONS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

Preamble

The course is designed to impart knowledge and skills related to 3D printing technologies its type applications.

Prerequisite – NIL

Course Objective

1	To Know the importance of 3D printing in Manufacturing
2	To know about Vat Photo Polymerization & Material Jetting.
3	To know about binder jetting material extrusion & sheet lamination
4	To know about the methods for powder bed fusion & direct energy deposition.
5	To know about the applications of 3D Printing.

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

CO1.	Importance of 3D printing in Manufacturing	Remember
CO2.	Vat Photo Polymerization & Material Jetting.	Understand
CO3.	Binder jetting material extrusion & sheet lamination	Understand
CO4.	Powder bed fusion & direct energy deposition.	Understand
CO5.	Applications of 3D Printing.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	L	M	-	S	M	M	-	-	-	-	-	M	M-	M
CO3	M	L	M	-	S	M	M	-	-	-	-	-	M	M-	M
CO4	M	L	M	-	S	M	M	-	-	-	-	-	M	M-	M
CO5	M	L	L	-	-	-	-	-	-	-	-	-			

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Need - Development of AM systems – AM process chain -Classification of AM processes- Applications- Advantages of AM and Types of materials for AM.Introduction to STL format, Pre & Post-processing of STL files, Various slicing methods, Part orientation and support generation, Support structure design, Tool path generation

VAT PHOTO POLYMERIZATION & MATERIAL JETTING

Vat Photo polymerization - Stereo lithography process, working principle, advantages and disadvantages, Material Jetting - process, working principle, advantages and disadvantages.

BINDER JETTING-MATERIAL EXTRUSION & SHEET LAMINATION

Binder Jetting- process, working principle, advantages and disadvantages. Material Extrusion –Fused Deposition Modeling process, working principle, advantages and disadvantages. Sheet Lamination – Laminated Object Manufacturing process, working principle, advantages and disadvantages.

POWDER BED FUSION & DIRECT ENERGY DEPOSITION

Powder Bed Fusion – Selective Laser Sintering process, working principle, advantages and disadvantages, Direct Energy Deposition- process, working principle, advantages and disadvantages.

APPLICATIONS OF 3D PRINTING

Applications for 3D Printing - Use of 3D Printing-Limitations of 3D Printing and Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing-Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions.

Text Books

1	Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
2	Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.

Reference Books

1	Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
2	Ali K. Kamrani, Emand Abouel Nasr,"Rapid Prototyping: Theory & Practice", Springer, 2006.
3	Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.

Course Designers

Sl.No	**Faculty Name**	**Designation**	**Department/ Na me of the college**	**Email id**
1	S.Kalyanakumar	Assistant Professor Gr II	Mech / AVIT	kalyanakumar@avit.ac.in

	INDUSTRIAL ROBOTICS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

Preamble

Theobjectiveofthiscourseistoimpartknowledgeaboutindustrialrobotsfortheircontrolanddesign.

Prerequisite :
NIL

CourseObjective

1	Tointroducebasicconcepts,partsofrobotsandtypesofrobots
2	TolearnaboutRobot kinematicsanddynamics
3	Tolearndifferent typesofsensorsusedinrobotsanditscontrol
4	Tounderstandthedifferenttypesofactuationsystemsusedinrobots
5	TounderstandtherobotcontrolSystems,programmingofrobotsanditsApplications.

CourseOutcomes:On thesuccessfulcompletionofthecourse,studentswillbeableto

CO1.	Understandthebasicconfigurationsandkinematicsystemsofrobots	Understand
CO2.	Solveproblemsofrobotkinematicsanddynamics	Apply
CO3.	Understandthedifferenttypesofsensorsusedinrobotsystemsandtheira pplications,different typesofcontrolsystemsused inrobots	Understand
CO4.	Understandandapplicationsofthedifferent types ofactuatorsusedin robot systems	Understand
CO5.	Understandthe RobotApplications in various fields	Understand

MappingwithProgrammeOutcomesandProgrammeSpecificOutcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	L	-	-	-	-	-	-	S	-	L
CO2	S	S	M	M	-	M	-	-	-	-	-	-	S	-	L
CO3	S	M	M	M	-	M	-	-	-	-	-	-	S	-	L
CO4	S	S	M	M	-	L	-	-	-	-	-	-	S	-	L
CO5	S	S	L	S	-	S	-	-	-	-	-	-	S	-	L

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTIONTOROBOTICS

Introduction to Automation and Robotics– Basic concepts, Need, Law, History, Anatomy, specificationsclassification, present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, degrees of freedom, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

ROBOT ARM KINEMATICS

Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control

GRIPPERS AND SENSORS FOR ROBOTICS

Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics, Selections of sensors. Necessity for sensors and vision system in the working and control of a robot.

ROBOTACTUATIONSYSTEMS

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

ROBOTAPPLICATIONS

Robot Application in Manufacturing: Material Transfer – Material handling, loading and unloading- Processing – spot and continuous arc welding & spray painting – Assembly and Inspection. ApplicationsinMedical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Micro and Nano robots, Future Applications.

TextBooks

1	Saha,S.K.,"IntroductiontoRobotics,2ndEdition,McGraw-HillHigherEducation,NewDelhi,2014.
2	MikellPGroover,NicholasGOdrey,MitchelWeiss,Roger NNagel,AshishDutta,"IndustrialRobotics, TechnologyprogrammingandApplications",McGrawHill,2012.
3	MittalR.K.andNagrathI.J.,"RoboticsandControl",TataMcGrawHill.

ReferenceBooks

1	Ghosal, A.,"Robotics",Oxford, NewDelhi,2006.
2	NikuSaeedB.,"IntroductiontoRobotics:Analysis,Systems,Applications",PHI,NewDelhi.
3	SteveHeath,"EmbeddedSystemDesign",2ndEdition,Newnes,Burlington,2003
4	MerzoukiR.,SamantarayA.K.,PhathakP.M.andBouamamaB.Ould,"IntelligentMechatronicSystem:Modeling, ControlandDiagnosis",Springer.

CourseDesigners

S.No	FacultyName	Designation	Department/ Nameofthe College	Emailid
1	P.KUMARAN	AP-II	MECH/AVIT	kumaranp@avit.ac.in

	BIOMOLECULES - STRUCTURE, FUNCTION IN HEALTH AND DISEASE	Category	L	T	P	C
		OE-EA	3	0	0	3

PREAMBLE

Biomolecules like carbohydrates, proteins, fat are vital components of any living system. Basic knowledge about them helps in maintaining a healthy lifestyle, free of sickness and a general awareness about hygiene.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To give an overview of importance of biomolecules
2	To elaborate the structure of proteins and nucleic acids and its role in disease.
3	To enumerate the role of carbohydrates and their cellular function in physiology and pathology
4	To enumerate the role of lipids and their cellular function in physiology and pathology.
5	To briefly cholesterol and its role in diseases

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Relate the basics of biomolecules in and around him	Understand
CO2. Understand the structure of biomolecules such as proteins and nucleic acids	Understand
CO3. Discover the role of carbohydrates in healthy and diseased conditions	Apply
CO4. Relate disfunctioning of lipids with disease	Analyse
CO5. Criticize the role of cholesterol in diseases.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	-	-	L	-	-	-	-	-	-	-	L	-
CO2	S	M	S	-	-	M	-	-	-	-	-	-	-	L	-
CO3	M	L	M	M	-	S	-	-	-	-	-	-	-	L	-
CO4	L	L	L	L	S	L	-	-	S	-	-	M	L	M	M
CO5	S	-	L	L	-	M	-	-	-	-	-	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

PROTEINS

Protein – Structure – primary, secondary, tertiary. Types of proteins and their function. Role of each type of Protein in Health and Disease.

NUCLEIC ACIDS

Nucleic Acids – Components of nucleic acids, Conformational parameters. Nucleic acids – Types of DNA and RNA. DNA Polymorphism, Circular DNA, Supercoil DNA, DNA-Protein interactions. Role of nucelic acids in Health and disease

CARBOHYDRATES

Carbohydrates – Introduction. Types – monosaccharide, disaccharide, oligosaccharide and polysaccharides. Structure of each type. Artificial sugars. Role of carbohydrates in Health and Disease

FATTYACIDS AND LIPIDS

Fatty acids- Introduction, nomenclature, types - Saturated and unsaturated fatty acids, Essential and non-essential fatty acids.

Lipids – Introduction, Classification - simple and compound lipids, phospholipids, Cholesterol and its role in health and disease, Micelles and Liposomes : Applications in biology and medicine

CELL MEMBRANE AND CELL SIGNALING

Cell membrane - components and architecture, Various membrane models including Fluid-mosaic model. Ion channels, Receptors, Signaling molecules, Signaling mechanism, Role of cell signaling in Health and Disease. Inter-relationship of biomolecules.

TEXTBOOKS

1. Biophysical Chemistry, Part II, Techniques for the study of biological structure and function, by Cantor C.R. and Schimmel P R., W.H. Freeman and Company, 1980.

2. Nucleic Acids in chemistry and Biology, by Blackburn G.M. and gait M.J., IRL Press, 1990.

3. Biochemistry, by Voet D. and Voet J.G., John Wiley and sons, 1995.

4. Physical Biochemistry, by Freifelder D., W.H. Freeman and company, 1976-1982.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID

1	Dr.P.David Annaraj	Assistant professor	Pharmaceutical Engineering	davidannaraj@vmkvec.edu.in
2	Ms.S.Sowmiya	Assistant Professor	Pharmaceutical Engineering	sowmiya.vmkvec@vmrf.edu.in

	PHARMACOGENOMICS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

Pharmacogenomics involves the study of the relationship between an individual's genetic makeup and his or her response to a drug. Pharmacogenetics, a component of pharmacogenomics, is the study of the relationship between a single gene and its response to a drug.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Discuss about the basic knowledge about pharmacogenomics and drug design using genomic applications for drug action and toxicity.
2	Perform how individualization of drug therapy can be achieved based on a person's genetic makeup while reducing unwanted drug effects.
3	Outline the Pharmacogenomics studies on how genetic differences between individuals can affect responses to various drugs.
4	Formulate on medicine skills acquired by the student and his action in different pathologies
5	Develop acquire knowledge about the influence of genetic alterations on the therapeutic effect and adverse reactions of the drugs, from a perspective of individualized therapy.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1.Recognize the effect of genetic differences between individuals in the outcome of drug therapy and in drug efficacy and toxicity.	Remember
CO2. Describe the role of single nucleotide polymorphism as a biomarker for the prediction of risk, therapeutic response and prognosis of malignancies.	Understand
CO3. Utilize and manage the new genomics based tools as they become available as well as make best treatment choices.	Understand
CO4. Examine the applications of genomics principles in drug action and toxicology	Analyze
CO5. Validation of case studies related to pharmacogenomics	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	L	L	L	-	L	L	L	L	L	L	
CO2	M	M	M	M	L	-	-	-	M	-	L	L	L	L	-
CO3	S	S	S	S	L	-	-	-	M	-	L	L	L	L	-

CO4	M	M	M	M	M	-	-	-	S	-	L	L	M	L	-
CO5	L	L	L	L	S	-	-	-	M	-	M	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

PHARMACOGENOMICS AND PERSONALIZED MEDICINE

Pharmacogenetics - Roots of pharmacogenomics and it is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, Drivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy,Barriers.

HUMAN GENOME

Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions, Protein coding genes, repeat elements, genome duplication, analysis of proteome, DNA variation, Biological complexity. Single nucleotide polymorphisms (SNP's) in Pharmacogenomics - approaches, number and types of SNPs, Study design for analysis, Analytical issues, Development of markers.

ASSOCIATION STUDIES IN PHARMACOGENOMICS

Viability and Adverse drug reaction in drug response, Multiple inherited genetic factors influence the outcome of drug treatments, Association studies in pharmacogenomics, Strategies for pharmacogenomics Association studies, Benefits of Pharmacogenomics in Drug R & D.

GENOMICS APPLICATIONS FOR DRUG ACTION, TOXICITY AND DESIGN

Platform technologies and Pharmaceutical process, its applications to the pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization, safety and toxicology studies. The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug targets leading to change in the ligand binding pocket.

PHARMACOGENOMICS – CASE STUDIES

Study of pharmacogenomics of human P-Glycoprotein, drug transporters, lipid lowering drugs,

chemotherapeutic agents for cancer treatment.

TEXT BOOKS

1. Martin M. Zdanowicz, M.M. “Concepts in Pharmacogenomics” Second Edition, American Society of Health-System Pharmacists, 2017.
2. Licinio, J and Wong, Ma-Li. “Pharmacogenomics: The Search for the Individualized Therapies”, Wiley-Blackwell, 2009.
3. Yan Q, “Pharmacogenomics in Drug Discovery and Development” Humana Press, 2nd Edition, 2014.

REFERENCES

1. Brazeau, D.A. and Brazeau, G.A. “Principles of the Human Genome and Pharmacogenomics” American Pharmacist Association, 2011
2. Werner, K., Meyer, U.A., Tyndale, R.F. “Pharmacogenomics”, Second Edition, Taylor and Francis, 2005.
3. Langman, L.J. and Dasgupta, A. "Pharmacogenomics in Clinical Therapeutics", Wiley – Blackwell, 2012

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Ms. R. Jaishri	Assistant Professor	Pharmaceutical Engineering	jaishri@vmkvec.edu.in

	PROJECT WORK	Category	L	T	P	Credit
		PI-P	0	0	16	8

PREAMBLE

The project provides learners with the opportunity to explore a problem or issue of particular personal or professional interest and to address that problem or issue through focused study and applied research under the direction of a faculty member. The project demonstrates the learner's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems. This final project affirms learners' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively.

PREREQUISITE –Nil

COURSE OBJECTIVES

1	To provide learners with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.
2	To allow learners to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.
3	To encourage learners to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.
4	To provide learners with the opportunity to refine research skills and demonstrate their proficiency in written & oral communication skills.
5	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Apply the knowledge and skills acquired in their courses to a specific problem or issue.	Apply
CO2. Extend their academic experience into areas of personal interest, working with new ideas, issues,organizations, and individuals.	Analyze
CO3. Think critically and creatively about academic, professional, or social issues and to furtherdevelop their analytical and ethical leadership skills necessary to address and help solve theseissues.	Create
CO4. Refine research skills and demonstrate their proficiency in written & oral	Evaluate

communication skills.	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO'S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	S	L	L	M	M	-	-	-	M	M	-	M	M	M	-
CO2	M	M	M	M	L	-	-	-	M	L	-	M	M	M	M
CO3	S	S	M	M	-	-	-	L	-	L	S	M	S	S	-
CO4	S	M	M	M	-	-	-	L	-	L	M	M	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. The project is a major component of our engineering curriculum: it is the culmination of the program of study enabling the learners to showcase the knowledge and the skills they have acquired during the previous four years, design a product/service of significance, and solve an open-ended problem in engineering.
2. Each student must register to the project course related to his or her program
3. Project course consists of one semester and would be allowed to register only during the final year of study.
4. Project may be initiated during the pre-final semester but will be assessed and credits transferred only during the last semester of study, upon completion of all other degree requirements. Generally the undergraduate project is a team based one.
5. Each team in the major course will consist of maximum of 5 learners.
6. Each project will be assigned a faculty, who will act as the supervisor.
7. The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability.
8. Each group must document and implement a management structure. Group leadership roles must be clearly identified including who has responsibility for monitoring project deliverables and group coordination.
9. A group project may be interdisciplinary, with learners enrolled in different engineering degrees, or in Engineering plus other faculties such as Management, Medical and Health Sciences, Science and Humanities.
10. Each student team is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session.
11. Salient points discussed at meetings with the supervisor (i.e., suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work.
12. The logbook may be formally assessed;

13. The contribution of each individual team member will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done.
14. A project report is to be submitted on the topic which will be evaluated during the final review.
15. Assessment components will be as spelt out in the regulations.
16. The department will announce a marking scheme for awarding marks for the different sections of the report.
17. The project report must possess substantial technical depth and require the learners to exercise analytical, evaluation and design skills at the appropriate level.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Devarajan	Professor	EEE/VMKVEC	deverajan@vmkvec.edu.in
2	Dr. L.Chitra	Asso. Prof.	EEE/AVIT	chitra@avit.ac.in

	MINI PROJECT / DESIGN PROJECT	Category	L	T	P	Credit
		PI-M	0	0	6	3

PREAMBLETo obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

PREREQUISITE –Nil

COURSE OBJECTIVES

1	To conceptualize a novel idea / technique into a product
2	Apply the acquired knowledge to carry out a capstone project having substantial multidisciplinary component
3	To understand the management techniques of implementing a project
4	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Apply the knowledge and skills acquired in their courses to a specific problem or issue.	Apply
CO2.Apply the acquired knowledge to carry out a capstone project having substantial multidisciplinary component	Apply
CO3. Take the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work	Analyze
CO4. Explain design thinking practices and their applications	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	L	-	-	-	M	M	-	M	M	M	M
CO2	S	L	L	M	M	-	-	-	M	M	-	M	M	M	-
CO3	M	M	M	M	L	-	-	-	M	L	-	M	M	M	M
CO4	S	S	M	M	-	-	-	L	-	L	S	M	S	M	-

S- Strong; M-Medium; L-Low

Norms

- Each student must register to the project course related to his or her program
- Mini Project course consists of one semester and would be allowed to register only during the final year of study.
- Minor design project identification, the objective and methodology and expected outcome of the proposed work.
- Presentation of the proposed work design, implementation and partial result
- Presentation of complete project work with results and discussion Demonstration of project work
- Minor Project Report

COURSE DESIGNERS

S. No	Name of the Faculty	Designation	Dept	Mail ID
1	Dr.R.Devarajan	Professor	EEE	deverajan@vmkvec.edu.in
2	Dr. L.Chitra	Asso. Prof.	EEE	chitra@avit.ac.in

Course Code	Course Title	Category	L	T	P	C
	YOGA AND MEDITATION	**AC**	**0**	**0**	**2**	**0**

OBJECTIVES:

Yoga is derived from a Sanskrit word 'yuj' which loosely means 'union.' It is a path through which an individual unites with the entire existence. Sounds heavy, right? It basically means how you are not a separate entity but part of a greater energy. It increases your consciousness and makes you realize your true self-clearing the clutter of all that you imbibed as part of your culture, family, and education. It makes you realize that there is something more than what you see around. It is a deeply spiritual practice that is part philosophy, religion, science, and exercise.

COURSE CONTENT

- Surya namaskar,Padmasana, Uttakatasana
- Surya pranayama, BrahmariPranayama
- Anjalimudra, Mahamudra, Chin Mudra
- Kapalabathikriya,Bhastrika, Tratakkriya
- Simple Meditation,YogaBreath awareness meditation,.

OUTCOMES :

- It incorporates breathing exercises, meditation and poses designed to encourage relaxation and reduce stress.
- Practicing yoga is said to come with many benefits for both mental and physical health.
- Yoga is known for its ability to ease stress and promote relaxation.
- Many people begin practicing yoga as a way to cope with feelings of anxiety.
- Could Improve Heart Health
- Improves Quality of Life.
- Could Promote Sleep Quality.
- Improves Flexibility and Balance.
- Could Help Improve Breathing.
- Promotes Healthy Eating Habits.
- Can Increase Strength.

TEXT BOOK:

YogacharyaSundaram, *Sundra Yoga Therapy*, Asana Publications, 2009

REFERENCES:

1. Dr.V.Krishnamoorthy, *Simple Yoga for Health*, Sri MathiNilayam, 2012.
2. Dr.AnandaBalayogiBhavanani, *A Primer of Yoga Theory*, Dhivyananda Creations,2008.
3. Dr.S.Hema, Easy *Yoga for Beginners*, Tara yoga Publications,2008.
4. Dr.AsanaAndiappan, *Ashtanga Yoga*, Asana Publications, 2009.
5. Dr.JohnB.Nayagam, *MudumaikkuMutrupulliVaikkumMuthiraigal*, SaaruPrabha Publications, 2010.

Subject Code _____	Gender Equity and Law (Common to all Branches)	Category	L	T	P	Credit
		AC	0	0	2	0

Gender Equity is the provision of fairness and justice in the distribution of benefits and responsibilities between Men, Women, Transgender, and Gender non-binary individuals. Gender equity is important because, historically, societies around the world have deemed females, transgender people, and nonbinary people as “weaker” or less important than males. Gender equity emphasizes respecting individuals without discrimination, regardless of their gender. There are legal provisions thataddress issues like inequalities that limit a person’s ability to access opportunities to achieve better health, education, and economic opportunity based on their gender.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To sensitize the students regarding the issues of gender and thegender inequalities prevalent in society.
2	To raise and develop social consciousness about gender equity among thestudents.
3	To build a dialogueand bring a fresh perspective on transgender and gender non-conforming individuals.
4	To create awareness among the students and to help them face gender stereotype issues.
5	To help the studentsunderstand the various legal provisions that are available in our society.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.Understand the importance of gender equity	Understand
CO2.Initiate the awareness and recognize the social responsibility with regards to gender equity.	Apply
CO3.To develop a sense of inclusiveness and tolerance towards various genders without any discrimination.	Apply
CO4. To evaluate the social issues and apply suitable gender-related regulations for inclusive living.	Evaluate
CO5.To identify and analyze the existing gender inequality problems faced in various institutions.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	S	M	L	-	-	S	S	S	-	-	-	S	-	-	-
CO2	S	M	M	-	-	S	S	S	-	-	-	S	-	-	-
CO3	S	L	M	-	-	S	S	S	-	-	-	S	-	-	-
CO4	S	S	S	L	-	S	S	S	-	-	-	S	-	-	-
CO5	S	S	S	M	-	S	S	S	-	-	-	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT –I INTRODUCTION TO GENDER AND SEX **6hrs**

Definition of Sex – Definition of Gender - Sex Vs. Gender - Social Construction of Gender and Gender Roles – GenderStereotypes - Gender Division of Labour - Patriarchy, Masculinity and Gender Equality -Feminism and Patriarchy.

UNIT –II - GENDER BIAS **6 hrs**

Introduction to Gender Inequality in India - Gender Bias in Media - Misleading Advertisement And Poor Portrayal of Women and gender non-conforming individuals- Objectification of Women, Transgender, and gender non-conforming individuals - Differential Treatment of Women, Transgender, Exploitation Caused by Gender Ideology - Female Infanticide - Honor Killing.

UNIT –III GENDER SENSITIZATION AND INTERNATIONAL CONVENTIONS **6 hrs**

Gender Sensitization -Need and Objective - Gender Sensitivity Training at Workplace – GenderSensitization in Judiciary - Gender Sensitization in School Curriculum.

UNIT-IV - SEXUAL OFFENCES AGAINST WOMEN **6 hrs**

Indian Penal Code, 1860 - S., 304B, 354, 354C, 354d, 376, 498A & 509 - The ImmoralTrafficPrevention Act 1986 - The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 - Protection of Women from Domestic Violence Act, 2005- Indecent Representation of Women Act, 1986**.**

UNIT-V ROLE OF GOVERNMENT FOR INCLUSIVE DEVELOPMENT **6hrs**

Initiatives of NCERT -Role of Ministry of Women and Child Development - Governmental Initiatives: Beti BachaoBeti Padhao (BBBP) - Ujjawala Scheme - Working Women Hostels (WWH), National Council for Transgender Persons.

TEXT BOOKS

1. IGNOU: Gender Sensitization: Society, Culture and Change (2019) BGSE001, New Delhi IGNOU
2. Jane Pilcher and Imelda Whelehan (2005): Fifty Key Concepts in Gender Studies

REFERENCES:

1. Women's Empowerment & Gender Parity: @Gender Sensitization, Dr. Shikha Bhatnagar, Repro Books (2020).

2. Gender Sensitization: Issues and Challenges, Anupama Sihag Raj Pal Singh, Raj Publications (2019).

3. Violence Against Women: Current Theory and Practice in Domestic Abuse, Sexual Violence, andExploitation (Research Highlights in Social Work), Jessica Kingsley Publishers (2012).

4. Gill, Rajesh, Contemporary Indian Urban Society- Ethnicity, Gender and Governance, BookwellPublishers, New Delhi (2009).

5. Sexual Violence Against Women: Penal Law and Human Rights Perspectives, Lexis Nexis (2009) 6. Chatterjee, Mohini, Feminism and Gender Equality, Aavishkar, Jaipur,2005.

7. Mies, Maria, Indian Women and Patriarchy, Concept Publishing Company, New Delhi, 2004.

COURSE DESIGNERS

S.No.	Name of the Faculty	Mail ID
1	Gnana Sanga Mithra.S	sangamithra@avil.edu.in
2	Aarthy.G	aarthy@avil.edu.in

Course Code	Course Title	Category	L	T	P	C
	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	**AC**	**0**	**0**	**2**	**0**

Course Objectives:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Course Outcomes:

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

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. Illustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

UNIT-I:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-2:

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

UNIT-3:

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT-4:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-5:

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation

and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Web Links:

1.https://www.youtube.com/watch?v=LZP1StpYEPM

Course Code	Course Title	category	L	T	P	C
	INDIAN CONSTITUTION	**AC**	**0**	**0**	**2**	**0**

Course Objectives:

On completion of this course, the students will be able:

1 To understand the nature and the Philosophy of the Constitution.

2 To understand the outstanding Features of the Indian Constitution and Nature of the Federal system.

3 To Analyse Panchayat Raj institutions as a tool of decentralization.

4 To Understand and analyse the three wings of the state in the contemporary scenario.

5 To Analyse Role of Adjudicatory Process.

5 To Understand and Evaluate the recent trends in the Indian Judiciary.

Course Content

UNIT I

The Constitution - Introduction

The Historical background and making of the Indian Constitution –Features of the Indian Constitution- Preamble and the Basic Structure - Fundamental Rights and Fundamental Duties –Directive Principles State Policy

UNIT II –Government of the Union

The Union Executive- Powers and duties of President –Prime Minister and Council of Ministers - Lok Sabha and Rajya Sabha

UNIT III –Government of the States

The Governor –Role and Powers - Cheif Minister and Council of Ministers- State Legislature

UNIT IV – Local Government

The New system of Panchayat, Municipalities and Co-Operative Societies

UNIT V – Elections

Powers of Legislature -Role of Chief Election Commissioner-State Election Commission

TEXTBOOKS AND REFERENCE BOOKS:

1 Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008

2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)

3 Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Fourth 2020 edition Suggested.

Total Hours: 30 hours

Software/Learning Websites:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of india/

Alternative NPTEL/SWAYAM Course:

S.NO	NPTEL ID	NPTEL Course Title	Course Instructor
1	12910600	CONSTITUTION OF INDIA AND ENVIRONMENTAL GOVERNANCE: ADMINISTRATIVE AND ADJUDICATORY PROCESS	PROF. M. K. RAMESH NATIONAL LAW SCHOOL OF INDIA UNIVERSITY

COURSE DESIGNER				
S.NO	**NAME OF THE FACULTY**	**DESIGNATION**	**NAME OF THE INSTITUTION**	**MAIL ID**
1	Dr.Sudheer	Professor	AV School of Law	Sudheersurya18@gmail.com

	ARCHITECTURE OF ELECTRIC AND HYBRID ELECTRIC VEHICLE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course introduces the fundamental concepts, principles, design and analysis of hybrid, electric vehicles.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To understand the basic concepts Electric drive train.
2	To familiarize the power flow control in different hybrid mode.
3	To analyze the Complex drive train configuration.
4	To Analyze characteristics of HEV drive train
5	To understand different types of power transmission configuration, clutch and braking.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Describe the basic concepts of electric drive train.	Understand
CO2: Explain the power flow control Electric drive train.	Evaluate
CO3: Explicate the different Hybrid drive train configuration.	Analyze
CO4: Elucidate performance characteristics of Speed – torque of Electric drive train.	Analyze
CO5: Explain the different characteristics for electric and hybrid drive train.	Analyze
CO6: Describe the power and auxiliary systems of drive train model for Hybrid electric vehicles.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	M	-	L	L	-	-	-	L	S	-	-
CO2	S	M	S	L	M	S	L	M	M	L	M	S	S	S	L
CO3	S	L	-	-	M	L	-	-	-	L	L	-	S	M	-
CO4	S	L	-	-	M	L	-	-	-	L	L	-	S	M	-
CO5	S	L	L		M		L		M	M		S	S	M	L
CO6	S	M	S	L	M	S	L	M	M	M	M	S	S	S	L

S- Strong; M-Medium; L-Low

SYLLABUS

ARCHITECTURE OF HYBRID DRIVE TRAIN

Hybrid Electric Vehicle: Gasoline ICE, Diesel ICE and Fuel Cell, Energy saving in conventional vehicles - Energy saving potentials of hybrid drive train – Regenerative Breaking – HEV Configuration.

POWER FLOW IN DRIVE TRAIN

Power flow control in ICE - Power flow in series and parallel and complex configuration of HEV – Series Hybrid – Parallel Hybrid – Battery charging in driving

COMPLEX DRIVE TRAIN

Power flow control in Complex Hybrid Control – Loading – Normal and Heavy - Start up mode – Driving mode – Throttle acceleration – Axial balancing - Battery charging.

DRIVETRAIN CHARACTERISTICS

Modelling and Characteristics of EV/HEV Powertrains Components- ICE Performance Characteristics, Electric Motor Performance Characteristics - Battery Performance Characteristics-Transmission and Drivetrain Characteristics-Regenerative Braking Characteristics-Driving Cycles Modelling and Analysis of Electric and Hybrid Electric Vehicles Propulsion and Braking - Longitudinal Dynamics Equation of Motion - Vehicle Propulsion Modelling and Analysis - Vehicle Braking Modelling and Analysis

DRIVE TRAIN CONFIGURATIONS

Propulsion – Electronic Controller – Power Converter – Motor – battery - Mechanical transmission – Auxiliary System: Steering, Temperature, Clutch & Gear box in differential mode – Battery and flywheel sources – Single and multi motor drives.

TEXT BOOKS:

1. Iqbal Hussain, *"Electric & Hybrid Vehicles – Design Fundamentals"*, Second Edition, CRC Press,
2. James Larminie, "*Electric Vehicle Technology Explained*", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, *"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals*", CRC Press, 2010.
2. L. Guzzella & A. Sciarretta, *"Vehicle Propulsion Systems: Introduction to Modelling and Optimization"* Springer 5th Edition 2007.
3. G. Lechner & H. Naunheimer, "*Automotive Transmissions: Fundamentals, Selection, Design and Applications", Springer* 3rd Edition, 1999.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. P. Loganathan	Assistant Professor	EEE/VMKVEC	loganathan@vmkvec.edu.in
2	Dr. B. Parvathi Sangeetha	Assistant Professor	EEE	parvathi.eee@avit.ac.in

	BATTERY MANAGEMENT SYSTEM	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course introduces the fundamental concepts, principles, design and analysis of hybrid, electric vehicles.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To understand the basic technical parameters of batteries
2	To understand the different characteristics of Batteries
3	To analyze the Modelling of batteries.
4	To understand the battery management system
5	To analyse the different testing of batteries

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Elaborate various technical parameters of batteries.	Understand
CO2: Distinguish between various types of batteries used for EV applications.	Understand
CO3: Describe about the battery characteristic & parameters	Analyze
CO4: Analyse the modelling of batteries.	Analyze
CO5: Explain the concepts of battery management system and design the battery pack.	Apply
CO6: Explain about the battery testing, disposal and recycling.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	M	M	M	-	L	L	-	-	M	L	S	-	-
CO2	S	M	S	L	M	S	L	M	M	L	M	S	S	-	L
CO3	S	L	-	-	M	L	-	-	-	L	L	-	S	M	-
CO4	S	L	-	-	M	L	-	-	-	L	L	-	S	M	-
CO5	S	L	L		M		L		M	M		S	S	M	L
CO6	S	M	S	L	M	S	L	M	M	M	M	S	S	S	L

S- Strong; M-Medium; L-Low

SYLLABUS

BATTERY PARAMETERS AND EV BATTERIES

Cell and battery voltages, Charge (or Amphour) capacity, Energy stored, Energy density, Specific power, Amphour (or charge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life and number of deep cycles - Lead Acid Batteries - Nickel-based Batteries - Sodium, Lithium and Metal air batteries

BATTERY CHARACTERISTICS & PARAMETERS

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design- Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.

BATTERY MODELLING

General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of the NiCd battery model, Simulation examples.

BATTERY PACK AND BATTERY MANAGEMENT SYSTEM

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

BATTERY TESTING, DISPOSAL & RECYCLING

Chemical & structure material properties for cell safety and battery design, battery testing, limitations for transport and storage of cells and batteries , Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.

TEXT BOOKS:

1. James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK, Electric Vehicle Technology Explained
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
3. James Larminie, "*Electric Vehicle Technology Explained*", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2)
2. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN:

978-1-1193-2185-9)
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", JohnWiley& Sons Ltd., 2016.
4. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
5. L. Guzzella & A. Sciarretta, *"Vehicle Propulsion Systems: Introduction to Modelling and Optimization"* Springer 5th Edition 2007.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. P. Loganathan	Assistant Professor	EEE/VMKVEC	loganathan@vmkvec.edu.in
2	Dr. B. Parvathi Sangeetha	Assistant Professor	EEE	parvathi.eee@avit.ac.in

	MODERN DRIVES FOR ELECTRIC VEHICLE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course introduces the fundamental concepts, principles, design and analysis of Modern drives and communication for Electric Vehicle.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To understand the Environmental Impacts of Electric and hybrid electric vehicle.
2	To familiarize the testing of Hybrid Electric Vehicles.
3	To analyze the static testing of Electric Vehicle.
4	To understand the Vehicle Component testing
5	To understand different types of vehicular communication.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Describe the environmental impacts of electric drives.	Understand
CO2: Explain the basic test and operation of electric vehicle drive	Evaluate
CO3: Analyse the different testing electric vehicle.	Analyze
CO4: Elucidate performance of vehicle component testing	Analyze
CO5: Explain the different types of vehicular communication	Analyze
CO6: Describe the security applications for Hybrid electric vehicles.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	M	-	L	L	-	-	-	L	S	-	-
CO2	S	M	S	L	M	S	L	M	M	L	M	S	S	S	L
CO3	S	L	-	-	M	L	-	-	-	L	L	-	S	M	-
CO4	S	L	-	-	M	L	-	-	-	L	L	-	S	M	-
CO5	S	L	L		M		L		M	M		S	S	M	L
CO6	S	M	S	L	M	S	L	M	M	M	M	S	S	S	L

S- Strong; M-Medium; L-Low

SYLLABUS

ENVIRONMENTAL IMPACT AND HISTORY OF MODERN TRANSPORTATION

Air Pollution - Global Warming - Importance of Different Transportation Development Strategies to Future Oil Supply - History of Electric Vehicles - History of Hybrid Electric Vehicles -

TESTS FOR HYBRID ELECTRIC VEHICLES, RETRO-FITMENT AND CHARGING STATION

Hybrid Electric Vehicles Tests (M and N category), Tests for Hybrid Electric System Intended for Retro-fitment on Vehicles of M and N Category (GVW < 3500 kg), Test for Electric Propulsion kit intended for Conversion, Test for Electric Vehicle Conductive AC Charging System, and Test for Electric vehicle conductive DC charging system.

STATIC TESTING OF VEHICLE

Photographs, CMVR physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement of Foot Controls for M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The Requirement of Temporary Cabin For Drive– Away – Chassis, Electric vehicle – Safety Norms, Energy consumption and Power test.

VEHICLE COMPONENT TESTING

Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500 kg), Body block test, Head form test, Driver Field Of Vision, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints test, Airbag Test, Accelerator Control System, Motor power, Safety Requirements of Traction Batteries, EMI-EMC (CI, BCI, RE,RI and CTE).

IN-VEHICLE NETWORKING AND VEHICULAR COMMUNICATION

Overview of Data communication and networking –need for In-Vehicle networking – layers of OSI reference model –multiplexing and de-multiplexing concepts –vehicle buses. Vehicular Communications: Intelligent Transportation Systems: IEEE 802.11p-ITS-IVC: Inter Vehicle Communications- Mobile Wireless Communications And Networks- Architecture Layers Communication Regime.V2V, V2I-VANET-WAVE; DSRC. Information In The Vehicle Network Routing - Physical Layer Technologies-Medium Access For Vehicular Communications- Security Applications And Case Studies.

TEXT BOOKS:

1. Iqbal Hussain, *"Electric & Hybrid Vehicles – Design Fundamentals"*, Second Edition, CRC Press,
2. James Larminie, "*Electric Vehicle Technology Explained*", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators
2. Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI PUNE

3. J.Gabrielleen,"Automotive In-Vehicle Networks", John Wiley & Sons, Limited, 2008
4. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007
5. Mehrdad Ehsani, Yimin Gao, Ali Emadi, *"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals*", CRC Press, 2010.
6. L. Guzzella & A. Sciarretta, *"Vehicle Propulsion Systems: Introduction to Modelling and Optimization"* Springer 5th Edition 2007.
7. G. Lechner & H. Naunheimer, "*Automotive Transmissions: Fundamentals, Selection, Design and Applications", Springer* 3rd Edition, 1999.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Mr. P. Loganathan	Assistant Professor	EEE/VMKVEC	loganathan@vmkvec.edu.in
2	Dr. B. Parvathi Sangeetha	Assistant Professor	EEE	parvathi.eee@avit.ac.in

	POWER CONVERTERS FOR ELECTRIC VEHICLE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

Power converter is the device used to process and control the flow of electric energy by supplying voltages and currents in a form that is optimally suited for electric vehicle.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To describe about importance of converters in electric vehicle.
2	To describe about the operating principle of bidirectional converter for electric vehicles.
3	To explain the working principle of integrated bidirectional converters for plug-in HEV applications
4	To explain the working principle of converters in electric vehicle battery charging
5	To explain about the operation of split converter

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Identify the suitable converters and also can able implement the suitable converters for any electric vehicle applications.	Remember
CO2: Implement the bi directional converters in electric vehicle applications.	Understand
CO3: Analyze the electric vehicle through simulation .	Analyze
CO4: Analyze the converters and also can able to suggest the suitable converters for electric vehicle battery charging	Apply
CO5: Explain about split converters and its principle operation also can able to implement the converters in EV	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	S	-	-	-	-	M	L	-
CO2	S	M	-	M	-	-	-	M	-	-	-	-	L	M	-
CO3	S	S	-	S	-	-	-	L	-	-	-	-	M	S	-
CO4	S	S	-	M	-	L	-	M	-	-	-	M	S	M	-
CO5	S	L	M	L	L	L	-	M	-	-	-	L	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

General EV setup – Plug-In Hybrid Electric Vehicle - Introduction about converters – Isolated Converters – Non isolated converter - Detailed classification of converters in EV - Power conversion Techniques.

BIDIRECTIONAL CONVERTER TOPOLOGIES FOR ELECTRIC VEHICLES

Bidirectional Converters - Topology Explanation - Plug-In Charging Mode - Propulsion Mode - Isolated Bidirectional Converter Topology - System Design - T-Type Converter Topology

INTEGRATED BIDIRECTIONAL CONVERTERS FOR PLUG-IN HEV APPLICATIONS

Introduction - Direct Conversion of an AC–DC Converter - Flow of Operation - Novel Eight-Switch Inverter – Bidirectional DC/DC Interleaved Converter - Simulation and Results

CONVERTERS FOR BATTERY CHARGING

Introduction - Bidirectional Power Flow Converters - Resonant Converter for a Bidirectional EV Charger - Topology and Analysis - Multiphase Integrated On-board Charger for Electric Vehicles - Split Converter-Fed SRM Drive for Flexible Charging in EV and HEV Applications - Simulation and Results

SPLIT CONVERTER –FED SRM DRIVE FOR FLEXIBLE CHARGING IN EV AND HEV APPLICATIONS

Introduction - Charging Control strategy – Simulation and Results – Case studies

TEXT BOOKS

1. L.Ashok Kumar & S. Albert Alexander, “Power Converters for Electric vehicles” CRC Press,2021

REFERENCES

1. Michael Nikowitz , “Advanced Hybrid andElectric vehicles” , Springer,2016.
2. J.Larminie , J.Lowry, “Electric Vehicle Technology ”, Wiley ,2021.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.G.Ramakrishnaprabu	Associate Professor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
2.	Dr.R.Sathish	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
3.	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	TESTING OF ELECTRIC AND HYBRID VEHICLES	Category	L	T	P	Credit
		EC - SE	3	0	0	3

PREAMBLE

To ensure safety and conformity, all current and future EV models must be tested for homologation, at both full-vehicle and component level. But in addition to the vehicles themselves, every other aspect affecting the operational safety must be tested too.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To describe the concept of electric vehicle testing
2	To explain the operating principle of static testing
3	To explain the working principle of dynamic testing
4	To employ the suitable techniques for component testing .
5	To describe the testing and retro fitment charging station of hybrid electric vehicle .

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Explain the testing procedure of electric vehicle	Remember
CO2: Understand the concept of static Testing .	Understand
CO3: Analyze the concept of dynamic testing	Analyze
CO4: Apply the suitable testing technique for Electric vehicle Component testing.	Apply
CO5: Evaluate the performance of Electric vehicle by the suitable methods	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	S	-	-	-	-	M	L	-
CO2	S	M	-	M	-	-	-	M	-	-	-	-	M	M	-
CO3	S	S	-	M	-	-	-	M	-	-	-	-	M	M	-
CO4	S	M	-	M	-	L	-	M	-	-	-	M	S	M	-
CO5	S	L	M	L	L	L	-	M	-	-	-	M	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Specification & Classification of Vehicles (including M, N and O layout), Homologation & its Types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR), Type approval Scheme, Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks, Hardware in The Loop (HIL) concepts for EV/HEVs.

STATIC TESTING OF VEHICLE

Photographs, CMVR physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement of Foot Controls for M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The Requirement of Temporary Cabin For Drive– Away – Chassis, Electric vehicle – Safety Norms, Energy consumption and Power test.

DYNAMICS TESTING OF VEHICLE

Hood Latch, Gradeability, Pass-by Noise, Interior Noise, Turning Circle Diameter & Turning Clearance Circle Diameter, Steering Effort, Constant Speed Fuel Consumption, Cooling Performance, Speedo-meter Calibration, Range Test, Maximum Speed, Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broad band / Narrow band EMI Test, Electric vehicle – Range Test.

VEHICLE COMPONENT TESTING

Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500 kg),Body block test , Head form test , Driver field of vision ,Safety belt assemblies ,Safety belt anchorages, Seat anchorages & head restrains test ,Airbag test , Accelerator Control system,Motor power , Safety requirements of Traction batteries ,EMI – EMC (CI,BCI,RE,RI and CTE)

TESTS FOR HYBRID ELECTRIC VEHICLES, RETROFITMENT AND CHARGING STATION

Hybrid Electric Vehicles Tests (M and N category), Tests for Hybrid Electric System Intended for Retrofitment on Vehicles of M and N Category (GVW < 3500 kg), Test for Electric Propulsion kit intended for Conversion, Test for Electric Vehicle Conductive AC Charging System, and Test for Electric vehicle conductive DC charging system.

REFERENCES

1. “Vehicle Inspection Handbook”, American Association of Motor Vehicle Administrators
2. Michael Plint& Anthony Martyr, “Engine Testing & Practice”, Butterworth Heinmenn, 3rd ed, 2007
3. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI PUNE
4. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.G.Ramakrishnaprabu	Associate Professor	EEE / VMKVEC	ramakrishnaprabu@vmkvec.edu.in
2.	Dr.R.Sathish	Assistant Professor	EEE / VMKVEC	sathish@vmkvec.edu.in
3.	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE /AVIT	sprakash@avit.ac.in

	DESIGN OF HYBRID ELECTRICAL VEHICLE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble

Design of Hybrid Electrical Vehicle, the students will be able to learn the constructional details and principle of hybrid electric and conventional vehicles, Electric drive-trains and electric propulsion unit, Energy storage, Sizing the drive system, Energy management strategies.

Prerequisite : NIL

Course Objective

1	To impart knowledge on the constructional details and principle of hybrid electric and conventional vehicles
2	To analyzing the various types electric drive-trains and electric propulsion unit.
3	To apply the various types of energy storage
4	To analyzing the parameters of sizing the drive system
5	To Analyzing the Various energy management strategies

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

CO1.	Recognize the constructional details and principle of hybrid electric and conventional vehicles	Apply
CO2.	Analyzing the various type electric drive-trains and electric propulsion unit.	Apply
CO3.	Analyzing the various types of sizing the drive system	Apply
CO4.	Analyzing the working parameters of various braking and suspension system in a vehicle	Apply
CO5.	Analyzing the Various energy management strategies.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	-	-	-	-	-	-	-	-	S	-	-
CO2	S	L	L	L	-	-	-	-	-	-	-	-	S	-	-
CO3	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-
CO5	S	M	M	M	-	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO HYBRID ELECTRIC AND CONVENTIONAL 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 vehicle performance, vehicle power source characterization, transmission characteristics, Vehicle performance.

ELECTRIC DRIVE-TRAINS AND ELECTRIC PROPULSION UNIT

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis, Introduction to electric components used in hybrid and electric vehicles, 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.

ENERGY STORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

SIZING THE DRIVE SYSTEM
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.
ENERGY MANAGEMENT STRATEGIES
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Text Books
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003. 2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
Reference Books
1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003. 2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Introduction to Hybrid and Electric Vehicles	Dr. Praveen Kumar Prof. S. Majhi	IIT Guwahati	12 Weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	T. Raja	Associate Professor	MECH/VMKVEC	rajat@vmkvec.edu.in
2				

	CONTROL SYSTEM FOR HYBRID ELECTRIC VEHICLE	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

This course introduces the fundamental concepts, principles, analysis and control techniques and design of hybrid, electric vehicles.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	Understand requirement of EV motors
2	Understand suitability of electric motor & their control
3	Understand speed control of Induction motor
4	Understand PWM techniques of Inverter for Induction motor
5	Understand different sensors and sensor less operation of motor

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Describe the basic concepts of electric vehicles.	Understand
CO2: Design the suitable control elements of electric motor drives	Evaluate
CO3: Explain the construction, characteristics and application of induction motor	Analyze
CO4: Elucidate performance characteristics of DC&AC electrical machines.	Analyze
CO5: Describe about the various types and configuration of hybrid electric vehicle.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	M	-	L	L	-	-	-	-	M	-	-
CO2	S	M	S	L	M	-	L	M	-	-	-	-	-	M	-
CO3	S	-	-	-	M	-	-	-	M	-	-	-	L	M	-
CO4	S	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CO5	S	M	S	L	M	-	L	M	-	M	M	-	M	L	-
CO6	S	-	-	-	M	-	L	L	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

EV MOTORS CHARACTERISTICS AND DC MOTOR

Requirement of EV motors, Comparison of EV motors, Basics of DC Motor, Torque speed characteristics, DC Motor dynamics, Field Weakening Control, Four quadrant operation

DC MOTOR DYNAMICS & CONTROL

Current Loop Control, Speed Control Loop Dynamical System Control: Gain & Phase Margins, PD Controller, PI Controller, Selecting PI Gain for Speed Controller, PI Controller Design, PI Controller with Reference model, Comparison of conventional PI Controller with PI controller with Reference Model, 2 DOF Controller with Internal Model Control, Load Torque Observer, Feedback Linearization, Simplified Modeling of Practical Current Loop

INDUCTION MOTOR

Rotating Magnetic Field, Basics of Induction motor, Speed-Torque Curve Leakage inductance, circle diagram, current displacement (double cage rotor), line starting, Dynamic modeling of Induction motor

INDUCTION MOTOR SPEED CONTROL

Rotating Magnetic Field, Basics of Induction motor, Speed-Torque Curve Leakage inductance, circle diagram, current displacement (double cage rotor), line starting, Dynamic modeling of Induction motor , Rotor Field oriented control, Stator Field Oriented Control, Field Weakening Control, Variable Voltage Variable Frequency Control

PWM AND INVERTER

Sinusoidal PWM, Injection of third order harmonics, Space Vector Modulation, Dead time & compensation, Encoders, Resolvers, R/D Converters, Hall current sensors and current sampling, Voltage Model Estimator, Current Model Estimator, Closed-loop MRAS observer, Sliding Mode Observer.

TEXT BOOKS:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. K Wang Hee Nam: AC Motor Control & Electrical Vehicle Application, CR Press, Taylor & Francis Group, 2019

REFERENCE BOOKS:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Devarajan	Professor	EEE	devarajan@vmkvec.edu.in
2	Mr. V.Rattankumar	Assistant Professor	EEE	rattankumar@avit.ac.in

	BRAKE SYSTEM OF EV AND HEV	category	L	T	P	C
		EC-SE	3	0	0	3

PREAMBLE

This course introduces the fundamental concepts, principles, design and analysis of hybrid, electric vehicles.

PREREQUUISITE :Nil

COURSE OBJECTIVE

1.	To understand the basic concepts of electric vehicles.
2.	To basic concepts of electric drives trains .
3.	To analyze the characteristics of different types Energy Storage
4.	To understand different types Sizing the drive system
5.	To study about hybrid electric vehicles of case study.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: Describe the basic concepts of electric vehicles.	Understand
CO2: Design the propulsion system for electric vehicles.	Evaluate
CO3: Explain the construction, characteristics and application of batteries.	Analyze
CO4: Elucidate performance characteristics of DC&AC electrical machines.	Analyze
CO5: Design the drive train model for electric vehicles.	Evaluate

Mapping with programme outcomes and programme specific outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	M	S	S	M	-	-	L	-	M	-	M
CO2	S	S	-	-	M	S	S	M	-	-	L	-	L	-	L
CO3	S	S	L	-	S	S	S	M	-	-	M	-	M	L	L
CO4	S	M	L	M	S	S	M	M	-	-	M	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG ,M-MEDIUM,L-LOW

SYLLABUS

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, mathematical models to describe vehicle performance. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains:

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, 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.

Energy Storage:

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system:

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting th ications, supporting subsystems

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies and Regenerative Braking systems

Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). Regenerative Braking - Real-world energy storage requirements and driver behaviour assessment. - Brake feel and customer acceptance - Mechanical System Design: New transmission options including split path design approaches and systems

Total Hours = 45

TEXT BOOKS:

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press,
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals", CRC Press, 2010.
2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000
.http://nptel.ac.in/courses/108103009

COURSE DESIGNERS

S.No	Name of the faculty	Designation	Department	Mail-id
1	Mr.A.BALAMURUGAN	ASSOCIATE PROFESSOR	EEE	balamurugan@vmkvec.edu.in
2.	S.Prakash	AP(Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	Energy Storage Simulation Lab	category	L	T	P	C
		EC-SE	0	0	4	2

PREAMBLE

To understand concepts and principle of Energy Storage simulation systems.

PREREQUUISITE : Nil

COURSE OBJECTIVE

1.	To understand the components , various theories and energy storage battery of systems
2.	To study the various types of mathematical modeling.
3.	To study about the Alternative and Novel Energy Sources
4.	To study about the various of Fuel Cell.

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1: Realize the basics of energy storage battery of systems	Understand
CO2:Comprehend various types of mathematical modeling systems	Analysis
CO3:understand the operations of various types of Alternative and Novel Energy Sources	Analysis
CO4: Analysis the various of Fuel Cell system.	Analysis

Mapping with programme outcomes and programme specific outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO2	PSO3
CO1	S	M	-	-	M	S	S	M	-	-	L	-	M	-	M
CO2	S	S	-	-	M	S	S	M	-	-	L	-	L	-	L
CO3	S	S	L	-	S	S	S	M	-	-	M	-	M	L	L
CO4	S	M	L	M	S	S	M	M	-	-	M	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG ,M-MEDIUM,L-LOW

LIST OF EXPERIMENTS

1. Study of Energy Storage Batteries Parameters
2. Measure of different type of battery and rating Energy Storage Batteries Parameters.
3. Study of Mathematical Modeling for Lead acid battery
4. Study of Alternative and Novel Energy Sources.
5. Study of Fuel Cell.
6. Study of data for different types of fuel cell.
7. Study of fuel cell efficiency and efficiency limits.
8. Study of Practical fuel cell voltages.
9. Study the experiment of the flywheels
10. Study the experiment of the Super Capacitors
11. Study of the MATLAB.

REFERENCES

REFERENCE LAB MANUAL

COURSE DESIGNERS

S.No	Name of the faculty	Designation	Department	Mail-id
1	Mr.A.BALAMURUGAN	ASSOCIATE PROFESSOR	EEE	balamurugan@vmkvec.edu.in

	ELECTRIC DRIVESLAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

PREAMBLE

This laboratory gives a practical exposure to the students to learn the electric drives. The students will be able to design and analyze ACand DC motor drivesforrealworldapplications.

PREREQUISITE:Nil

COURSEOBJECTIVES

1	ToconstructDC chopperscircuitforanalyse theperformancebyconductingsuitableexperiments.
2	To analysetheperformancecharacteristicsofthe givenACdrive byconductingsuitable experiments.
3	To analyse the performance characteristics ofthe given DC drive by conducting suitableexperiments.
4	To analyze the performance characteristics ofthe given PLC and DSP based AC drive byconducting suitable experiments.
5	Tosimulate ACand DCdrivercircuitsusingMATLAB-Simulink.

COURSEOUTCOMES

On the successfulcompletionofthecourse,studentswillbeable to

CO1:ConstructDCchoppersforthe givenspecificationsexperimentally.	Apply
CO2:AnalyzetheperformancecharacteristicsofAC drivercircuitbyconductingsuitable experiments.	Analyze
CO3: Analyze the performance characteristics ofthe given DC drive by conducting suitableexperiments	Analyze
CO4: Analyze the performance characteristics ofthe given PLC and DSP based AC drive byconducting suitable experiments	Analyze
CO5:ConstructAC andDCdrivercircuitsusingMATLAB-Simulink.	Apply
CO6:Evaluate the performance ofthegivenACandDCdrivercircuitsusingMATLAB-Simulation.	Evaluate

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	M	M	-	-	-	-	-	-	M	-	-	S	-
CO2	S	M	S	M	-	-	-	-	-	-	M	-	-	S	-
CO3	S	S	M	M	S	-	-	-	S	S	M	-	-	-	-
CO4	S	S	M	M	S	-	-	-	S	S	M	-	-	-	-
CO5	S	L	M	M	S	-	-	-	-	-	S	-	-	S	-
CO6	S	M	S	M	S	-	-	-	S	S	S	-	-	S	-

S-Strong;M-Medium;L-Low

LISTOFEXPERIMENTS

1. Voltage commutated chopper fed DC motor
2. AC voltage controller fed single phase induction motor
3. V/FControlofVSIFedInductionMotor.
4. Half controlled rectifier fed DC motor
5. RotorResistanceControlofInductionMotor.
6. PLC/DSP based 3 phase induction motor drive
7. SimulationofPWMinverterfedsinglephase inductionmotorcontrol
8. SimulationofPWMinverterfedthreephaseinductionmotorcontrol
9. SimulationofCSIfedinduction motordriveanalysis
10. SimulationofVSIfedinductionmotordriveanalysis

ReferenceBooks

LaboratoryReference Manual

COURSEDESIGNERS

S.No.	NameoftheFaculty	Designation	Department	MailID
1	Dr. R.Sankarganesh	AssociateProfessor	EEE/VMKVEC	sankarganesh@vmkvec.edu.in
2	Dr.K. Boopathy	Professor	EEE/AVIT	boopathyk@avit.ac.in

	NEW AND RENEWABLE ENERGY SOURCES AND ITS APPLICATIONS	Category	L	T	P	C
		EC - SE	3	0	0	3

Preamble

To study the fundamentals of non conventional sources due to crisis of conventional sources and understand the fundamentals and application of Non-conventional energy sources in the energy sector

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To study about energy Sources and its types, scope of Renewable energy
2	To understand about solar energy and various types of solar energy & conversion methods
3	To understand about wind energy system & its component, and Analyze the selection factor & output power
4	To study about the Basics Biomass & geothermal energy and its various sources
5	To study different forms of non-conventional energy.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	To Understand the renewable energy sources & systems.	Understand
CO 2	To impart the techniques of solar energy and different methods.	Understand
CO 3	To analyze the wind turbine system and components.	Analyze
CO 4	To analyze biomass and geothermal energy generations	Analyze
CO 5	Demonstrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-		S	S	-		L	-	-	-	L	-
CO2	M	-	M	-	S	L	M	-	M	L	-	-	S	-	M
CO3	M	-	M	-	S	L	M	-	-	L			-	M	-
CO4	S	-	S	-	S	M	M	L	-	L	M		-	-	L
CO5	S	M	S	S	S	M	S	-	M	L	L	M	L	L	-

SYLLABUS

INTRODUCTION TO ENERGY SOURCES

Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources.

SOLAR ENERGY

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar cooker, solar heating & cooling of buildings, photo voltaic - solar cells & its applications

WIND ENERGY

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

BIOMASS AND GEOTHERMAL ENERGY

Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantage es, constructional details, site selection, Fuel properties of bio gas, utilization of biogas. geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. advantages, disadvantages and application of geothermal energy.

OTHER ALTERNATE ENERGY SOURCES

Energy from tides, basic principle of tidal power, Basics of Magneto Hydro Dynamic (MHD) Power Generation, Basic Fuel Cells construction and Operation, hydrogen as alternative fuel for vehicles.

TEXTBOOK

1. G. D. Rai, “Non-Conventional Energy Sources”,4th Edition, Khanna Publishers, 2000.
2. B H Khan , “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
3. S.P.Sukhatme, “Solar Energy”,3rd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2008

REFERENCES

1. S.Hasan Saeed and D.K.Sharma , “Non-Conventional Energy Resources”,3rd Edition,S.K.Kataria & Sons, 2012.
2. G.N.Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles And Applications”, Narosa Publishing House,2004

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Mr. S.Prakash	AP(Gr-II)	EEE/AVIT	sprakash@avit.ac.in
2	Mr. P. Loganathan	AP	EEE/VMKVEC	loganathan@vmkvec.edu.in

	SOLAR COLLECTORS AND THERMAL ENERGY CONVERSION	Category	L	T	P	C
		EC- SE	3	0	0	3

Preamble

To familiarize the students with principles of operation, structure, testing and installation of major types of solar therm collectors.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	Understand the fundamentals of solar flat plate collectors
2	Familiar with the solar low, medium and high temperature applications
3	The basics of solar thermal technology for process heating applications.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Explain the principle of direct solar energy conversion to power using PV technology	Understand
CO 2	Name the fundamentals of solar flat plate collectors	Remember
CO 3	Recall the structure, materials and operation of solar cells, PV modules, and arrays	Remember
CO 4	Construct the basics of solar thermal technology for process heating applications	Apply
C0 5	Develop the solar collector for low, medium and high temperature applications	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-	-	S	S	-	-	L	-	-	L	-	-
CO2	M	-	M	-	S	L	M	-	M		-	-	-	M	-
CO3	M	-	M	-	-	L	M	-	-		-	-	M	-	L
CO4	S	-	S	-	-	M	M	L	-	L	M	-	-	M	-
CO5	S	M	S	S	S	M	S		M	L	L	M	-	-	L

SYLLABUS

INTRODUCTION

Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems

SOLAR FLAT PLATE COLLECTORS

Fundamentals of solar collectors as devices to convert solar energy to heat. Nonconcentrating low temperature flat-plate and evacuated tube collectors. Design and structures of collectors for heating liquids and air.

SOLAR PV AND SOLAR SYSTEM

Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

SOLAR THERMAL APPLICATIONS

Solar systems for process heat production - Solar cooking – Performance and testing of solar cookers. Seawater desalination – Methods, solar still and performance calculations. Solar pond - Solar greenhouse

APPLICATIONS OF SOLAR COLLECTORS

Application of non-concentrating collectors in low temperature solar thermal plants for space heating and cooling, drying, seawater desalination. Use of concentrating collectors for process heat production and power generation.

TEXTBOOK

1. Artur V.Kilian, “Solar Collectors: Energy Conservation, Design and Applications”, Nova Science Publishers Incorporated, 2009.
2. Duffie .J. A, Beckman .W. A, “Solar Engineering of Thermal Process”, Wiley, 3rd ed. 2006.

REFERENCES

1. Sukhatme .K, Suhas P.Sukhatme., “Solar energy: Principles of thermal collection and storage”, Tata McGraw Hill publishing Co. Ltd, 8th edition, 2008.
2. Garg .H.P,Prakash .J, “Solar energy fundamentals and applications”, Tata McGraw Hill publishing Co. Ltd, 2006.
3. Goswami .D.Y, Kreith .F, Kreider .J.F, “Principles of Solar Engineering”, 2nd ed., Taylor and Francis, 2000, Indian reprint, 2003

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	K.S.Kavitha Kumari	Assistant Professor (Gr-II)	EEE	kavitha.eee@avit.ac.in
2	Mrs. V.Manjula	Assistant Professor	EEE/VMKVEC	Cmanjula@vmkvec.edu.in

	ENERGY CONSERVATION AND ENERGY EFFICIENCY	Category	L	T	P	C
		EC- SE	3	0	0	3

Preamble

To enable the students to acquire the knowledge of energy conservation measures in thermal and electrical

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To impart knowledge on energy management and facilitate application of energy conservation
2	To impart knowledge on thermal and electrical utilities for evaluating energy saving potential.
3	To learn the positions of energy management in energy intensive industries using various model and chart.
4	To inculcate knowledge and skills about assessing the energy efficiency of an entity/ establishment.
5	To bring out Energy Conservation Potential and Business opportunities across different user segments under innovative.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO1	Acquaintance with conservation of energy and its management, energy planning, and energy economics.	Analyse
CO2	Recognize - How of energy efficient machinery systems, energy losses and their management	Evaluate
CO3	Ability in Energy analysis techniques and methods & Energy conservation planning and practices.	Understand
CO4	Estimate the techno economic feasibility of the energy conservation technique adopted.	Apply
CO5	Evaluate the performance of thermal utilities like furnace, boilers and steam distribution systems to improve efficiency	Creating
C06	Takeout performance assessment and suggest methods to improve the overall efficiency for different energy intensive industries	Analyse

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	L	M	S	-	-	-	-	L	-	-	L	L	-	-
CO2	L	-	M	L	-	L	-	L	-	-	-	-	L	-	-
CO3	L	-	L	-	-	-	-	-	-	-	-	-	-	M	-
CO4	S	-	L	-	-	M	-	-	L	-	-	-	-	L	-
CO5	L	M	S	M		-	-	-	-	-	-	-	-	-	-
CO6	M	-	L	-	-	M	-	-	-	-	-	L	-	M	-
S- Strong; M-Medium; L-Low															

SYLLABUS

ENERGY CONSERVATION PRINCIPLES
Energy scenario past and present scenario of world, principles of energy conservation, resource availability, energy savings, current energy consumption in India, roles and responsibilities of energy managers in industries.
ELECTRICAL SYSTEMS
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.
ENERGY CONSERVATION IN ELECTRICAL SYSTEMS
Potential areas for electrical energy conservation in various industries, conservation methods, energy management opportunities in electrical heating, lighting system, cable selection, energy efficient motors, factors involved in determination of motor efficiency, adjustable AC drives, variable speed drives, energy efficiency in electrical system
ENERGY CONSERVATION IN THERMAL SYSTEMS
Energy conservation in thermal utilities like boilers, blowers, furnaces, pumps and fans, compressors, Heat exchangers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.cogeneration - steam and gas turbines.
ENERGY MANAGEMENT
Organizational background desired for energy management persuasion, motivation, publicity role, tariff analysis, industrial energy management systems, energy monitoring, auditing and targeting, economics of various energy conservation schemes — energy policy and energy labeling.SCADA and EMS function.
TEXTBOOK

1. Reay .D.A, “Industrial Energy Conservation”, Pergamon Press, 1st edition, 2003.
2 White .L. C, “Industrial Energy Management and Utilization”, Hemisphere Publishers, 2002.

REFERENCES

1. Beggs, Clive, “Energy— Management, Supply and Conservation”, Taylor and Francis, 2‘d edition, 2009.
2. Smith .C.B, “Energy “Management Principles”, Pergamon Press, 2006.
3. Hamies, “Energy Auditing and Conservation; Methods, Measurements, Management and Case study”, Hemisphere, 2003.
4. Trivedi .P.R and Jolka .K.R, “Energy Management”, Common Wealth Publication, 2002.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. B. Parvathi Sangeetha	Assistant Professor	EEE	parvathi.eee@avit.ac.in
2	Mr. P. Loganathan	AP	EEE/ VMKVEC	loganathan@vmkvec.edu.in

	APPLICATIONS OF GREEN BUILDING TECHNOLOGIES	Category	L	T	P	C
	Total Contact Hours – 45	EC - SE	3	0	0	3
	Prerequisite – NIL					
	Co-requisite - NIL					

Preamble

To have a Sustainable architecture for creating an environment friendly and energy efficient building by harnessing renewable sources of energy and utilizing materials that least pollute the environment.

COURSE OBJECTIVES

1	To create awareness for the need of green buildings and imparting knowledge of designing green buildings.
2	To understand the applications of passive and active use of renewable energy system
3	To promote the efficient use of water, materials and waste through the sustainable concept of Reduce, Recycle and Reuse.
4	Describe the concepts of sustainable design and green building techniques including energy efficiency

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	To Understand the designing and concept of an environmentally friendly building (low-emissions, low resource-consumption, small environmental footprint)	Understand
CO 2	To describe the Concepts of different Heating techniques available for Sustainable Design And Green Building Environment Analyze	Remember
CO 3	To describe the Concepts of different passive cooling techniques, energy efficient building available for Sustainable Design And Green Building Environment Analyze	Remember
CO 4	To analyze and determine the different Use of Environment friendly materials and find the methods of recycling and reuse	Apply
C0 5	To know about the innovative green technologies methods and case study of a buildings	Understand

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	S	M	-		S	S	-		L	-	-	-	-	-
CO2	M	-	M	-	S	L	M	-	M	L	-	-	-	-	-
CO3	L	-	M	-	S	M	M	-	-	M	-	-	-	-	-
CO4	S	-	S	-	S	M	M	L	-	L	M	-	-	-	-
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	-	-

SYLLABUS

INTRODUCTION

Green buildings- salients features- LEED rating systems by IGBC - origin from USGBC –Concept of Sustainable sites –Orientation to sun and Wind -Land form & orientation – Vegetation & Pattern – Water Bodies– Open Space & Built form.

PASSIVE AND ACTIVE HEATING TECHNIQUES

Passive Cooling techniques : General principles – Evaporative cooling, Nocturnal radiation cooling, Passive Dessicant cooling, induced ventilation, earth sheltering, Berming, Wind Towers, earth – Air tunnels, Curved Roofs & Air Vents, Active Cooling techniques : Air coolers

PASSIVE AND ACTIVE COOLING CONCEPTS, ENERGY EFFICIENT BUILDINGS

Passive cooling and day lighting – Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency – Energy audit and energy targeting- Technological options for energy management. Active Cooling techniques : Air coolers

REDUCE, RECYCLE AND REUSE

Water conservation by Rainwater Harvesting systems – Treatment of waste water: Physical, Chemical and Biological methods – Root Zone treatment -Use of recycled water. Use of Environment friendly materials, Bio degradable materials. Recycling and Reuse of steel, Aluminium and Glass.

INNOVATIVE GREEN TECHNOLOGIES AND CASE STUDIES

Innovative uses of solar energy : BIPV, Solar Forest,Solar powered street elements-Integrated Use of Landscape : Vertical Landscape, Green Wall, Green Roof.Case studies on Green buildings : Olympia Technology Park, Chennai.

TEXTBOOK

1.Sustainable design manual, Vols 1& 2, The energy and resource institute, New Delhi.
2.Kibert, C. “Sustainable Construction: Green Building Design and Delivery”, John Wiley & Sons, 2005

REFERENCES

1. Arvind Krishnan & Others – Climate Responsive Architecture, Tata Mcgraw –Hill New Delhi 2001.
2. Ralph M .Lebens – Passive Solar Architecture in Europe – 2, Architecture Press, London 1983.
3. Sandra Mendler, William Odell, The Guide Book Of Sustainable Design, John Wiley & Sons, 2000.
4. Lawson.B,Bulding Materials, Energy And The Environment; Towards Ecologically Sustainable Development Raia, Act, 1996

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
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2	Dr. R. Sankarganesh	Associate Professor	EEE/VMKVEC	sankarganesh@vmkvec.edu

	NUCLEAR REACTOR THEORY	Category	L	T	P	C
		EC - SE	3	0	0	3

Preamble

Basic concepts of radioactivity, nuclear binding energy, cross-sections, and nuclear fission which are covered by standard undergraduate courses on reactor physics and nuclear physics. Basic knowledge of solving ordinary differential equations and basic linear algebra concepts

COURSE OBJECTIVES

1	To study the Fundamental concepts of Nuclear systems. To analyse the Nuclear data, reaction rates.
2	To provide the students with description of the computational methods for nuclear engineering applications.
3	To perform analytical and numerical calculations necessary in nuclear system research and development. To understand the Core Composition changes during Reactor operation.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Remember the Fundamentals concepts of Nuclear systems	Remember
CO 2	Explain the principles of nuclear reactor based on neutron transport theory and neutron diffusion theory	Understand
CO 3	Analyse the Nuclear data, reaction rates.	Analyse
CO 4	Knowing the computational methods for nuclear engineering applications.	Evaluate
C0 5	Knowledge about the analytical and numerical calculations necessary in nuclear system research and development .	Analyse and evaluate
C0 6	Information about Core Composition changes during Reactor operation.	Remember

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	M	S	M	M	-	-	-	-	S	M	S
CO2	S	M	M	-	M	S	S	M	M	-	-	-	S	S	S
CO3	M	S	M	S	L	M	-	-	-	L	-	-	S	M	S
CO4	S	M	M	M	-	L	-	-	-	L	L	L	S	S	S
CO5	S	S	S	M	L	M	L	L	-	-	-	-	S	M	S

SYLLABUS

INTRODUCTION

Course overview - Fundamental concepts- Nuclear energetic -Radioactivity-Binary nuclear reactions, neutron nuclear reactions- Principles of nuclear reactors, nuclear power. Materials for Nuclear Reactors-Fuel materials, Moderator and Reflectors, Cladding materials, Coolants and control Rods.

FUNDAMENTALS OF NUCLEAR SYSTEMS

Characteristics of the fission reaction, neutron moderation, practical fission fuels-Reactor power, fuel burn up, and fuel consumption-Neutron chain-reacting systems-Homogeneous and heterogeneous cores, reflectors, Reactor kinetics and dynamics, reactivity feedback- Core composition changes during reactor operation, nuclear system lifetime

MATHEMATICAL DESCRIPTION OF PHYSICAL PHENOMENA : NEUTRON AND MODELLING METHODS

General considerations about reactor physics, engineering requirements- Description of the neutron distribution: fluxes, currents, and sources-Nuclear data, cross sections, and reaction rates- Basic scheme of nuclear system modeling methods-Deterministic modeling of nuclear systems-Neutron balance (conservation) equations

NUCLEAR DATA AND CROSS SECTION PROCESSING

Cross-section data- Evaluated nuclear data files-Introduction to the data formats and procedures of the ENDF-6 system-NJOY nuclear data processing system, multigroup cross section libraries.

CORE COMPOSITION CHANGES DURING REACTOR OPERATION

Core composition changes-Nuclide production-destruction equations, adiabatic fuel depletion modelling Equilibrium fuel cycle-Solution of the nuclide production-destruction equations-Reactivity effects of fuel composition changes

TEXTBOOK

1. W. M. Stacey, Nuclear Reactor Physics, John Wiley & Sons, 2001
2. J. J. Duderstadt, L. J. Hamilton, Nuclear Reactor Analysis, John Wiley & Sons, 1976

REFERENCES

1. J.R.Lamarsh, Introduction to Nuclear Reactor Theory, Addison-Wesley Pub., 1966 .
2. J. R. Lamarsh, A. J. Baratta, Introduction to Nuclear Engineering, 3d ed., 2001
3. George I. Bell, Samuel Glasstone, “Nuclear Reactor Theory”, Robert E. Krieger Publishing Co., Inc. (1970).

COURSE DESIGNERS

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	CONVENTIONAL ENERGY TECHNOLOGIES	Category	L	T	P	C
		EC - SE	3	0	0	3

Preamble

This course provides the knowledge of working principles of conventional power generation and the importance of renewable energy sources.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	The operating principles and components of steam and nuclear power plant.
2	The operating principles and components of hydro, gas turbine power plants.
3	The solar and wind energy conversion systems.
4	The biomass, tidal and geothermal power plants.
5	The operating principles of hydrogen energy, fuel cells and MHD power generation.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Remember the Fundamentals concepts of Steam and Nuclear Power Generation	Remember
CO 2	Understand the performance of hydro, Gas turbine plants	Understand
CO 3	Understand the concept of solar and wind energy conversion system	Understand
CO 4	Have an idea about Tidal, Bio mass, Geothermal resources and power generation.	Understand
C0 5	Design and develop suitable hydrogen storage system to be used along with fuel cell system.	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-	-	S	S	-	-	L	-	-	-	-	L
CO2	M	-	M	-	S	L	M	-	M	L	-	-	-	M	-
CO3	M	-	M	-	S	L	M	-	-	L	-	-	L	-	L
CO4	S	-	S	-	S	M	M	L	-	L	M	-	-	-	-
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	M	-

SYLLABUS

STEAM AND NUCLEAR POWER GENERATION

Steam power plant-Selection of site-Generated layout-coal and ash handling-Steam generating plants-Feed make circuit - Cooling towers-Turbine governing, plant performance enhancement techniques, advanced technologies for coal-fired power plants, power plant major and auxiliary equipment. Nuclear power plants– Classification, Nuclear Fuels

HYDRO, GAS TURBINE AND COMBINED CYCLE PLANTS

Hydro power plant - Selection of Site - Classification layout governing of turbines - Gas turbine power plants - Performance enhancement techniques, equipment. combined cycle power plants, integrated gasification combined cycle, cogeneration plant - Equipment and performance.

SOLAR AND WIND ENERGY

Solar radiation – Measurements of solar radiation and sunshine – Solar thermal collectors – Flat plate and concentrating collectors – Solar applications – Fundamentals of photo voltaic conversion – Solar cells – PV applications. WECS components and classification, Wind data and energy estimation - Wind energy generators and performance.

BIOMASS, TIDAL AND GEOTHERMAL ENERGY SOURCES

Biomass – Biogas, source, composition - Technology for utilization – Biomass direct combustion, biomass gasifier, biogas plant, digesters, ethanol production, Bio-diesel production and economics. Tidal energy – Wave energy – Technology options – Open and closed OTEC cycles. Geothermal energy sources, power

HYDROGEN, FUEL CELL AND MHD POWER

Hydrogen - generation, storage, utilization and applications. Fuel cell technology – Types, power generation and economics. MHD power generation – Principle and classification.

TEXTBOOK

1. Rai .G.D, "Non Conventional Energy Sources", 4th edition, Khanna Publishers, New Delhi, 2000.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.

REFERENCES

1. Sukhatme .S.P, "Solar Energy", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.
2. Khartchenko .N.V, "Advanced Energy Systems", Taylor and Francis, Washington DC, 1998.
3. Chauhan .D.S, Srivastava .S.K, "Non-Conventional Energy Resources", New Age, 2009
4. M.C, "Energy Systems Engineering", Wiley-VCH, 2008.
5. Rajput .R.K, "Power Plant Engineering", 4th ed., Laxmi Publ., 2008.

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2	Mr. P. Loganathan	AP	EEE/VMKVEC	loganathan@vmkvec.edu.in

	SOLAR ENERGY LAB	Category	L	T	P	Credit
		EC - SE	0	0	4	2

PREAMBLE

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis. This laboratory mainly deals with the solar PV part. The electrical parameters are mainly concentrated.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To understand the behavior of PV Solar panel in different combinations
2	To understand the power flow with different types of loads
3	To understand the behavior battery connected and grid connected system.

COURSE OUTCOMES

On the successful completion of the laboratory course, students will be able to

CO1. Understand the various characteristics of PV Panels	Understand
CO2. Understand Power flow calculations with different load	Understand
CO3. Explain Performance of a PV system with batteries	Understand
CO4. Understand the grid connected performance of a PV system	Understand
CO5. Understand the islanding and other abnormal conditions	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO2	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO3	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO4	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO5	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. I-V and P-V characteristics with series and parallel combination of modules.
2. Effect of variation in tilt angle and shading on PV module power.
3. Power flow calculations of standalone PV system of DC load with battery.
4. Power flow calculations of standalone PV system of AC load with battery.
5. Power flow calculations of standalone PV system of DC and AC load with battery
6. Charging and discharging characteristics of battery.
7. Interfacing of hardware using RS232 ports and suitable software.
8. Evaluation of Active, Reactive Power & Apparent Energy Flow between Grid-Tied Inverter, Grid & Load and Net Metering concept
9. Grid Synchronization of Solar PV Inverter and it Performance Analysis
10. Impact of Transmission Line Inductance on Voltage Quality at PCC.
11. Study of the online monitoring data of an existing solar power plant

References

1. *Laboratory reference manual*

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	V.Rattan Kumar	AP(II)	EEE	rattankumar@avit.ac.in

	WIND ENERGY LAB	Category	L	T	P	Credit
		EC - SE	0	0	4	2

PREAMBLE

A wind turbine turns energy in the wind into electricity using the aerodynamic force created by the rotor blades, which work similarly to an airplane wing or helicopter rotor blade. When the wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The student will be able to understand basic operation of wind turbine with all parameters.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To understand the performance curve of a wind turbine
2	To do power analysis of a wind turbine.
3	To understand the behavior of wind turbine controller with respect to the load(AC & DC).

COURSE OUTCOMES

On the successful completion of the laboratory course, students will be able to

CO1.Understand various characteristics of wind turbine with respect to V, I & P	Understand
CO2.Understand the concept of cut in and cut off speed.	Understand
CO3. Understand the performance of wind turbine at various frequencies.	Understand
CO4. Understand the concept of tip speed ratio.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO1	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO2	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO3	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-
CO4	S	S	S	M	L	-	M	-	M	-	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1. Evaluate the efficiency of charge controller used in the Wind Energy Training System (WETS).
2. Evaluate the cut-in speed of wind turbine experimentally.
3. Evaluate the Tip Speed ratio (TSR) at different wind speeds.
4. Draw the turbine Power versus wind speed curve.
5. Draw the curve between TSR and coefficient of power.
6. Draw the power curve of turbine with respect to the rotational speed of rotor at fix wind speeds.
7. Demonstrate the power analysis at turbine output (for high wind speeds).
8. Demonstrate the power analysis at different branches of wind turbine energy system (at high frequency) with AC load only.
9. Demonstrate the power analysis at different branches of wind turbine energy system (at high frequency) with AC load only.
10. Demonstrate the power analysis at different branches of wind turbine energy system (at high frequency) with DC load only.

References

1. Laboratory reference manual

COURSE DESIGNERS

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1	V.Rattan Kumar	AP(II)	EEE	rattankumar@avit.ac.in

	POWER ELECTRONICS SIMULATION LAB - I	Category	L	T	P	Credit
		EC - SE	0	0	4	2

PREAMBLE

To acquire the practical knowledge in power electronic devices and circuits. Students will be able to understand and analyze power converters such as AC-DC converters, DC-DC converters, DC-AC converters, AC-AC converters and their control circuits for real world applications using MATLAB tool

PRERQUISITE

Nil

COURSE OBJECTIVES

1	To impart knowledge on single-phase and three-phase AC-DC converters.
2	To understand the simulation of various DC-DC converters.
3	To learn the simulation of the various inverter circuits.
4	To make the students simulate the ac voltage controllers and cycloconverters.
5	To gain the knowledge of MATLAB interfacing circuit

COURSE OUTCOMES

On the successful completion of the course, students will be able to

1. Design and develop the controlled rectifiers and AC-AC converters as per solar panel	Remember
2. Design and analyze switched-mode power converters as per power rating	Apply
3. Design and analyze single-phase and three-phase inverters as per power source.	Analysis
4. Implement the gating pulses using a microcontroller for various solar panel	Implement
5. Analysis of the various power circuit using MATLAB tool	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	S	M	-	M	-	-	-	-	-	-	L	L	M	-
CO2	M	S	S	M	S	-	-	-	-	-	-	L	L	-	M
CO3	L	S	S	M	L	-	-	-	-	-	-	M	M	-	M
CO4	S	M	M	L	S	-	-	-	-	-	-	L	S	-	-
CO5	M	S	M	M	M	-	-	-	-	-	-	L	L	M	M

S- Strong; M-Medium; L-Low

Syllabus :

1. Simulation of Single phase Semi controlled converter
2. Simulation of Single phase Fully controlled converter
3. Simulation of Single phase PWM inverter
4. Simulation of Three phase bridge inverter
5. Simulation of Three phase semi and fully controlled converter
6. Simulation of Buck, Boost, Buck-Boost and Cuk converters
7. Simulation of Resonant converters
8. Simulation of single phase AC Voltage Controller and cycloconverters

COURSE DESIGNERS				
S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.K.Boopathy	Associate Professor	EEE/AVIT	boopathyk@avit.ac.in
2	Dr. R. Devarajan	Professor	EEE/VMKVEC	devarajan@vmkvec.edu.in

	POWER ELECTRONICS SIMULATION LAB -II	Category	L	T	P	Credit
		EC - SE	0	0	4	2

PREAMBLE

To acquire the practical knowledge in power electronic devices and circuits. Students will be able to understand and analyze power converters such as AC-DC converters, DC-DC converters, DC-AC converters, AC-AC converters and their control circuits for real world applications using PCB board.

PRERQUISITE

Power Electronics

COURSE OBJECTIVES

1	To impart knowledge on the Hardware fabrication process
2	To understand the hardware fabrication of various DC-DC converters.
3	To learn the interfacing kit of the various inverter circuits for solar panel
4	To understand the performance of single-phase half & full controlled rectifier controller.
5	To gain knowledge on hardware interfacing circuits for various PV System

COURSE OUTCOMES

On the successful completion of the course, students will be able to

1. Analyze the performance characteristics of semiconductor devices by Hardware Kit	Remember
2. Design a solar panel with a power converter for solar panel rating.	Apply
3. Performance analysis of power converter for the various PV system.	Analysis
4. Fabricate the triggering circuit for various power rating	Implement
5. Design and analysis of the performance characteristics of AC voltage controller & cycloconverter by hardware kit	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	M	-	-	-	-	-	-	L	L	M	-
CO2	S	S	S	M	S	-	-	-	-	-	-	L	L	-	M
CO3	S	S	S	M	L	-	-	-	-	-	-	M	M	-	M
CO4	S	M	M	L	S	-	-	-	-	-	-	L	S	-	-
CO5	S	S	M	M	M	-	-	-	-	-	-	L	L	M	M

S- Strong; M-Medium; L-Low

Syllabus :

1. Implantation of single-phase Half controlled converter using PCB for Solar panel
2. Design of single phase fully controlled converter using PCB for 10 W solar panel
3. Design of single phase PWM inverters for KVA inverter kit.
4. Analysis of three phase bridge inverter for low power solar system.
5. Analysis of single-phase AC voltage controller for Solar drives.
6. Fabrication of Cycloconverter for AC motor drives
7. Fabrication of Chopper circuit using PCB for 24 W Solar Panel

COURSE DESIGNERS				
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	Fundamentals of Automotive Systems	Category	L	T	P	C
			3	0	0	3

Preamble

The course provides a fundamental understanding of the electric vehicle.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To impart knowledge on electric drives
2	To impart knowledge on Motor Drive and Propulsion Systems of Electric Vehicles
3	To understand the concepts of energy storage systems.
4	To design and analyze the energy management strategies of electric vehicle.
5	To create the network systems for electric vehicles.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Understand the concepts of electric vehicle drives.	Understand
CO 2	Apply the AC, DC and permanent magnet electric drive concepts in electric vehicles.	Apply
CO 3	Develop the charging systems and also can able to implement the regeneration.	Create
CO 4	Design the electric drive systems for different topologies.	Create
CO 5	Exposure the vehicular communication protocols.	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	S	S	-		L	-	-	S	S	-
CO2	S	M	S	S	S	L	M	L	M	L	-	-	L	M	-
CO3	S	M	M	L	L	L	M	-	-	L	-	-	L	M	-
CO4	S	M	S	S	S	M	M	L	M	L	M	-	M	M	-
CO5	S	M	M	L	S	M	S	-	M	L	L	M	-	L	M

SYLLABUS

Introduction

xEV:- Introduction to xEV's – BEV, HEV, PEV, FCEV- Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, xEV Drive Trains:- Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.

Electric Propulsion Systems

Electric Propulsion systems: EV consideration, DC motor drives, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives, Sizing of Electric Machine for EVs and HEVs.

Energy Storage Systems

Energy Storage and power electronics for battery charging and grid interface**,** Energy Storage Requirements in (Hybrid and) Electric Vehicles:- Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices. EV and PHEV Battery Charging: Grid and Renewable Energy Interface, Regenerative braking.

Energy Management Strategies

Energy Management Strategies: classification, comparison and implementation issues of EMS. On-board power electronic battery Management systems. Design of Electric and Hybrid Electric vehicle: Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, and energy storage design.

Vehicular Networks

Vehicular Networks: Cross-System Functions, Requirements For Bus Systems, Classification Of Bus Systems, Application In The Vehicle, Coupling Of Networks, Examples Of Networked Vehicles;
Bus Systems: CAN Bus, CAN-FD, LIN Bus, MOST Bus Bluetooth, Flex Ray, Diagnostic Interfaces: Implementation Of Body Electronics Functionalities Using Controllers. Control Systems for the HEV and EVs:, On-Board Diagnostics (OBD), Introduction to autonomous driving.

TEXTBOOK

1.M. Ehsani, Y. Gao, S. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2015

2. Iqbal Hussain, "Electric & Hybrid Vechicles – Design Fundamentals", Second Edition, CRC Press, 2011. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.

3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

REFERENCES

1.Paul, A., Chilamkurti, N., Daniel, A. and Rho, S. Intelligent Vehicular Networks and Communications. Elsevier Science and Technology Books, Inc. 2017

2.Wai Chen,"Vehicular Communications and Networks: Architectures, Protocols, Operation and Deployment", Elsevier Science and Technology Books 2015

COURSE DESIGNERS

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	Vehicular Networks and Communication	Category	L	T	P	C
			3	0	0	3

Preamble:
Vehicular Network and Communication is a course that focuses on the study of communication technologies and protocols specifically designed for vehicles and their integration into intelligent transportation systems. The course examines the characteristics, challenges, and opportunities of vehicular networks, including their deployment, performance, and security aspects.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To Identify the knowledge on communication technologiesand standards of automotive systems.
2	To Understand the fundamental concepts and principles of vehicular networks and their role in intelligent transportation systems.
3	To Familiarization with vehicular network models and functions.
4	To Evaluate the performance of various vehicular network architectures.
5	To Analyze the protocols and standards for V2V and V2I communication.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Identify the knowledge on communication technologiesand standards of automotive systems.	Understand
CO 2	Understand the fundamental concepts and principles of vehicular networks and their role in intelligent transportation systems.	Understand
CO 3	Familiarization with vehicular network models and functions.	Apply
CO 4	Evaluate the performance of various vehicular network architectures.	Evaluate
CO 5	Analyze the protocols and standards for V2V and V2I communication.	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	-	M	-	-	-	-	M	M	M	-	M	-
CO2	L	-	-	-	M	L	-	-	-	L	M	M	-	S	-
CO3	L	-	-	-	M	L	-	-	-	L	L	L	-	M	-

CO4	L	L	S	L	S	L	-	-	-	M	M	L	-	S	L
CO5	L	M	S	L	S	L	-	-	-	L	S	M	-	S	L

SYLLABUS

Vehicular communications
Introduction to vehicular communications- Overview on transportation networks, Evolution of transportation models, Vehicular network standardization, Vehicular communication technologies.
Vehicular network
Vehicular network (VN) model- Cluster based vehicular networks, Vehicle platooning, Vehicular cloud, Hybrid sensor–vehicular networks, Information distribution, Internet of Vehicles.
Vehicular network models and functions
Vehicular Networks: Cross-System Functions, Requirements for Bus Systems, Classification of Bus Systems, Application in the Vehicle, Coupling of Networks, Examples of Networked Vehicles;
Vehicular network architectures
Bus Systems: CAN Bus, CANFD, LIN Bus, MOST Bus Bluetooth, Flex Ray.
Protocols and standards for V2V and V2I communication
Vehicular Communications: Intelligent Transportation Systems: IEEE 802.11p-ITS-IVC: Inter- Vehicle Communications- Mobile Wireless Communications and Networks- Architecture Layers Communication Regime.V2V, V2I-VANET-WAVE; DSRC.
TEXTBOOK
1. Dominique Paret, “Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe-by-Wire”, Wiley,2007. 2. Popescu-Zeletin R, Radusch I and Rigani M.A, “Vehicular-2-X Communication”, Springer,2010.
REFERENCES
1. Dominique Paret, “FlexRay and its Applications: Real Time Multiplexed Networks”, Second Edition, Wiley,2012. 2. Xiang W, “Wireless Access in Vehicular Environments Technology”, Springer, 2015. 3. Laun T.H, Shen X. (Sherman) and Bai F, “Enabling Content Distribution in Vehicular AdHoc Networks”, Springer, 2014.
COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Sankarganesh	Associate Professor	EEE/VMKVEC	sankarganesh@vmkvec.edu.in
2	Mr. S. Prakash	Assistant Professor (Gr-	EEE/AVIT	sprakash@avit.ac.in

	E-mobility Business and Policies	Category	L	T	P	C
			3	0	0	3

Preamble

To impart knowledge on the need of policies for Electric Vehicle charging and infrastructure requirements.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	Understanding the models used in public transportation system
2	Familiarize the concept of shared mobility services, advantages and monitory benefits.
3	Introduce to the infrastructure requirements for electric vehicle charging
4	Ability to comprehend, design and develop policies for electric vehicle charging
5	Understanding the various standards of electric vehicle.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Understand the concepts of public transport system.	Understand
CO 2	To apply the concept of E mobility services	Apply
CO 3	Develop the charging systems and also can able to implement the regeneration.	Create
CO 4	To design and develop the policies for electric vehicle charging	Create
CO 5	To understand the various standards of electric vehicle.	Understand

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	S	L	-	M	M	-	-	M	L	-
CO2	S	M	M	S	M	L	M	L	M	L	-	-	M	M	-
CO3	S	M	M	L	M	L	M	-	-	L	-	-	M	M	-
CO4	S	M	S	S	S	M	M	L	M	L	M	-	M	M	-
CO5	S	M	M	L	S	M	S	-	M	L	M	M	-	M	M

SYLLABUS

Introduction
Introduction to India's passenger mobility sector- current state of India's public transport system, public transport: efficiently and affordably mobilizing cities, opportunities to maintain and ideally increase the utilization of public transport in India, expanding India's definition of public transport through data and new business models.
Electric Mobility
India's Path Forward In Public Transport, Sharing and Mobility Services: Unlocking Economic Electrification- the business case for shared, electric mobility services, Examples of Shared Mobility Services Active In Today's Global Marketplace.
Incentives for Electric Mobility
Ride-Hailing Services: Pooled Ride-Hailing Services: Vehicle Sharing: Peer-To-Peer Vehicle Sharing: Fixed-Route Commuter Services: Incentives to promote electric mobility and sharing: Parking and pick-up benefits: Road toll and road tax discount or exemption: Licensing and registration benefits.
EV Charging Infrastructure Deployment
Congestion pricing: Low-emission zones: EV Charging Infrastructure: Powering EVs and Recharging 4 India's Electricity Sector: Considerations and Implications for India's EV Charging Infrastructure Deployment Standards
EV Standards
EV standards-IEEE, IEC and SAE, Basics of EV charging, EV charging standards and infrastructure, Smart Parks, V2G, G2V, V2B, V2H, renewable energy integration to EV charging infrastructure.
TEXTBOOK
1.Emadi, A. (Ed.), Miller, J., Ehsani, M. (2003). Vehicular Electric Power Systems. Boca Raton: CRC Press. 2.Husain, I. (2010). Electric and Hybrid Vehicles. Boca Raton: CRC Press.
REFERENCES
1.Larminie, James, and John Lowry. Electric Vehicle Technology Explained. John Wiley and Sons, 2012. 2.Tariq Muneer and Irene Illescas García, 1 - The automobile, In Electric Vehicles: Prospects and Challenges, Elsevier, 2017.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Sathish	Associate Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
2	Mr. S Prakash	Assistant Professor	EEE/AVIT	sprakash@avit.ac.in

	AUTOMOTIVE ELECTRONICS	Category	L	T	P	C
			3	0	0	3

Preamble

To equip students with the knowledge and skills required to work in the rapidly evolving field of automotive industries. Automotive Electronics provides the knowledge of both Electrical and Automotive field. This course covers basic electronics, automotive electrical systems and components. It gives power electronics applications for engine control systems, advanced sensing, communication and control systems, and advanced electronics for green vehicles.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control
2	Use available automotive sensors and actuators while interfacing with microcontrollers/ microprocessors during automotive system design.
3	Understand the Digital Engine control systems and Onboard diagnosis system.
4	Ability to analyze the performance of various control systems, engine management and electrical networks and components in electric vehicles.
5	Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Understanding the evolution of automotive electronics and electronic engine management system	Understanding
CO 2	Understanding the automotive control system applications of Sensors and Actuators	Understanding
CO 3	Analyzing the Digital Engine control systems of various electronic dash board of automotive	Analyze
CO 4	Able to analyze the performance of various control systems to automotive systems	Apply
CO 5	Analyzing the different On-board diagnostics, Off-board diagnostics to the automotive	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	-	-	-	M	S	L		L	-	-	S	L	M
CO2	M	-	M	-	S	L	M	-	M	L	-	-	L	M	-
CO3	M	-	M	-	S	L	M	-	-	L	-	-	M	L	-

CO4	S	-	S	-	-	L	M	-	-	L	M	-	M	L	-
CO5	S	M	S	S	S	L	S	-	M	L	L	M	-	L	M

SYLLABUS

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS
Evolution of Automotive Electronics, Automobile Physical Configuration, Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to control strategies: Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines
SENSORS & ACTUATORS
Automotive Control System applications of Sensors and Actuators - Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (02/EGO) Lambda Sensors, Piezoelectric Knock Sensor.
DIGITAL ENGINE CONTROL SYSTEM
Digital Engine control features, engine cooling and warm up control, idle speed control, acceleration and full load enrichment, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System, future automotive electronic systems, Electronic dash board instruments – Onboard diagnosis system
AUTOMOTIVE NETWORKING&VEHICLE MOTION CONTROL
Bus Systems- Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles, Buses - CAN Bus, UN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)
AUTOMOTIVE DIAGNOSTICS
Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems -Accelerometer based Air Bag systems
TEXTBOOK
1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing, 2002. 2 Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007 3. Hillier's, "Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics", Fifth Edition, Nelson Thrones, 2007. 4. Bosch,"Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive", Fifth edition, Springer view 2014.
REFERENCES

1. Automobile Electrical & Electronic Equipments - Young, Griffitns - Butterworths, London.
2. Understanding Automotive Electronics, Wiliam B. Ribbens, 5th Edition, Newnes, Butterworth–Heinemann.
3. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
4. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004
5. Understanding Automotive Electronics – Bechfold SAE 1998
6. Automobile Electronics by Eric Chowanietz SAE.
7. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
8. Automotive Computer & Control System – Tomwather J. R., Cland Hunter, Prentice Inc. NJ
9. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall
10. Eaglewood, Cliffs, NJ
11. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical
12. Automobile Electrical & Electronic Systems – Tom Denton, Allied Publishers Pvt. Ltd.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	K.S.Kavitha Kumari	Assistant Professor	EEE/AVIT	kavitha.eee@avit.ac.in
2	P. LOGANATHAN	Assistant Professor	EEE/VMKVEC	loganathan@vmkvec.edu.in

	AUTOMOTIVE CONTROL SYSTEMS	Category	L	T	P	C
			4	0	0	4

Preamble

It is a design oriented course aimed at automotive system control is the active control of the suspension system, which is widely used in industry, and feedback control system.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To discuss about the impart knowledge control.
2	To estimate the modeling of vehicle dynamics system design.
3	To explain about, design controllers for automotive systems.
4	To discuss the various driver models,
5	To explain about complete simulationsystem.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Understanding of vehicle dynamics and road-driver models.	Understand
CO 2	Ability to diagnosis the vehicle faults using fault models	Create
CO 3	Ability to analyze the ABS control systems.	Apply
CO 4	Ability to develop a complete driver model with path, road surface and wind strength.	Create
CO 5	Ability to develop a complete simulation.	Analyze

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	**S**	L	-	M	S	S	-		L	-	-	S	S	-
CO2	S	S	S	S	S	L	M	L	M	L	-	-	L	S	-
CO3	S	S	L	L	L	L	S	-	-	L	-	-	L	S	-

CO4	S	S	S	S	S	M	M	L	M	L	M	-	L	M	-
CO5	S	M	M	L	S	M	S	-	M	L	L	M	-	S	M

SYLLABUS

Overview of Control System: Modeling, Time/Frequency Response Analysis And Stability Analysis: PID, State Variable Analysis.
Model Based Diagnosis: Characteristics, Faults, Fault Modeling, Principles Of Model Based Diagnostics- Residual Generator Design, Residual Evaluation, Engineering Of Diagnosis Systems, Application Example.
Vehicle Control Systems: ABS Control Systems- Torque Balance At Vehicle- Road Contact, Control Cycles Of The ABS System, ABS Cycle Detection; Control Of Yaw Dynamics- Deviation Of Simplified Control Law, Derivation Of Reference Values.
Road and Driver Models: Road Model- Requirements of The Road Model, Definition of The Course Path, Road Surface and Wind Strength; PID Driver Model; Hybrid Driver Model – Vehicle Control Tasks, Characteristics of Human as A Controller, Information Handling, Complete Driver Model.
Simulation/case studies on relevant topics.

TEXTBOOK

TEXT BOOKS/REFERENCES

1. Kiencke, Uwe and Nielsen, Lars, “Automotive Control Systems for Engine, Driveline and Vehicle”, Springer, 2005
2. I.J Nagrath and M.Gopal, “Control Systems Engineering”, Wiley Eastern Limited, New Delhi, 2008.

M.Gopal, “Modern Control System Theory”, New Age International,2005.

3. Katsuhiko Ogata, “Modern Control Engineering”, Fifth Edition, Prentice Hall, 2010.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. A.Balamurugan	Associate Professor	EEE/VMKVEC	balamurugan@vmkvec.edu.in
2	Dr. L. Chitra	Professor	EEE/AVIT	chitra@avit.ac.in

	VEHICLE DYNAMICS AND CONTROL	Category	L	T	P	C
		EC(PE)	4	0	0	4

Preamble

.To understand the concept of vehicle dynamics and analyze the parameters for adaptive vehicular control

PREREQUISITE : Control System

COURSE OBJECTIVES

1	To analyze the performance of vehicle control systems.
2	Develop the analytical skills necessary to quantitatively predict the behavior of open-loop and closed-loop systems.
3	Experimental design will be complemented with a careful analysis of the performance by simulation.
4	Develop skills in using professional computer-aided control system design and analysis tools.
5	To explore properties of dynamic systems composed of a large number sub-systems.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Understanding of concepts in vehicle dynamics and control.	Remember
CO 2	Knowledge on control system architecture and adaptive vehicular control	Remember
CO 3	Ability to design and develop controllers for braking system in Electric vehicle	Analyze
CO 4	Ability to analyze the electronic stability control in Electric Vehicles	Analyze
CO 5	Expected to design feedback control systems for an actual scaled vehicle platform.	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	S	M	L	-	-	-	M	L	M
CO2	S	-	-	L	-	-	-	-	M	-	M	L	M	L	M
CO3	L	S	S	M	-	-	-	M	-	-	-	-	M	L	L
CO4	L	S	M	-	M	-	-	M	-	-	-	-	M	L	L
CO5	S	L	S	M	S	-	-	-	M	-	-	-	M	L	M

SYLLABUS

UNIT I- INTRODUCTION

Introduction to Driver Assistance Systems, Active Stability Control, Ride Quality, Technologies for Addressing Traffic Congestion, Emissions and Fuel Economy; Lateral Vehicle Dynamics: Kinematic Models, Dynamic Bicycle Model, From Body Fixed To Global Coordinates: Lateral Vehicle Control: State Feedback.

UNIT II- STEADY STATE ANALYSIS:

Understanding Steady State Comering, the Output Feedback Problem, Compensator Design with Look Ahead Measurement; Longitudinal Vehicle Dynamics: Longitudinal Vehicle Model, Driveline Dynamics, Mean Value Engine Models

UNIT III LONGITUDINAL VEHICLE DYNAMICS

Longitudinal Vehicle Control: Introduction: Cruise Control, Control System Architecture, Adaptive Cruise Control, Individual Vehicle Stability and String Stability, String Stability with Constant Spacing, String Stability with Constant Time Gap, Controller for Transitional Maneuvers, Automated Highway Systems, Longitudinal Control for Vehicle Platoons, String Stability with Inter- Vehicle Communication, Adaptive Controller for Unknown Vehicle Parameters.

UNIT IV ELECTRONICS STABILITY CONTROL

Electronics Stability Control: Vehicle Model, Control Design for Differential Braking Based Systems, Control Design for Steer-By-Wire System, Independent All Wheel Drive Torque Control.

UNIT V AUTOMOTIVE SUSPENSIONS

Active Automotive Suspensions: H2 Optimal Control, LQR Formulation for Active Suspension Design, Analysis of Trade-Offs Using Invariant Points, Performance of The Sky-Hook Damping Controller, Control with Hydraulic Actuators; Lab Experiments Based on Simulation Tools.

TEXTBOOK

1.Thomas D. Gillespie, “Fundamentals of Vehicle Dynamics”, SAE International, 1992.

2.R. Rajamani, “Vehicle Dynamics and Control”, Second Edition, Springer Verlag 2012.

REFERENCES

1.Uwe Kiencke and Lars Nielsen, “Automotive Control Systems: For Engine Driveline, and Vehicle”, Second edition, Springer, 2005.

2.John C Dixon, “Tyres, Suspension and handling”, 2nd Revised Edition, SAE International, 1996.

3.Hans B. Pacejka, “Tyre and Vehicle Dynamics”, Second Edition, Butterworth-Heinemann, 2006.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Mr. S. Prakash	Assistant Professor(Gr-II)	EEE/AVIT	sprakashavit.ac.in
2	Mrs. N.Aishwarya	Assistant Professor	EEE/VMKVEC	aishwarya@vmkvec.edu.in

	SENSORS & ACTUATORS	Category	L	T	P	C
			3	0	0	3

Preamble

The objective of this course is to make the students to list common types of sensor and actuators used in automotive.
Vehicles.

PREREQUISITE:

COURSE OBJECTIVES

1	To convey types of sensor and actuators used in vehicles.
2	To familiarize with the concepts of measurement of pressure force, temperature and flow.
3	To understand the sensors and actuators and their applications.
4	To learn the concept of operation of the sensors, actuators and electronic control.
5	To understand the concepts of temperature control actuators for vehicles.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	To understand basics of sensors, actuators and their characteristics.	Understand
CO 2	To explain working of various types of transducers and actuators.	Remember
CO 3	To educate the students on different types of sensors and other special sensors.	Remember
CO 4	To provide information about interfacing of actuators and drives.	Apply
C0 5	To understand the characteristics of controller and its applications.	Understand

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	L	S	L	-	-	S	S	-	-	L	-	-	-	-	L
CO2	M	M	M	-	M	L	M	-	M	L	-	-	-	-	L
CO3	M	-	M	-	M	L	M	-	-	L	-	-	-	-	-
CO4	L	-	S	-	M	M	M	L	-	L	M	-	M	L	-
CO5	S	L	S	S	S	M	S	-	M	L	L	L	-	-	-

SYLLABUS

INTRODUCTION TO MEASUREMENTS AND SENSORS
Sensors: Functions-Classifications-Main technical requirement and trends Units and standards-Calibration Methods-Classification of errors-Error Analysis-Limiting Error-Probable error-Propagation of error-Odds and uncertainty-principle of transduction-Classification. Static characteristics-mathematical model of transducers-Zero, First and Second order transducers- Dynamic characteristics of first and second order transducers for standard test inputs.
VARIABLE RESISTANCE AND INDUTANCE SENSORS
Principle of operation-Construction details-Characteristics and applications of resistive potentiometer-Strain gauges-Resistive thermometers-Thermistors-Piezoresistive sensors, Inductive potentiometer-Variable reluctance transducers:-EI pick up and LVDT.
VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type-capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor-digital transducers- Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.
AUTOMOTIVE ACTUATORS
Electromechanical actuators-Fluid mechanical actuators-Electrical Machines-Direct current machines-Three-phase machines-Single phase alternating-current Machines. Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc
AUTOMATIC TEMPERATURE CONTROL ACTUATORS
Different types of actuators used in automatic temperature control-Fixed and variable displacement temperature control-Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TEXTBOOK

1. Doebelin's Measurement Systems:7th Edition (SIE), Ernest O.Doebeling Dhanesh N.Manik McGraw Hill Publishers,2019.
2. Robert Brandy,"Automotive Electronics and Computer System", Prentice Hall,2001.
3. William Kimberley, "Bosch Automotive Handbook",6thEdition,Robert Bosch GmbH,2004.
4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive,5th Edition,2007,ISBN No:978-3-658-01783-5.

REFERENCES

1. James D Halderman," Automotive Electrical and Electronics",Prentice Hall, USA, 2013.
2. Tom Denton, "Automotive Electrical and Electronics Systems,"Third Edition,2004,SAE International.
3. Patranabis.D,"Sensors and Transducers",2nd Edition, Prentice Hall India Ltd,2003.
4. William Ribbens,"Understanding Automotive Electronics-An Engineering Perspective,"7th Edition, Elsevier Butterworth-Heinemann Publishers,2012.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. Kavitha Kumari. K.S	AP(Gr-II)	EEE/AVIT	kavitha.eee@avit.ac.in

	PLC AND ITS APPLICATIONS	Category	L	T	P	C
			4	0	0	4

Preamble

To introduce the fundamentals of Programmable Logic Circuits and its applications in Engineering. Programmable Logic Controllers is the applied science of automatic control for multi-axis manipulatorsand is a large subset of the field of "Mechatronics".

PREREQUISITE :

COURSE OBJECTIVES

1	To understand the basic PLC terminologies, digital principles, PLC architecture andoperation.
2	To understand the programming instructions of PLC.
3	To develop the basic programming for simple applications using PLC.
4	To understand the hardware and software behind PLC and SCADA.
5	To develop the PLC logics for real time applications with PLC programming.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Understand the basic requirement of a PLC input/output devices andarchitecture.	Understand
CO 2	Ability to understand basics instructions used for PLC programming.	Understand
CO 3	Ability to design PLC programmes by applying timer/counter and arithmetic and logic instructions.	Apply
CO 4	Ability to understand the concepts of communication between PLC/SCADA	Understand
CO 5	Able to develop a PLC logic for a specific real world applications.	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	L	-	-	-	S	-	-	-	L	-	-	-	-	L
CO2	M	M	M	-	-	L	M	-	-	L	-	-	L	-	L
CO3	M	L	S	-	-	L	M	-	-	L	-	-	L	-	-
CO4	S	L	M	-	S	M	M	-	-	L	-	-	L	M	-
CO5	S	M	M	S	S	M	S	L	M	L	M	S	M	S	M

SYLLABUS

INTRODUCTION TO PLC

Introduction to PLC: Parts of PLC, Principle of operation, I/O section, Special I/O modules, CPU, Drivers-PLCConstruction: PLC Memory Design, HMIs, PLC I/O, Types of PLC.

INSTRUCTIONS IN PLC

Process memory organization, Bit- Level Logic Instructions – Instruction addressing -Function block Programming- Ladder/Function Block functions,
PLC Basic Instructions, Basic Examples (Jump Instructions, Suspend Instructions)– Latching Relay, Configuration of Sensors, Switches - Timers, Counters, Examples.

PROGRAMMING IN PLC

Different types of PLC program, PLC programming languages - Basic Ladder logic, logic functions, PLC module addressing, registers basics, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer and shift instructions.

PLC AND SCADA

Types of process - Communication Protocol – Modbus, Profibus-DP - Communication facilities SCADA - Hardware and software, Remote terminal units, Master Station and Communication architectures.

CASE STUDIES/APPLICATIONS OF PLC

PLC ladder diagram using logic gates - Stepper Motor Control- Elevator Control-Traffic light control - ON / OFF control in Flow and Pressure process control - CNC Machine Control- conveyor control-Interlocking Problems

TEXTBOOK

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

REFERENCESS

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.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. L.N.Ramya	AP(Gr-II)	EEE	ramya.avee077@avit.ac.in

	Digital Twin for Process Industry	Category	L	T	P	C
			3	0	0	3

Preamble

In this course, the students will learn how to develop digital twins and use them to model, simulate, and manage, industrial processes.

PREREQUISITE :Nil

COURSE OBJECTIVES

1	To Understand the Concept of Digital Twins technologies.
2	To analyse the Master Digital Twin Development Techniques with cyber physical techniques.
3	To Apply Data Analytics to Digital Twins for Supply Chain and Warehousing
4	To Design Effective Visualization Interfaces for healthcare.
5	To Explore Advanced Trends and Ethical Considerations for real time application.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	demonstratingand applying the concept of digital twins in real timeapplication.	Understand
CO 2	develop digital twins for process industry systems, showcasing their proficiency in data collection, integration, modeling, and simulationtechniques.	Remember
CO 3	apply data analytics methods to real-time and historical data collected fromdigital twins.	Remember
CO 4	design effective visualization interfaces to interact with digital twins,monitor process parameters, analyze data, and interpret insights.	Apply
C0 5	critically evaluate advanced trends in digital twin technology, such as AI integration, and assess their potential impact on the process industry andbroader society.	Understand

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	S	L	-	-	L	L	-	-	L	-	-	-	-	L
CO2	M	-	M	-	S	L	M	-	M	L	-	-	-	-	L
CO3	M	L	M	-	S	L	M	-	-	L	-	-	-	-	-
CO4	S	-	S	-	S	M	M	L	-	L	M	-	L	M	-
CO5	S	M	S	S	S	M	L	-	M	L	L	M	-	-	L

SYLLABUS

Introduction to Digital Twin

Introduction to technologies, need for digital twin, applications, opportunities, and challenges influencing digital twin. Application of digital twin, Merits and demerits of digital twin.

Manufacturing and Production

Introduction to the impact of the digital twin, cyber-physical systems, process automation and optimization, predictive maintenance and anomaly detection on the manufacturing ecosystem and its application

Supply Chain and Warehousing

Introduction to digital twin-based operation and management, and simulation-based smart supply chain ecosystem, including quality assurance in the food and beverage sector, warehousing with machine learning and path planning, and warehousing with machine learning and pallet loading

Healthcare

Introduction to healthcare and bioengineering applications of digital twins. The bioprocess and its potential, industrial-scale bioreactors and biomanufacturing, hospital administration in industry 4.0, epidermic control prediction, and cloud computing for radiotherapy systems.

Application

The fundamental characteristics and applications of digital twins, the future of digital twins and forecast for industrial 5.0.

TEXTBOOK

1. Fei Tao, Meng Zhang and A.Y.C. Nee, "Digital Twin Driven Smart Manufacturing" Elsevier, 2019.
2. Surjya Kanta Pal, Debasish Mishra, Arpan Pal, Samik Dutta, Debashish Chakravarty, Srikanta Pal "Digital Twin – Fundamental Concepts to Applications in Advanced Manufacturing", Springer 2021

REFERENCES

1. Osvaldo A. Bascur , Jim O'Rourke , "Digital Transformation for the Process Industries: A Roadmap", CRC Press, 2020.
2. Gopal Chaudhary, Manju Khari, Mohamed Elhoseny, "Digital Twin Technology", CRC Press, 2021.

COURSE DESIGNERS

SI No	Name of the Faculty	Designation	Department	Mail ID
1	K. R. Devabalaji	AssociateProfessor	EEE / AVIT	devabalaji.avee080@avit.ac.in

	Industrial Internet of Things	Category	L	T	P	C
			3	0	0	3

Preamble

This course delivers into the convergence of cutting-edge technologies, data analytics, and industrial processes t o creat a holistic understanding of IIoT and its transformative impact on modern industries.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To provide students with a comprehensive overview of the principles, evolution, and key components of Industry 4.0
2	To explore how Industry 4.0 and IIoT contribute to the transformation of traditional manufacturing into smart and agile digital manufacturing processes.
3	To discuss the role of cloud computing and data analytics in harnessing IIoT-generated data for improved decision-making.
4	To address the challenges and concerns related to cybersecurity and data privacy in the context of Industry 4.0 and IIoT.
5	To analyze real-world case studies showcasing successful implementations of Industry 4.0 and IIoT across various industries.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	design the core principles and technological foundations of Industry 4.0 and IIoT for real time application.	Understand
CO 2	identify and assess the potential benefits and challenges associated with the integration of Industry 4.0 and IIoT in industrial processes.	Remember
CO 3	apply appropriate sensors, communication protocols, and data analytics techniques for monitoring and optimizing industrial processes.	Remember
CO 4	design cybersecurity strategies and protocols to protect interconnected industrial systems from potential threats.	Apply
C0 5	analyze real-world case studies, propose innovative solutions, and create actionable plans for the implementation of Industry 4.0 and IIoT concepts in various industrial settings.	Understand

CO1	S	M	L	-	-	S	S	-	-	L	-	-	-	-	L
CO2	M	-	M	L	S	L	M	-	M	L	-	-	-	-	L
CO3	M	M	M	-	S	L	M	L	-	L	-	-	-	-	-
CO4	S	-	S	L	S	M	M	L	-	L	M	-	L	M	L
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	-	-

SYLLABUS

INDUSTRY 4.0
Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis
INDUSTRIAL IoT
IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking
IIoT ANALYTICS
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop. Need of Sensors.
IoT SECURITY
Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT.
CASE STUDY
Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries.
TEXTBOOK
1. Alasdair Gilchrist , "Industry 4.0: The Industrial Internet of Things", A press, 2017. 2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat ,"Industrial Internet of Things: Cyber manufacturing Systems", Springer, 2017
REFERENCES
1. Giacomo Veneri, Antonio Capasso , "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT", Packt, 2018. 2. Ismail Butun, "Industrial IoT Challenges, Design Principles, Applications, and Security", Springer 2020.

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	K. R. Devabalaji	Associate Professor	EEE/AVIT	devabalaji.avee080@avit.ac.in

	INTRODUCTION TO MEMS	Category	L	T	P	Credit
			3	0	0	3

PREAMBLE

Micro Electro Mechanical System (MEMS) contains components of sizes less than 1 millimeter. MEMS achieve some engineering functions by electro mechanical or electro chemical means. In general a sensor, an actuator and a signal transduction unit forms the MEMS device. Automobile, Aerospace, Health care are some of the areas where MEMS found applications. Natural science, Mechanical, Electrical, Chemical, Materials and Industrial Engineering are the disciplines involved in design, Manufacture and Packaging of MEMS devices. This course provides a comprehensive treatment with synergetic integration of wide spectrum of discipline in science and engineering to cater the multidisciplinary nature of Mechatronics

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques
2	This enables them to design, analysis, fabrication and testing the MEMS based components
3	Introduce the students various opportunities in the emerging field of MEMS.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1.Know the basics of MEMS fabrication technologies and Piezo resistanceEffect, Piezoelectricity, Piezoresistive Sensor	Understand
CO2. Understandthe Mechanics of Beam and Diaphragm Structures	Understand
CO3. Use mechanics principles and Basic Equations for Slide-film AirDamping, Couette-flow Model, Stokes-flow Model.	Apply
CO4. Know the concept of Electrostatic Actuation	Analyze
CO5. Understand the applications of MEMS in RF	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO	PO4	PO5	PO6	PO	PO8	PO9	PO1	PO11	PO12	PSO1	PSO2	PSO3

			3				7			0					
CO1	S	L	-	-	M	M	-	-	-	-	-	-	S	-	-
CO2	S	M	M	M	L	S	-	L	-	M	L	-	-	-	-
CO3	S	M	M	-	M	-	-	-	M	-	M	-	-	-	-
CO4	S	S	M	-	-	-	-	-	-	-	-	-	-	-	-
CO5	S	S	S	M	M	-	L	-	M	-	-	M	-	L	-
S- Strong; M-Medium; L-Low															

SYLLABUS

Overview of MEMS and Micro Systems: MEMS and Microsystems, products, Evolution of micro-fabrication, Micro system and Microelectronics, The multidisciplinary nature of MEMS, Miniaturization, applications of micro systems in automotive, health care, aerospace, and telecommunication fields.

Working Principles of Microsystems: Introduction, micro sensors: Acoustic waves, optical, chemical, pressure, thermal, biomedical and bio sensors. Micro actuation: using thermal forces, shape memory alloys, piezoelectric crystals and electrostatics forces. MEMS with micro actuators: micro grippers, micro motors, micro valves, micro pumps, micro accelerometer

Scaling law in miniaturization: Introduction to scaling, scaling in rigid body dynamics, electrostatic forces, electromagnetic forces, electricity, fluid mechanics and heat transfer.

Materials for MEMS and Microsystems: Introduction, substrate and wafers, active substrate materials, silicon, silicon compounds, silicon piezoresistors, polymers and packaging materials.

Microsystem fabrication process: Introduction, Photolithography, ion implantation, diffusion, oxidation, chemical vapour deposition, physical vapour deposition (sputtering), Deposition by epitaxy, wet and plasma etching.

Overview of Micro manufacturing: Introduction, bulk micromachining, surface micromachining, the LIGA process. Microsystem packaging: Introduction, Microelectronics packaging, Microsystem packaging, Interfaces in microsystem packaging, Essential packaging technologies, Pressure sensor packaging

TEXTBOOKS

1. Tai –Ran Hsu, "MEMS and Microsystem: Design and Manufacture ", Tata McGraw Hill, First Edition, 2002.

REFERENCE BOOKS

1. G.K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Athrae "Micro and Smart System", Wiley India Pvt Ltd, First edition, 2010.
2. Chang Liu , "Foundation of MEMS", 2nd Edition, Pearson education, 2012.
3. Gad El Hak (Editor), "The MEMS Hand Book", Three volume set, 2nd revised Edition.CRC press, 2005.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. L. Chithra	Professor & Head	EEE/AVIT	chitra@avit.ac.in
2	Dr. R. Sathish	Associate Professor	EEE/VMKVEC	sathish@vmkvec.edu.in

	PROCESS CONTROL DESIGN	Category	L	T	P	C
			3	0	0	3

Preamble

Expose students to the Process Control methods used in industries and research application.

PREREQUISITE :

COURSE OBJECTIVES

1	To get adequate knowledge about basic control actions and related issues.
2	To educate the effect of various control actions and the methods of tuning the controller
3	To study the control schemes for typical processes and its P & I model.
4	To learn the concepts of process control, including principles of industrial practices
5	To introduce the dynamics of various processes and modelling of physical processes using poles and zero principles.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO 1	Discuss the principles of process control, evaluation, data representation and the elements of final control operation.	Understand
CO 2	Analyze the principle and working of continuous and discontinuous controller modes.	Remember
CO 3	Design analog controllers based on multi-process and decoupling systems	Remember
CO 4	Design the fundamental concepts of multivariable and intelligent controllers for industrial application.	Analysis
C0 5	Model type of controller that can be used for specific problems in Automation industry	Apply

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	S	S	L	-	-	S	S	-	-	L	-	-	-	-	L
CO2	M	L	M	-	M	L	M	-	M	L	-	-	-	-	L
CO3	M	-	M	-	M	-	M	-	-	L	-	-	-	-	-
CO4	L	-	S	-	M	M	M	L	-	L	M	-	M	L	-
CO5	S	L	-	S	S	-	S	-	M	L	L	L	-	-	-

SYLLABUS

Process Control
Plan aspects – Fundamentals of Hardware Process Control System. Mathematical modeling of Processes: Basic laws and equations – linearization – transfer function representation of process – variable gain, variable time constant.
Loop Control of Processes:
Basic control actions – characteristics of ON/OFF, PI, PD, PID control modes – non-linear PID control – position and velocity forms of PI(D) controllers – anti-reset windup
Control Techniques:
Cutting-edge control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control
Multivariable Control Analysis:
Introduction to state-space methods, degrees of freedom analysis and analysis, Interaction, Bristol arrays, Nieder link index - design of controllers, Tuning of multivariable controllers
Design of Control Systems for Multivariable Process:
Design equations – degrees of freedom – poles and zeros – number of controlled and manipulated variables – generation of alternative loop configurations – design of non-interacting control loops. Decoupling control.
TEXTBOOK
1. *Peter Harriott, Process Control, Tata McGraw Hill 26th Reprint, 2005.* 2. *S. Bhanot, Process Control-Principles and Applications, Oxford University Press, Edition No.04, 2010*
REFERENCES
1. *D.E. Seborg, T.F. Edger, and D.A. Millichamp, 'Process Dynamics and Control', John Wileyand Sons, 3nd Edition, 2016.* 2. *T. E. Marlin, Process Control: Designing Processes and Control Systems for DynamicPerformance, McGrow Hill, Edition No. 02, 2019.*
COURSE DESIGNERS

Sl No	*Name of the Faculty*	*Designation*	*Department*	*Mail ID*
1	*Dr.K.Boopathy*	*Prof*	*EEE*	*Boopahyk@avit.ac.in*