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:

M.E. – POWER SYSTEMS ENGINEERING

PART TIME (3 Years)

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM

(Semester I to VI)

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 Power Systems Engineering programme will be able to:

Sl. No.	Description
PSO 1	The use of recent techniques with the software tools for developing, simulating, analyzing electrical and electronic systems in order to pursue lifelong learning.
PSO 2	Empowering to provide socially acceptable technical solutions to real time electrical engineering problems with the application of modern and appropriate techniques for sustainable development
PSO 3	Acquire knowledge in the field of power engineering by doing research in the lifelong learning process.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

Sl. No.	Description
PEO 1	To obtain a solid education in electrical engineering and mathematics are necessary for pursuing successful careers in higher education, research, and industry.
PEO 2	To obtain the capacity to create diverse controllers to improve the Power System's stability and power transmission capability..
PEO 3	To act with professionalism, ethics and to work on projects in a multidisciplinary setting for the good of society.

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

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 (5)**	Mathematics/Applied Mathematics	3
		Research Methodology and IPR	2
2.	**B. Program Core Courses**	Core Courses	32
3.	**C. Elective Courses**	Program electives	15
		Open electives (Courses on emerging areas..)	3
4.	**D. Employability Enhancement Courses and courses for presentation of Technical skills related to the specialization**	Project work phase I	6
		Project work phase II	12
		Technical Seminar *	1*
		Research Presentation Skills *	1*
		Internship *	1*
5.	****E. Mandatory Courses/Audit Courses**	Any two courses on: 1. English for Research Paper Writing 2. Disaster Management 3. Value Education 4. Constitution of India 5. Pedagogy Studies 6. Personality Development Through Life Enlighten Skills	Zero Credit Course (Minimum 2 Courses to be Completed)
Minimum Credits to be earned			**74**

*** In Category D , Out of 20 Credits minimum Two Credits should be earned among any of the following courses - Technical Seminar , Research Presentation skills and Internship**

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

CURRICULUM

M.E (PART TIME) – POWER SYSTEMS ENGINEERING

SEMESTER
I TO VI

M.E.(PART TIME) – POWER SYSTEMS ENGINEERING – SEMESTER I TO VI

A. Foundation Courses

SL. NO	COURSE CODDE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1.		RESEARCH METHODOLOGY AND IPR	EEE	FC - HS	2	0	0	2	NIL
2.		APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	MATH	FC - BS	2	1	0	3	NIL

B. Programme Core Courses (Credits-32)

SL. NO	COURSE CODDE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1		ADVANCED POWER SYSTEM ANALYSIS	EEE	CC	3	0	0	3	NIL
2		POWER CONVERTERS FOR DISTRIBUTED GENERATION SYSTEMS	EEE	CC	3	0	0	3	NIL
3		POWER SYSTEM DYNAMICS AND CONTROL	EEE	CC	3	0	0	3	NIL
4		DIGITAL PROTECTION FOR POWER SYSTEM	EEE	CC	3	0	0	3	NIL
5		TRANSIENTS IN POWER SYSTEM	EEE	CC	3	0	0	3	NIL
6		EHV POWER TRANSMISSION	EEE	CC	3	0	0	3	NIL
7		HVDC TRANSMISSION	EEE	CC	3	0	0	3	NIL
8		POWER QUALITY	EEE	CC	3	0	0	3	NIL
9		POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	EEE	CC	3	1	0	4	NIL
10		POWER ELECTRONICS FOR POWER SYSTEMS LAB	EEE	CC	0	0	4	2	NIL
11		POWER SYSTEM SIMULATION LAB	EEE	CC	0	0	4	2	NIL

B. Elective Courses (Credits-18)

Program electives courses relevant to chosen specialization/branch (Credits - 15)

SL. NO	COURSE CODDE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1		DISTRIBUTED ENERGY RESOURCES AND MICRO GRID	EEE	EC-PS	3	0	0	3	NIL
2		OPTIMAL CONTROL AND FILTERING	EEE	EC-PS	3	0	0	3	NIL
3		WIND ENERGY CONVERSION SYSTEM DESIGN	EEE	EC-PS	3	0	0	3	NIL
4		LINEAR AND NON-LINEAR SYSTEM THEORY	EEE	EC-PS	3	0	0	3	NIL
5		ELECTRIC POWER DISTRIBUTION SYSTEM DESIGN	EEE	EC-PS	3	0	0	3	NIL

6		PULSE WIDTH MODULATION FOR PE CONVERTERS	EEE	EC-PS	3	0	0	3	NIL
7		RESTRUCTURED POWER SYSTEM	EEE	EC-PS	3	0	0	3	NIL
8		SMART GRID TECHNOLOGIES	EEE	EC-PS	3	0	0	3	NIL
9		ADVANCED MICROCONTROLLER BASED SYSTEMS	EEE	EC-PS	3	0	0	3	NIL
10		SCADA SYSTEM AND APPLICATIONS	EEE	EC-PS	3	0	0	3	NIL
11		FACTS AND CUSTOM POWER DEVICES	EEE	EC-PS	3	0	0	3	NIL
12		POWER SYSTEM RELIABILITY	EEE	EC-PS	3	0	0	3	NIL
13		POWER SYSTEM SECURITY	EEE	EC-PS	3	0	0	3	NIL
Open Subjects – Electives from other Technical and /or Emerging Courses (Credits - 3)									
SL. NO	**COURSE CODDE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1		BIO MEMS	ECE	OE - EA	3	0	0	3	NIL
2		BIOMEDICAL PRODUCT DESIGN AND DEVELOPMENT	BME	OE - EA	3	0	0	3	NIL
3		METAL ADDITIVE MANUFACTURING	MECH	OE - EA	3	0	0	3	NIL
4		WASTE TO ENERGY	BTE	OE - EA	3	0	0	3	NIL
5		SUSTAINABLE BUILT ENVIRONMENT	CIVIL	OE - EA	3	0	0	3	NIL
6		ADVANCED CYBER SECURITY	CSE	OE - EA	3	0	0	3	NIL
D. Employability Enhancement Courses and courses for presentation of Technical skills related to the specialization (Credits-20)									
SL. NO	**COURSE CODDE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1		PROJECT WORK – PHASE I	EEE	EE - P	0	0	12	6	NIL
2		PROJECT WORK – PHASE II	EEE	EE - P	0	0	24	12	NIL
3		TECHNICAL SEMINAR *	EEE	EE - S	0	0	2	1	NIL
4		RESEARCH PRESENTATION SKILLS *	EEE	EE - D	0	0	2	1	NIL
5		INTERNSHIP *	EEE	EE - I	3 Weeks			1	NIL

E. MANDATORY COURSES/AUDIT COURSES (NO CREDITS) (NOT INCLUDED FOR CGPA CALCULATIONS)									
SL. NO	**COURSE CODDE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		ENGLISH FOR RESEARCH PAPER WRITING	ENG	AC	0	0	2	0	NIL
2.		DISASTER MITIGATION AND MANAGEMENT	CIVIL	AC	0	0	2	0	NIL
3.		VALUE EDUCATION	HS	AC	0	0	2	0	NIL
4.		CONSTITUTION OF INDIA	LAW	AC	0	0	2	0	NIL
5.		PEDAGOGY STUDIES	HS	AC	0	0	2	0	NIL
6.		PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTEN SKILLS	ENG	AC	0	0	2	0	NIL

Course Code	Course Title	Category	L	T	P	C
	RESEARCH METHODOLOGY AND IPR	**FC-HS**	**2**	**0**	**0**	**2**

Course Outcomes:

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

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis, the need of information about Intellectual Property Right to be promoted among students in general & Engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT I- RESEARCH PROBLEM AND SCOPE FOR SOLUTION

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II- FORMAT

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT III- PROCESS AND DEVELOPMENT

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT IV- PATENT RIGHTS

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V- NEW DEVELOPMENTS IN IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"Juta Publishers,1996.

2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" , Juta Publishers,2004.

3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

REFERENCES

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

2. Mayall, "Industrial Design", McGraw Hill, 1992.

3. Niebel, "Product Design", McGraw Hill, 1974.

4. Asimov, "Introduction to Design", Prentice Hall, 1962.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	Category	L	T	P	Credit
		FC-BS	2	1	0	3

PREAMBLE

The lectures provide an introduction to Calculus of Variations, addressing both classical subjects (action functionals, isoperimetric problems), and modern approaches (direct methods, applications to physics and optimal control). The student will be required to understand the theoretical aspects of the theory, as well as to apply it to specific cases. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including matrix theory, PERT and CPM,

PREREQUISITE - Nil

COURSE OBJECTIVES

1	To make the students to decompose the matrices into required form and to know its uses.
2	To understanding the modelling and interpretation of classical and modern variational problems. Knowledge of the basic techniques to identify optimal solutions to variational models.
3	To understand the knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry.
4	To formulate the problem and prepare the computational procedure of PERT and CPM method.
5	To be get exposed to the concepts of random processes and discrete time Markov chain.

COURSE OUTCOMES

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

CO1. Apply the concept of diagonalisation of matrices in the field of electrical and electronics communication engineering.	Apply
CO2.Being able to model various classes of a variational and optimal control problems, and derive sufficient and necessary conditions for extremality.	Apply
CO3. Formulate the Linear programming problem. Conceptualize the feasible region. Solve the LPP with two variables using graphical method and by simplex method.	Apply
CO4.Conceptualize the computational procedure of PERT and CPM method.	Apply
CO5.Classify and apply the concepts of Random Process, Markov Process and their applications to answer quantitative questions about the outcomes of probabilistic systems.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO2	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO3	S	S	M	M	--	--	--	S	--	--	--	M	--	--	--
CO4	S	S	S	M	--	--	--	S	--	--	--	M	--	--	--

CO5	S	S	S	M	L	--	--	M	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

ADVANCED MATRIX THEORY

Matrix norms – Jordan canonical form – Generalised eigenvectors – Singular value decomposition – Pseudo inverse – Least square approximations – QR algorithm - Some important matrix factorizations – The Cholesky decomposition.

CALCULUS OF VARIATIONS

Variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functionalsdependent on functions of several independent variables – Some applications – Direct methods: Ritz and Kantorovich methods.

LINEAR PROGRAMMING

Mathematical Formulation of Linear programming problems- applications & limitations – Graphical method - Simplex method – Big M method – Two phase method-Duality principle.

NETWORK MODELS

Basic terminologies, constructing a project network, network computations in CPM and PERT, Sequencing Models: Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing n jobs through m machines.

RANDOM PROCESSES

Classification – Stationary random processes – Auto Correlation – Cross Correlations – Power spectral density – Linear system with random input – Gaussian Process.

TEXT BOOKS:

1. Bronson, R.Matrix Operation, Schaum's outline series, McGraw Hill, New York, Second Edition, 2011.
2. Gupta.A.S.Calculus of Variations with Applications,Prentice Hall of India, New Delhi, 1999.
3. Taha, H.A., Operations Research, An introduction, 7th edition, Pearson education editions, Asia, New Delhi, 2002.
4. Peebles Jr., P.Z., "Probability Random Variables and Random Signal Principles ", McGraw Hill Inc., (1993).

REFERENCE BOOKS:

1. Lewis.D.W.Matrix Theory,Allied Publishers, Chennai 1995.
2. Elsgoltis, "Differential Equations and Calculus of Variations ", MIR Publishers, Moscow (1970).
3. KantiSwarup, Gupta P K and Manmohan, - Operations Research, Sultan Chand and Sons New Delhi,2014.
4. T. Veerarajan, - Higher Engineering Matheamtics, Yee Dee Publishing Pvt Ltd, Chennai, 2016.

COURSE DESIGNERS

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

			AVIT	

	ADVANCED POWER SYSTEM ANALYSIS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

The aim is to introduce the study of power system analysis in planning and operation of power system.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To study various methods of load flow and their advantages and disadvantages
2	To understand how to analyze various types of faults in power system
3	To understand power system security concepts and study the methods to rank the contingencies
4	To understand need of state estimation and study simple algorithms for state estimation
5	To study voltage instability phenomenon

COURSE OUTCOMES

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

CO1: Calculate voltage phasors at all buses, given the data using various methods of load flow	Apply
CO2: Calculate fault currents in each phase and Rank various contingencies according to their severity	Apply
CO3: Calculate the network model equivalents	Apply
CO4: Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc.	Evaluate
CO5: Estimate closeness to voltage collapse and calculate PV curves using continuation power flow	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

LOAD FLOW ANALYSIS

Load flow: Overview of Newton-Raphson, Gauss-Siedel and fast decouple methods. Convergence properties, sparsity techniques, Handling Q-max violations in constant matrix, inclusion in frequency effects. AVR in load flow. Handling of discrete variable in load flow.

FAULT AND SECURITY ANALYSIS

Fault Studies - Analysis of balanced and unbalanced three phase faults - fault calculations - Short circuit faults - open circuit faults - Security state diagram - Contingency analysis -- generator shift distribution factors - Line outage distribution factor. - Multiple line outages, overload index ranking.

NETWORK MODEL

DC power flow –Single phase and three phase - AC - DC load flow - DC system model – Sequential Solution Techniques – Extension to Multiple and Multi-terminal DC systems – DC convergence tolerance –Power System Equivalents: WARD and REI equivalents.

STATE ESTIMATION

Sources of errors in measurement -- Virtual and Pseudo Measurement, Observability. Tracking state estimation.-- WSL method -- bad data correction.

VOLTAGE STABILITY

Voltage collapse. P-V curve. Multiple power flow solution -- continuation power flow -- Optimal multiplies load flow - Voltage collapse proximity indices

TEXT BOOKS

1. J.J. Grainger &W.D.Stevenson, “Power System Analysis”, McGraw Hill, 2003. M.G.Say, “Performance and Design of Alternating Current Machines”, 3rd Edition, CBS Publisher.
2. L.P. Singh, “Advanced Power System Analysis and Dynamics”, New Age International, 2006.

REFERENCES

1. G.L. Kusic, “Computer Aided Power System Analysis”,Prentice Hall India, 1986..
2. A. R. Bergen & Vijay Vittal, “Power System Analysis”, Pearson, 2000.
3. A.J. Wood, “Power Generation, Operation and Control”, John Wiley, 1994.
4. P.M. Anderson, “Faulted Power System Analysis”, IEEE Press, 1995.

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

	POWER CONVERTERS FOR DISTRIBUTED GENERATION SYSTEMS	Category	L	T	P	C
		CC	3	0	0	3

PREAMBLE

This is a research level course on energy generation and distributed power generation systems and introduces power electronic converters in grid-connected AC systems and their control technologies. It also presents control strategies of voltage-source converters, followed by an overview of multilevel converters and modular multilevel converters.

PREREQUISITE :Nil

COURSE OBJECTIVES

1	To impart the concepts of distributed power through power converter and grid implementation technique.
2	To gain the knowledge about interchange of power and energy, the power system security and contingency analysis.
3	To know the general concepts of generating electric power and connecting synchronous generators to grid with different solution method
4	To understand the power converter for grid challenging issues
5	To study the concept of harmonics in various power conversion technique.

COURSE OUTCOMES

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

CO 1: Explain the HVDC transmission system and the power converters used in it.	Understand
CO2: Select the suitable power converters for solar energy conversion	Remember
CO3: Implement the power converters for wind energy power conversion.	Apply
CO4: Analyze the topologies of power converters in smart grid.	Analyze
CO5: Check the performance of the power converters through harmonics.	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	L	-	-	M	M	M	M	-	M	L	L
CO2	S	M	M	S	L	-	-	M	M	M	M	M	M	M	-
CO3	S	M	M	S	-	M	-	M	M	M	M	M	M	M	M
CO4	S	M		S	-	M	-	M	M	M	-	-	S	M	-
CO5	S	M	M	S	L	M	-	M	M	M	M	-			

S- Strong; M-Medium; L-Low

SYLLABUS

HVDC CONVERTERS

Introduction - Comparison of AC and DC transmission – Application & Description of DC transmission system - Choice of converter configuration – Converter bridge characteristics – Characteristics of a twelve pulse converter. General principles of DC link control – Converter control characteristics - rol – Current and extinction angle control –

Power control.

POWER CONVERTERS FOR SOLAR ENERGY CONVERSION

Basic components – Different schemes for PV energy conversion – DC and AC power conditioners – Principle of operation: line commutated converters (inversion mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing.

POWER CONVERTERS FOR WIND ENERGY CONVERSION

Basic components - AC-DC-AC converters - Uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters - Matrix converters – PWM rectifiers – Multilevel inverters.

SMART GRID CONVERTERS

Power converter topologies for smart grid Distributed Generation systems - Inverters & PWM rectifiers for smart grid Distributed Generation systems.

HARMONIC CONTROL OF CONVERTERS

Harmonic indices - Harmonic behaviour & characteristics of HVDC converters, Solar and Wind converters - Devices for controlling harmonics - Passive and active filters - Harmonic filter design - Custom power devices- D-STATCOM & UPQC.

References :

1. K.R.Padiyar, HVDC Power Transmission Systems, New Age International (P) Ltd., New Delhi, 2002.
2. Ned Mohan, Tore Undeland & William Robbins, Power Electronics: Converters Applications and Design-John Willey and sons 2003.
3. D.Grahame Holmes & Thomas Lipo, Pulse width modulation for power converters, WileyInterscience, 2003.
4. Ali Keyhani, M.N.Marwali & Min Dai, Integration of green and renewable energy in electrical power systems, Wiley and sons, 2010.
5. Felix A.Farret & M.G.Simoes, Integration of alternative sources of energy, Wiley-IEEE press, 2007.
6. S.Choudhury, SP.Choudhury & P.Crossley, Micro grids and active distribution networks, IET publications, 2009.
7. Arindam Ghosh & Gerald Ledwich, Power quality enhancement using custom power devices, Kluwer Academic Publishers, 2002.
8. G.T.Heydt, Electric Power Quality, Stars in Circle Publications, 1994.

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.K.Boopathy	ASP/EEE	EEE/AVIT	boopathyk@avit.ac.in

	POWER SYSTEM DYNAMICS AND CONTROL	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE:

This course purposes to give an insight into the active models of power system components. Transient response of the system both controllers are used to analysis the content. It also deals with implement and control strategies for the smooth and reliable operation of a power system.

PREREQUISITE: Nil

COURSE OBJECTIVES

1	To impart knowledge on dynamic phenomena of electric power system
2	To gain knowledge on stability analysis of power system under different working conditions
3	To understand the fundamental dynamic behavior of power systems to perform basic stability issues
4	Obtain fundamental knowledge about modelling of synchronous machines.
5	To Design power system stabilizers to dampen inter-area modes of oscillation

COURSE OUTCOMES

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

CO1: Coherent causes and effects of different types of power system stability	Remember
CO2: Model and adapt the applications of mathematics and engineering tools in the analysis of stability problems	Analysis
CO3: Propose possible solutions to address the stability issues	Implement
CO4: Analyze theory and practice of modeling main power system components, such as synchronous machines, excitation systems and governors	Analysis
CO5: Formulate the detailed simulations for single machine and multi-machine systems for various application	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO2	PS O3
CO1	M	S	-	-	M	L	-	S	-	L	-	L	M	L	-
CO2	L	M	-	M	-	M	-	M	-	-	-	-	M	M	-
CO3	M	S	-	M	M	-	-	M	L	M	L	-	M	M	-
CO4	M	M	-	M	-	L	-	M	M	S	M	M	S	M	-
CO5	S	L	M	L	L	L	-	M	S	L	S	M	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

Power System Stability

Stability of modest system-Fundamental concepts, system stability and energy of a system, manifestation of power system instability, cause, nature and effects of disturbance, characterization of rotor angle stability, basic assumptions made in stability studies, rotor dynamics and the swing equations

Analysis of Dynamical Systems:

Concept of Equilibria, Small and Large Disturbance Stability. Example: Single Machine Infinite Bus System. Modal Analysis of Linear Systems. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff Systems.

Modeling of a Synchronous:

Machine Physical Characteristics. Rotor Position Dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronous Machine Connected to Infinite Bus, Physical Characteristics and Models. Control system components. Excitation System Controllers. Prime Mover Control Systems.

Modeling of Transmission Lines and Loads:

Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Other Subsystems - HVDC, protection systems.

Transient stability analysis of power systems:

Concept of transient stability, response to a step change in mechanical power input, Swing equation, multi-machine analysis, factors influencing transient stability, numerical integration method, Euler method, R-K method (4th order), critical clearing time and angle, methods for improving transient stability

TEXT BOOKS

1. Power System Dynamics Stability and Control By K R Padiyar, B S Publications
2. Power System Stability & Control, By- P.Kundur, Tata Mcgraw hill
3. Power Systems Analysis By Vijay Vittal, Bergen , Pearson Education
4. Electric machinery and Drive Systems By P C Crause, Viley IEEE Press

REFERENCES

1. Anil M. Kulkarni and K. R. Padiyar, Dynamics and Control of Electric Transmission and Microgrids, Wiley – IEEE Press
2. K. N. Shubhanga, Power System Analysis – A dynamic perspective, Pearson
   P.Sauer and M.A.Pai, Power System Dynamics and Stability, Prentice Hall (I) Ltd. 7.
   P.M. Anderson and A.A. Fouad, Power system control and stability, Wiley Publishers
3. K.R.Padiyar, Power System Dynamics, Stability and Control, Interline Publishers, Bangalore
4. J. Machowski, J.W. Bialek and J.R. Bumby, Power System Dynamics, Stability and Control, Wiley publishers
5. Dynamic Models for Steam and Hydro Turbines in Power System Studies, IEEE Committee
6. Report on Turbine Governor Model, IEEE Trans., vol. PAS-92, pp.

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.	Dr.K.Boopathy	ASP/EEE	EEE/AVIT	boopathyk@avit.ac.in

	DIGITAL PROTECTION FOR POWER SYSTEM	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

Digital protection is based on the use of computers in power line relaying. Since the late 1960s, digital devices and techniques have been applied to almost all new protection schemes. Today the technology is moving towards standardized hardware platforms; at the software level, however, there remains a huge variety in approaches and protection algorithms.

PREREQUISITE : Nil

COURSEOBJECTIVES

1	To gain the knowledge in digital relay
2	To enhance the knowledge in transient analysis of power system
3	To understand the concept of digital protection
4	To Study of algorithms for numerical protection
5	To understand digital protection for various components

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1:Learn the importance of Digital Relays	Understand
CO2:Analyze transient behavior of power systems	Analyze
CO3: Apply basic elements for the digital protection	Apply
CO4:Learn to develop various Protection algorithms	Apply
CO5: Acquire knowledge on the protection of power system components	Understand

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

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

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTION TO DIGITAL RELAY

Introduction- advantages of microprocessor technology-desirable features in a protection scheme-sub systems of a digital relay-operating algorithms- substation digital protection system-adaptive relaying-simulators for testing of relays

TRANSIENT ANALYSIS OF POWER SYSTEMS

Introduction-Derivation of linear equivalents-G-Matrix building and nodal solutions-modelling of three phase networks-frequency dependence of distributed parameters of lines-Switches and non-linear elements-modelling AC machines and transformers-simulation results.

BASIC ELEMENTS OF DIGITAL PROTECTION

Continuous versus Discrete time signals- analog signal conditioning- sample and hold circuit- multiplexer – A/D conversion- Digital filters – Real time considerations in digital relay- microcomputer for digital relay – Data acquisition interface card for PC – DSP based hardware schemes.

RELAYING ALGORITHMS

Introduction- classification of relaying algorithms- algorithms for numerical relaying-full cycle fourier algorithmcascaded Fourier algorithm- cosine filters- Fourier half cycle algorithm- Walsh algorithm- Haar algorithm-least square fitting algorithm- differential equation algorithm- mean square error minimization technique.

PROTECTION OF POWER SYSTEM COMPONENTS

Busbar protection – digital protection schemes for Busbars - digital techniques for protection of transformers- digital relays for synchronous generators protection- transmission line protection- feeder protection- typical numerical over current relay – motor protection-Recent Advances in Digital Protection of Power Systems.

TEXT BOOK(S):

1.K.Parthasarathy, U.J.Shenoy, 'Digital Protection of Power Systems', ISTE-working professional Learning project, Bangalore, 2006.

2.A.T.Johns and S. K. Salman, 'Digital Protection of Power Systems', 2008.

REFERENCE(S):

1.A.G. Phadke and J. S. Thorp, 'Computer Relaying for Power Systems', Wiley/Research studies Press, 2012.

2.S.R.Bhide,'Digital, 'Power System Protection', PHI Learning Pvt.Ltd.2014.

3.Gerhard Zeigler, 'Numerical Distance Protection', Siemens Public is Corporate Publishing, 2011.

4.https://nptel.ac.in/courses/108101039/

COURSEDESIGNERS

S.No.	NameoftheFaculty	Designation	Department	MailID
1.	Dr.G.Ramakrishnaprabu	AssociateProfessor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in

2.	Dr.R.Sathish	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
3.	Mr.S.Prakash	AssistantProfessor(Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	TRANSIENTS IN POWER SYSTEMS	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE
To Study about the concepts of transients in power system

PREREQUISITE : Nil

COURSE OBJECTIVES

1	Identify the concepts of lightning surges and effect of transients
2	Interpret the concepts of switching surges
3	Outline the computation of transmission in conversion equipment
4	Demonstrate the idea of insulation co ordination and case studies using simulation of electromagnetic transients
5	To gain the knowledge in digital relay

COURSE OUTCOMES

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

CO1: Explain the concept of lightning surges	Understand
CO2: Relate the concept of the switching surges	Apply
CO3: Analyze the transients of conversion equipments	Analyze
CO4: Construct the system with protective devices	Analyze
CO5: Model the electromagnetic transients and also can able to solve the issue .	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	M	S	-	-	M	L	-	S	-	L	-	L	M	L	-
CO2	L	M	-	M	-	M	-	M	-	-	-	-	M	M	-
CO3	M	S	-	M	M	-	-	M	L	M	L	-	M	M	-
CO4	M	M	-	M	-	L	-	M	M	S	M	M	S	M	-
CO5	S	L	M	L	L	L	-	M	S	L	S	M	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION AND LIGHTNING SURGES

Review of various types of power system transients – effect of transients on power systems- relevance of the study and computation of power system transients. Electrification of thunderclouds – lightning current stages – lightning current parameters and their values – stroke to tower and midspan – induced lightning surges.

SWITCHING SURGES

Closing and reclosing of lines – load rejection – fault initiation – fault clearing – short line faults – Ferro Resonance – isolator switching surges – temporary over voltages – surges on an integrated systems – switching – harmonics.

COMPUTATION OF TRANSIENTS IN CONVERSION EQUIPMENT

Traveling wave method – Beweley's Lattice diagram – analysis in time and frequency domain – eigenvalue approach – Z-transform.

INSULATION CO ORDINATION

Over voltage protective devices – shielding wires, rods gaps, surge diverters, principles of insulation coordination – recent advancements in insulation co ordination – Design of EHV system – Insulation co ordianation as applied to transformer, substations.

CASE STUDIES-SIMULATION OF ELECTROMAGNETIC TRANSIENTS

(i) Energisation of a single phase 0.95 pf load from a non ideal source and a realistic line representation.
(ii) Energisation of a single phase 15 mile long line from an ideal voltage source (equivalent-Π) – lumped and distributed parameter representation.
(iii) Energisation of a 3 phase, 15 mile distributed parameter line connected to a transformer and RL load, (three phase closure simulations)
(iv) Same as above but only one phase closed.
(v) Energisation of a 120 mile transposed line from an ideal voltage source.(Adequate model needed)

REFERENCES

1. Allan Greenwood, "Electrical Transients in Power Systems", Willey Interscience, New York, 1971.
2. Klaus Ragaller, "Surges in High Voltage Networks", Plenum Press, New York,1980.
3. Diesendorf, W., "Over Voltage on High Voltage Systems", Renselaer Bookstore, Troy New York, 1971.
4. Peterson,H.A., "Transient in Power Systems", Dover Publication, New York, 1963.
5. Rakosh das Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Ltd, New Delhi, 1990.
6. C.S.Indulkar, DP Kothari, "Power System Transients" - A Statistical approach , Prentice Hall 1996

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.	Mrs.K.S.Kavithakumari	Assistant Professor (Gr-II)	EEE/AVIT	kavitha.eee@avit.ac.in

	EHV POWER TRANSMISSION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To Study about the importance and its use of Extra high voltage in power transmission.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To Study about the concept of standard transmission voltage and its power handling technique.
2	To Obtain the calculation of resistance, inductance and capacitance on line parameters.
3	To Study about the charge potential in voltage gradient of conductors.
4	To Study about the Power losses and audible losses and also Radio Interference.
5	To understand the concept of electrostatic field of EHV lines for a long object

COURSE OUTCOMES

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

CO1: Understand the concept of transmission lines	Understand
CO2: Calculate the line parameters	Remember
CO3: Understand the importance and concepts of conductors	Understand
CO4: Explain the impacts of corona effects	Apply
CO5: Understand the concepts of EHV lines	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	-	-	-	-	M	-	-	-	-	M	L	-
CO2	S	M	-	M	-	-	-	-	-	-	-	-	M	M	-
CO3	S	-	-	-	M	M	-	L	-	M	-	-	M	-	L
CO4	S	M	-	M	-	L	-	M	-	-	-	M	S	M	-
CO5	S	L	M		L	L	-	M	-	S	-	M	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Standard Transmission Voltages – Average Values of Line Parameters – Power Handling Capacity and Line Loss – Costs of Transmission Lines and Equipment – Mechanical Considerations in Line Performance.

CALCULATION OF LINE PARAMETERS

Calculation of Resistance, Inductance and Capacitance – Calculation of sequence inductances and capacitances – Line parameters for Modes of propagation.

VOLTAGE GRADIENTS OF CONDUCTORS

Charge-Potential Relations for Multi-conductor lines – Surface Voltage Gradient on Conductors – Gradient Factors and their use – Distribution of Voltage Gradient on Sub conductors of Bundle - Voltage Gradients on Conductors in the Presence of Ground Wires on Towers.

CORONA EFFECTS

Power losses and audible losses : I2R Loss and Corona Loss -Attenuation of Traveling Waves Due to Corona Loss - Audible Noise Generation and Characteristics - Limits for Audible Noise - Day-Night Equivalent Noise Level. Radio Interference : corona pulse generation and properties - Limits for Radio Interference Fields - The CIGRE Formula - The RI Excitation Function -Measurement of RI, RIV and Excitation Function - Design of Filter.

ELECTROSTATIC FIELD OF EHV LINES

Capacitance of Long Object - Calculation of Electrostatic Field of AC Lines Effect of High Field on Humans, Animals, and Plants - Meters and Measurement of Electrostatic Fields - Electrostatic Induction in Unenergised Circuit of a D/C Line - Induced Voltages in Insulated Ground Wires - Electromagnetic Interference.

TEXT BOOKS

1. R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P) Ltd, 2009.
2. A Chakrabarti,D.P.Kothari, Mukhopadhyay, Performance Operation & control of EHV Power transmission System", Wheelers Publisher ltd, 1999.

REFERENCES

1. S. Rao, EHVAC and HVDC Transmission, Khanna Publications Limited, 2006

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.	Mrs.S.Jensie Anita	Assistant Professor	EEE/AVIT	jensiepresley@avit.ac.in

	HVDC TRANSMISSION	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To Study about the needs of high voltage direct current transmission in todays.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To Understand the concept of DC power transmission technology,
2	To analysis of HVDC converters
3	To understand the concept of converters and HVDC system control.
4	To understand the concept harmonics and the importance of filters in HVDC system .
5	To understand and initiate the simulation process

COURSE OUTCOMES

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

CO1: Develop the knowledge of HVDC transmission and converters. The applicability and advantage of HVDC transmission over conventional AC transmission.	Understand
CO2: Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links	Analyse
CO3: Analyze the different harmonics generated by the converters and their variation with the change in firing angles.	Understand
CO4: Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters.	Apply
CO5: Develop the knowledge of Philosophy and tools. Modeling of HVDC systems for digital dynamic simulation.	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	L	M	S	S	L	S	S	-	S	S	M	L	-	-	-
CO2	M	M	M	M	M	-	-	S	S	M	M	M	S	-	L
CO3	S	M	-	-	L	-	S	-	S	S	-	S	L	-	L
CO4	M	S	L	-	M	S	S	-	M	S	M	M	L	M	L
CO5	S	L	-	M	-	S	S	M	S	S	M	M	L	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

DC POWER TRANSMISSION TECHNOLOGY

Introduction-comparison of AC and DC transmission application of DC transmission – description of DC transmission system planning for HVDC transmission-modern trends in DC transmission.

ANALYSIS OF HVDC CONVERTERS

Pulse number, choice of converter configuration-simplified analysis of Graetz circuit-converter bridge characteristics – characteristics of a twelve pulse converter-detailed analysis of converters.

CONVERTER AND HVDC SYSTEM CONTROL

General principles of DC link control-converter control characteristics-system control hierarchy-firing angle control-current and extinction angle control-starting and stopping of DC link-power control-higher level controllers-telecommunication requirements.

HARMONICS AND FILTERS

Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise.

SIMULATION OF HVDC SYSTEMS

Introduction-system simulation: Philosophy and tools-HVDC system simulation-modeling of HVDC systems for digital dynamic simulation

REFERENCES

1. Padiyar, K.R., “HVDC Power Transmission System”, Wiley Eastern Limited, New Delhi 1990. First edition.
2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, Sydney, 1971
3. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering” New Age International (P) Ltd., New Delhi, 1990.
4. Arrillaga, J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983

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.B.Parvathi Sangeetha	Assistant Professor (Gr-II)	EEE/AVIT	parvathi.eee@avit.ac.in

	POWER QUALITY	Category	L	T	P	Credit
		CC	3	0	0	3

PREAMBLE

To Study about the concepts of Power Quality.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To Understand about the Characterisation of Electric Power Quality,Short duration and long duration voltage variations, Voltage imbalance,Voltage fluctuations and Power quality standards.
2	To Understand about single and three phase static and rotating AC/DC converters supplying non-linear loads.
3	To Understand about Measurement and Analysis Methods
4	To Understand about Analysis and Conventional Mitigation methods
5	To Understand about the Power Quality issues and implement the improvement techniques .

COURSE OUTCOMES

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

CO1: Understand the concepts of power quality and issues.	Understand
CO2: Understand the impacts of nonlinearloads in power quality issues	Understand
CO3: Introduce the suitable techniques for measuring voltage, current, power, energy and power factor and analysis using various transform methods.	Analyse
CO4: Describe about power quality problems, categories, causes and its effects.To Study the production of voltages sags.	Understand
CO5:Analyze the active compensation techniques used for load voltage regulation	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	-	-	-	-	M	-	-	-	-	-	L	-	L
CO2	-	M	-	L	L	M	-	-	-	-	-	-	-	M	-
CO3	M	S	M	S	M	L	M	L	M	M	L	M	M	M	L
CO4	M	S	S	S	S	S	M	L	M	M	L	M	-	L	M
CO5	L	M	L	L	M	-	-	-	L	-	-	-	L	L	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

NON-LINEAR LOADS

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

MEASUREMENT AND ANALYSIS METHODS

Voltage, Current, Power and Energy measurements, power factor measurements and definitions, event recorders, Measurement Error – Analysis: Analysis in the periodic steady state, Time domain methods, Frequency domain methods: Laplace's, Fourier and Hartley transform – The Walsh Transform – Wavelet Transform.

ANALYSIS AND CONVENTIONAL MITIGATION METHODS

Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

POWER QUALITY IMPROVEMENT

Utility-Customer interface –Harmonic filters: passive, Active and hybrid filters –Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC –control strategies: P-Q theory, Synchronous detection method – Custom power park –Status of application of custom power devices.

TEXT BOOKS

1.Arindam Ghosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002

2.G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition)

3. Power Quality - R.C. Duggan

4. Power system harmonics –A.J. Arrillga

5. Power electronic converter harmonics –Derek A. Paice

COURSE DESIGNERS

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

	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To Study about the concepts of Power electronics equipments utilization in renewable energy systems .

PREREQUISITE : Nil

COURSEOBJECTIVES

1	To comprehend the electrical energy generation from various renewable and non-renewable sources of energy
2	To recognize the fundamental principles of electrical machines in wind energy conversion system
3	To identify the power converters for wind and solar energy conversion systems
4	To analyze the wind and PV systems with its grid integration.
5	To study about the hybrid systems with wind and PV

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1:To understand the power generation from various sources of energy	Understand
CO2:To know the fundamentals and principles of electrical machines in energy conversion	Understand
CO3: To find the power electronic converters needed for energy conversion applications	Analyze
CO4:To analyze the various wind energy systems and PV systems	Analyze
CO5: To extract the maximum power using MPPT algorithm in hybrid systems	Apply

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

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

S-Strong;M-Medium;L-Low

SYLLABUS

INTRODUCTION

Environmental aspects of electric energy conversion: Impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and Hybrid renewable energy systems.

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

Review of reference theory fundamentals-Principle of operation and analysis: IG, PMSG, SCIG and DFIG.

POWER CONVERTERS

Solar: Block diagram of solar photo voltaic system - Principle of operation of line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Wind: Three phase AC voltage controllers- AC-DC-AC converters, Uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-Matrix converters.

ANALYSIS OF WIND AND PV SYSTEMS

Solar: Stand-alone operation of fixed and variable speed wind energy conversion systems and solar systemGrid connection Issues -Grid integrated PMSG and SCIG based WECS-Grid integrated solar system. [9]

HYBRID RENEWABLE ENERGY SYSTEMS

Need for hybrid systems- Range and type of hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).

TEXT BOOK(S):

1.G.D.Rai, “Non-conventional energy sources”, Khanna publishes, 2004.

2.M. H Rashid, “Power electronics Hand book”, (3rd Edition) Academic press, 2017.

REFERENCE(S):

1.G.D.Rai,” Solar energy utilization”, Khanna publishes, 2012.

2.Philippe Coiffet, “Robot Technology” Vol. II (Modelling and Control), Prentice Hall Inc, 1983.

3.S. Sumathi, “Solar PV and Wind Energy Conversion Systems (Green Energy and Technology)”, L. Ashok Kumar , P. Surekha, 2015

4.Bimal K. Bose “Power Electronics in Renewable Energy Systems and Smart Grid”Wiley, 2019

COURSEDESIGNERS

S.No.	NameoftheFaculty	Designation	Department	MailID
1.	Dr.G.Ramakrishnaprabu	AssociateProfessor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
2.	Dr.R.Sathish	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
3.	Mr.V.Rattan Kumar	AssistantProfessor(Gr-II)	EEE/AVIT	rattankumar@avit.ac.in

	POWER ELECTRONICS FOR POWER SYSTEMS LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To study and analyze the concept and equipments of the power electronics in power system network

PREREQUISITE : Nil

COURSEOBJECTIVES

1	To configure the single phase converter for continuous and discontinuous conduction modes
2	To construct the three phase converters with various loads
3	To design the MOSFET and IGBT based converters for power system applications
4	To model the wind and PV system
5	To develop a model the for reactive power control

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1:To demonstrate the continuous and discontinuous modes of single and three phase converters with various loads	Analyze
CO2:To observe the performance of MOSFET, IGBT based choppers and inverters	Analyze
CO3: To design a power circuit for controlling the single-phase AC voltage using power components	Apply
CO4:To model the energy conversion system based on wind and solar	Apply
CO5: To develop the circuit for HVDC and to control the reactive power	Apply

MAPPINGWITHPROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

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

S-Strong;M-Medium;L-Low

SYLLABUS

1.Single Phase Semi-converter with R-L and R-L-E loads for continuous and discontinuous conduction modes

2. Single Phase Full- Converter With R-L And R-L-E Loads for Continuous and Discontinuous Conduction Modes

3. Three phase full-converter with R-L-E load

4. MOSFET, IGBT based Choppers

5. IGBT based Single phase inverters

6. Single phase AC voltage controller

7. Modeling of PV system

8. Modeling of Wind Energy conversion System

9. Modeling of HVDC

10. Modeling of reactive power control

Lab Manual:

Power Electronics Applications to Power Systems Laboratory Manual" by EEE Staff members.

COURSEDESIGNERS

S.No.	NameoftheFaculty	Designation	Department	MailID
1.	Dr.G.Ramakrishnaprabu	AssociateProfessor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
2.	Dr.R.Sathish	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
3.	Mr.V.Rattankumar	AssistantProfessor(Gr-II)	EEE/AVIT	rattankumar@avit.ac.in

	POWER SYSTEM SIMULATION LAB	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To study about the concepts of power system simulation laboratory.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To study about the Contingency analysis, Small signal stability analysis , transient stability analysis ,
2	To analyze the switching surge using EMTP.
3	To study about the economic dispatch , Unit commitment solution method
4	To study about the co ordination of over current and distance relays.
5	To study about the concept of induction motor starting analysis.

COURSE OUTCOMES

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

CO1: To get insight of contingency analysis problem and the solution methods.	Apply
CO2: To schedule the generating units by simulation.	Analyze
CO3: To analysis transient behaviour of power system by using simulink model.	Analyze
CO4: To analysis stability of power system by using simulink model.	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	L	-
CO2	S	M	-	M	-	-	-		-	-	-	-	-	-	-
CO3	L	S	-	M	-	-	-	M	-	L	-	-	M	M	L
CO4	S	M	-	M	-	L	-	M	-	-	-	M	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

1.Contingency analysis: Generator shift factors and line outage distribution factors

2. Small signal stability analysis: SMIB and Multi machine configuration

3. Transient stability analysis of Multi – machine configuration

4. Economic dispatch with line flow constraints

5. Unit commitment: Priority-list schemes and dynamic programming

6. Co-ordination of over current and distance relays for radial line protection

7. Induction motor starting analysis

8. Analysis of switching surge using EMTP

Lab Manual:

Power System Simulation Lab" by EEE Staff members.

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.	Mr.R.Sathish	Assistant Professor	EEE/VMKVEC	sathish@vmkvec.edu.in
3.	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	DISTRIBUTED ENERGY RESOURCES AND MICROGRID	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

Application of power electronic converters play a major role in renewable energy system such as wind power, solar power, fuel cell plants, high speed micro turbine generator etc. Different types of advanced power converters derived from basic ac-ac, dc-dc, ac-dc, and dc-ac converters are analyzed with respect to those applications. The converters used for the control of smart grid distributed generation systems are also analyzed.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To identify the distributed energy resources.
2	To illustrate the concept of distributed generation
3	To analyze the impact of grid integration
4	To study concept of microgrid and its configuration
5	To illustrate the control and operation of microgrid

COURSE OUTCOMES

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

CO1: Review the conventional power generation	Evalate
CO2: Analyze the concept of distributed generation and installation	Analyze
CO3: Design the grid integration system with conventional and nonconventional energy sources	Apply
CO4: Design the dc and ac microgrid	Apply
CO5: Analyze power quality issues and control operation of microgrid	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	S	S	L		S		S		S	S		S	M
CO2	S	S	S	S	M		S		M		S	S	L	S	M
CO3	S	S	S	S	S		M		M		S	S	L	S	S
CO4	S	S	S	S	S		M		M		S	S	L	S	M
CO5	S	S	S	S	M		M		M		S	S	L	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

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

Distributed Generations (DG)
Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces: IEEE 1547, DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

Impact of Grid Integration
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.

Basics of a Microgrid
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.

Control and Operation of Microgrid
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.

Text book(s):
1. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
2. DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2017.

Reference(s):
1. Chetan Singh Solanki, "Solar Photo Voltaics", PHI learning Pvt. Ltd., New Delhi, 2009.
2. J.F. Manwell, J.G "Wind Energy Explained, Theory Design and Applications," McGowan Wiley publication, 2nd Edition, 2009.
3. John Twidell and Tony Weir, "Renewable Energy Resources", Taylor and Francis Publications, Second Edition, 2015.
4. https://nptel.ac.in/courses/108/107/108107143/

COURSE DESIGNERS

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

	OPTIMAL CONTROL AND FILTERING	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

Analytical frame work is needed and is used to control the bulk power systems in such a fashion to improve power system security. Power system practices try to control and operate power systems in a defensive posture so that the effects of these inevitable failures are minimized. In any energy management/ operations control centre, knowledge of security analysis, state estimation and optimal power flow is essential.To learn and apply filtering techniques.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To educate on formulation of optimal control problems and introduce the minimum principle
2	To educate on Linear Quadratic tracking problems- in continuous and discrete domain
3	To introduce the numerical techniques used for solving optimal control problems
4	To educate on the concepts of filtering in the presence of noise
5	To educate on the theory and design of Kalman filter

COURSE OUTCOMES

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

CO1: Identify solutions for optimal control problem	Remember
CO2: Solve the tracking problems with the knowledge of characteristics of dynamic programming	Creat
CO3: Implement various numerical techniques for optimal control	Apply
CO4: Analyse the problem and apply suitable estimation methods	Analyze
CO5: Implement the kalman filter in various fields by knowing its properties	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	M	S				S		S	M	S	S	M
CO2	S	S	M	S	S				S		S	M	S	S	M
CO3	S	S	S	M	S				M		S	S	S	S	M
CO4	S	S	M	S	S			M	S		S	S	S	S	M
CO5	M	S	M	M	S			M	M		S	M	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction
Statement of optimal control problem – Problem formulation and forms of optimal Control – Selection of performance measures- Necessary conditions for optimal control – Pontryagin's minimum principle – State inequality constraints – Minimum time problem.

Linear Quadratic Tracking Problems
Linear tracking problem – LQG problem – Computational procedure for solving optimal control problems – Characteristics of dynamic programming solution – Dynamic programming application to discrete and continuous systems – Hamilton Jacobi Bellman equation

Numerical Techniques for Optimal Control
Numerical solution of 2-point boundary value problem by steepest descent and Fletcher Powell method solution of Ricatti equation by negative exponential and interactive Methods

Filtering and Estimation
Filtering – Linear system and estimation – System noise smoothing and prediction – Gauss Markov discrete time model – Estimation criteria – Minimum variance estimation 30 – Least square estimation – Recursive estimation.

Kalman Filter and Properties
Filter problem and properties – Linear estimator property of Kalman Filter – Time invariance and asymptotic stability of filters – Time filtered estimates and signal to noise ratio improvement – Extended Kalman filter.

Text Book(s):
1. D.E.Kirk, 'Optimal Control Theory – An introduction', Prentice hall, N.J., 2004.
2. Brian D.O.Anderson and John B.Moore, 'Optimal Filtering', Prentice hall Inc., N.J., 2005.

Reference(s):
1. Mohinder S. Grewal, "Kalman Filtering", Angus P. Andrews, 2008.
2. K.J.Astrom, "Introduction to Stochastic Control Theory", Academic Press, Inc, N.Y., 2006.
3. AlokSinha, Linear Systems Optimal and Robust Control, CRC Press, First Indian Reprint, 2009.
4. Brian D. O. Anderson, John B. Moore "Optimal Filtering"Dover Publications,2012

COURSE DESIGNERS

S. 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	AP (Gr–II)	EEE/AVIT	sprakash@avit.ac.in

	WIND ENERGY CONVERSION SYSTEM DESIGN	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

Renewable energy sources are gaining importance to minimize the global warming. The renewable energy usage may be met up to 50% level in the end of this century to make the world green. Energy has become an important and one of the basic infrastructures required for the economic development of a country. The importance and role of renewable energy sources is stressed on the aspects of growing energy demand. The harnessing of energy through renewable resources, using efficient technologies is expected to play an important role of serving a clean energy source for mankind and for the mother earth. The mission of the Renewable Energy Sources Course is to prepare students for the challenges of designing, promoting and implementing renewable energy solutions. Graduates will have a fundamental understanding of energy engineering and a sense of social responsibility for the implementation of sustainable energy solutions.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To understand the fundamentals of wind energy and its conversion system.
2	To understand the aerodynamics theory related to wind turbine types.
3	To learn gear coupled generator wind turbine components
4	To analyze the grid integration and related issues with direct drive generators.
5	To learn modern wind turbine control & monitoring

COURSE OUTCOMES

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

CO1: Implement the knowledge in conversion techniques of wind energy and Wind Measurements.	Apply
CO2: Understand the wind turbine components and their construction.	Understand
CO3: Learn the types and construction of fixed speed wind generator and Turbine.	Understand
CO4: Learn the types and construction of Variable speed wind generator and Turbine.	Understand
CO5: Illustrate the modern wind turbine control & monitoring.	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	S	S	S				S		S	M	S	S	
CO2	S	S	M	L	L				M		S	M	L	L	
CO3	S	M	M	M	L				M		S	L	L	L	
CO4	S	M	M	L	L				M		S	L	L	L	
CO5	S	S	S	S	S				S		S	M	S	S	

S- Strong; M-Medium; L-Low

SYLLABUS

Wind Energy Fundamentals & Wind Measurements
Wind Energy Basics - Wind Speeds and scales-Terrain – Roughness - Wind Mechanics – Power Content-Class of wind turbines - Atmospheric Boundary Layers - Turbulence. Instrumentation for wind Measurements - Wind data analysis – tabulation - Wind resource estimation - Betz's Limit –Turbulence Analysis.

Aerodynamics Theory & Wind Turbine Types
Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics - Balancing technique (Rotor & Blade). Types of loads- Sources of loads - Vertical Axis Type - Horizontal Axis - Constant Speed Constant Frequency - Variable speed Variable Frequency - Up Wind - Down Wind - Stall Control - Pitch Control - Gear Coupled Generator type - Direct Generator Drive – PMG - Rotor Excited Sync Generator.

Gear Coupled Generator Wind Turbine Components and their Construction
Electronics Sensors; Encoder, Resolvers - Wind Measurement - Anemometer & Wind Vane – Grid Synchronisation System - Soft Starter - Switchgear [ACB/VCB] – Transformer - Cables and assembly - Compensation Panel - Programmable Logic Control- UPS. Yaw & Pitch System: AC Drives – Safety Chain Circuits - Generator Rotor Resistor controller (Flexi Slip) - Differential Protection Relay for Generator - Battery - Super Capacitor Charger & Batteries - Super Capacitor for Pitch System- Transient Suppressor - Lightning Arrestors - Oscillation & Vibration sensing.

Direct Rotor Coupled Generator - Multipole& Variable Speed Variable Frequency
Excited Rotor Synchronous Generator - PMG Generator - Control Rectifier - Capacitor Banks - Step Up - Boost Converter (DC-DC Step Up) - Grid Tied Inverter - Power Management - Grid Monitoring Unit (Voltage and Current) – Transformer - Safety Chain Circuits.

Modern Wind Turbine Control & Monitoring System
Details of Pitch System & Control Algorithms - Protections used & Safety Consideration in Wind Turbines - Wind Turbine Monitoring with Error codes - SCADA & Databases: Remote Monitoring and Generation Reports Operation & Maintenance for Product Life Cycle - Balancing technique (Rotor & Blade) - FACTS control & LVRT - New trends for new Grid Codes.

Text book(s):
1. Mario Garcia – Sanz, Constantine H. Houpis, "Wind Energy Systems", CRC Press, 2012..
2. J.K .Kaldellis, "Stand – alone and Hybrid Wind Energy Systems", CRC Press, 2010.

Reference(s):
1. L.L.Freris, "Wind Energy Conversion Systems", Prentice Hall, 1990
2. Erich Hau,"Wind Turbines: Fundamentals, Technologies, Application, Economics ",Horst von Renouard,2011.
3. John D Sorensen and Jens N Sorensen, "Wind Energy Systems", Woodhead Publishing Ltd, 2011.
4. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd., 2015.

COURSE DESIGNERS

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

	LINEAR AND NONLINEAR SYSTEM THEORY	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

Modern control theory is a powerful technique for the analysis and design of linear and nonlinear, time-invariant or time varying MIMO systems. The classical design methods suffer from certain limitations due to the fact that the transfer function model is applicable only to linear time invariant systems, and that there too it is generally restricted to single-input, single-output (SISO) systems. This course aims at giving an adequate exposure in state space analysis, state space controller design, MIMO system, Non-linear system, stability analysis.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To educate on modeling and representing systems in state variable form
2	To educate on solving linear and non-linear state equations
3	To impart knowledge on Describing function based approach to non-linear systems
4	To educate on stability analysis of systems using Lyapunov' theory
5	To educate on optimal control and adaptive control systems

COURSE OUTCOMES

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

CO1: Design a state model with various variables	Apply
CO2: Implement the knowledge of pole placement and state observers in control system	Apply
CO3: Interpret the function based approach to non-linear systems	Understand
CO4: Analyse the system with suitable methods	Analyze
CO5: Apply the knowledge of control system in various 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	S	M	S				L		S	L	S	S	
CO2	S	S	S	S	M				M		S	L	S	S	
CO3	M	L	M	M	L				L		M	L	M	M	
CO4	S	S	S	M	S				M		S	L	S	M	
CO5	S	S	S	S	S	L			L		S	M	S	L	

S- Strong; M-Medium; L-Low

SYLLABUS

State Space Analysis
Concept of State – State Model – State Diagram — State Variable representation: Physical Variables, Phase Variables, Canonical Variables – Solution of state equation- State transition matrix – Derivation of transfer function from state model – Diagonalization – Controllability and observability - stabilizability and detectability Kalman decomposition -Introduction to Kalman filter.

Design of Control Systems in State Space
Pole Placement by state feedback for both SISO and MIMO Systems- Necessary and sufficient condition for arbitrary pole placement – selection of location of desired closed loop poles- Design of Servo Systems. State Observers: concept of state observer – Full Order and Reduced Order Observers – Necessary and sufficient condition for state observation – effects of the addition of the observer on a closed loop system – transfer function of the observer based controller.

Non-Linear Systems
Introduction –Types of non-linearity – Typical examples – Describing function method: Derivation of describing functions – Stability analysis of Nonlinear systems - Phase Plane Analysis : Singular points – Limit cycles – Types of Phase portraits - Construction of phase trajectories- Isocline method – Delta method.

Lyapunov's Stability Analysis
Introduction-Equilibrium Points-Stability in the sense of Lyapunov- Equilibrium Stability of Nonlinear Continuous time autonomous Systems- Positive definite, negative definite, positive semi and negative semi definite – quadratic form – Liapunov's stability theorem -The Direct Method of Lyapunov and the Linear Continuous time autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous time autonomous Systems- Krasovskii and Variable-Gradiant Method.

Optimal Control and Adaptive Control Systems
Optimal Control: Optimal Control Problems: Transfer function Approach – State variable approach – the state regulator problem – The Infinite-time regulator problem – Output regulator and the tracking Problems – Parameter Optimization: Regulators.(Continuous system only)
Adaptive control: Introduction – Essential Component of Adaptive Systems – Adaptive Schemes: Model Reference Adaptive Reference Control – Self tuning control - Applications.

Text book(s):
1. Nagrath.I.J. and Gopal. M. "Control Systems Engineering", New Age International (P) Limited, New Delhi, 2017.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, New Delhi, Fifth Edition, 2015.

Reference(s):
1. Benjamin C.Kuo. "Automatic Control Systems", Prentice Hall of India Private Ltd., New Delhi, Ninth Edition, 2014.
2. Aggarwal K.K. "Control System Analysis and Design", Khanna Publishers, New Delhi, 2001.
3. Alberto Isidori "Nonlinear Control Systems"Springer,2013
4. OdedYaniv "Quantitative Feedback Design of Linear and Nonlinear Control Systems"Springer US, 2013

COURSE DESIGNERS

S. 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	AP (Gr–II)	EEE/AVIT	sprakash@avit.ac.in

	ELECTRIC POWER DISTRIBUTION SYSTEM DESIGN	Category	L	T	P	C
		EC - PS	3	0	0	3

PREAMBLE

This subject deals with the general concept of distribution system, substations and feeders as well as discusses distribution system analysis, protection and coordination, voltage control and power factor improvement.

PREREQUUISITE : Nil

COURSE OBJECTIVE

1.	• To learning about power distribution system
2.	• To understand the definition and reconfiguration of Distribution Management System
3.	• To study the communication system for automation
4.	• To learning of SCADA System
5.	• To understanding the optimal Distribution monitoring

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1:Knowledge of power distribution system	Understand
CO2:Comprehend Study of Distribution automation and its application in practice	Analysis
CO3: Know about the Automatic metering and remote metering	Analysis
CO4: Learn SCADA system	Analysis
CO5: Learn about the remote terminal unit in electrical distribution and monitoring.	Create

Mapping with programme outcomes and programme specific outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	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

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power SystemLoading, Technological Forecasting.

Distribution Management System

Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration Reconfiguration of Distribution Network, Different, Methods and Constraints, Power Factor Correction.

Communication System for Automation

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Readingand its implementation.

SCADA

Introduction, Block Diagram, SCADA Applied to Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

Optimal Distribution Systems

Calculation of Optimum Number [illegible] itching Device Placement in Radial,

Distribution Systems, Sectionalizing Switches Types, Benefits, Bellman"s Optimality Principle, Remote TerminalUnits, Energy efficiency in electrical distribution & Monitoring.

Distribution Automation Techniques

Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution. Automation in ActualPractice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

Total Hours = 45

Text book(s):

1. A.S. Pabla, “Electric Power Distribution”, Tata McGraw Hill Publishing Co. Ltd., Fourth Edition, 2011.
2. James Momoh, “Electric Power Distribution, automation, protection & control", CRC Press 2008.

Reference(s):

1. M.K. Khedkar, G.M. Dhole, “A Text Book of Electrical power Distribution Automation”, University Science
Press, New Delhi, 2010.
2. Anthony J Panseni, “Electrical Distribution Engineering”, CRC Press, 2006.
3 TuranGonen, Electric Power Distribution Engineering, CRS Press,2014.
4 https://nptel.ac.in/courses/108/107/108107112/

COURSE DESIGNERS

S.No	Name of the faculty	Designation	Department	Mail-id
1.	Mr.A.BALAMURUGAN	ASSOCIATE PROFESSOR	EEE	balamurugan@vmkvec.edu.in
2.	Mr. V.RATTAN KUMAR	ASSOCIATE PROFESSOR	EEE	rattankumar@avit.ac.in

	PULSE WIDTH MODULATION FOR PE CONVERTERS	Category	L	T	P	C
		EC - PS	3	0	0	3

PREAMBLE

This subject deals with the general concept of Converter topologies for AC/DC and DC/AC power conversion, overview of applications of voltage source converters over modulation, extension of modulation methods to multilevel inverters.

PREREQUUISITE : Nil

COURSE OBJECTIVE

1.	• To enhance the knowledge of various power converters.
2.	• To understand necessity and importance of PWM techniques
3.	• To learn the space vector based PWM technique.
4.	• To know the current ripple, torque ripple and inverter losses
5.	• To Implementation of PWM techniques for different applications

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1: Appreciate importance of PWM techniques.	Understand
CO2: Implement PWM using different strategies	Analysis
CO3: Compare performance of converter for different PWM techniques	Analysis
CO4: Analyze the parameter of Power electronic converter using PWM techniques	Analysis
CO5: Design and analyze the PWM based multi-level inverter	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 to Power Electronic Converters

Electronic switches, DC-DC buck and boost converters, H-bridge, multilevel converters – diode clamp, flyingcapacitor and cascaded-cell converters; voltage source and current source converters; evolution of topologies forDC-AC power conversion from DC-DC converters - Overview of applications of voltage source converter, motordrives, active front-end converters, reactive compensators, active power filters - Purpose of Pulse WidthModulation.

Pulse Width Modulation (PWM) at low switching frequency

Square wave operation of voltage source inverter, PWM with a few switching angles per quarter cycle, equal voltagecontours, selective harmonic elimination, THD optimized PWM, off-line PWM – Triangle - comparison based PWM- Average pole voltages, sinusoidal modulation, third harmonic injection, continuous PWM, bus- clamping ordiscontinuous PWM.

Space vector based PWM& Analysis of line current ripple and DC link current

Space vector concept and transformation, per-phase methods from a space vector perspective, space vector basedmodulation, conventional space vector PWM, bus-clamping PWM, advanced PWM, triangle comparison approachversus space vector approach to PWM.

Synchronously revolving reference frame; error between reference voltage and applied voltage, integral of voltageerror; evaluation of line current ripple; hybrid PWM for reduced line current ripple - Relation between line- sidecurrents and DC link current; DC link current and inverter state; RMS DC current ripple over a carrier cycle; RMScurrent

Analysis of torque ripple and Inverter loss

Evaluation of harmonic torques and RMS torque ripple, hybrid PWM for reduced torque ripple - Simplifying assumptions in evaluation of inverter loss, dependence of inverter loss on line power factor, influence of PWMtechniques on switching loss, design of PWM for low inverter loss. Effect of inverter dead-time effect-Requirementof dead-time, effect of dead-time on line voltages, dependence on power factor and modulation method,compensation of dead-time effect.

Over modulation& PWM for multilevel inverter

Per-phase and space vector approaches to over modulation, average voltages in a synchronously revolving *d-q*reference frame, low-frequency harmonic distortion.

Extensions of sine-triangle PWM to multilevel inverters, voltage space vectors, space vector based PWM, analysisof line current ripple and torque ripple.

Total Hours :45

Text book(s):

1. D. Grahame Holmes, Thomas A. Lipo, "Pulse width modulation of Power Converter: Principles and Practice",
John Wiley & Sons, 2014.
2. Bin Vew, " High Power Converter", Wiley Publication, 2017.

Reference:

1. Marian K. Kazimicrczuk, "Pulse width modulated DC-DC power converter", Wiley Publication, 2015.
2. https://nptel.ac.in/courses/108/108/108108035/
3 https://nptel.ac.in/content/syllabus_pdf/108108035.pdf
4 https://nptel.ac.in/content/storage2/courses/108105066/PDF/L-36(DP)(PE)%20((EE)NPTEL).pdf

COURSE DESIGNERS

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

	RESTRUCTURED POWER SYSTEM	Category	L	T	P	C
		EC - PS	3	0	0	3

PREAMBLE

This subject deals with the general concept of Converter topologies for AC/DC and DC/AC power conversion, overview of applications of voltage source converters over modulation, extension of modulation methods to multilevel inverters.

PREREQUUISITE :Nil

COURSE OBJECTIVE

1.	To Understand the concept of restructured power system, market operations and Transmission Pricing in power systems.
2.	To Understand the need behind requirement for deregulation of the electricity market.
3.	To impart the knowledge about available power transfer capability and challenges to Electricity Pricing.
4.	To learn operational planning activities of ISO and competiveness in power system environment .
5.	To understand transmission cost allocation methods and ancillary services management.

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1: Understand the basics of restructured power system	Understand
CO2: Identify the open access information system.	Analysis
CO3: Define the electricity prices and available power transfer capability	Analysis
CO4: Understand the planning activities and competiveness in power system environment	Analysis
CO5: Identify the cost allocation methods and its comparison	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	L	L
CO4	S	M	-	M	S	S	M	M	-	-	-	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG ,M-MEDIUM,L-LOW

SYLLABUS

Key Issues in Electric Utilities

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations– Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intrazonal Congestion.

Open Access Same-Time Information System (OASIS) & Market Power

Structure of OASIS - Posting of Information – Transfer capability on OASIS. Market Power: Introduction – Differenttypes of market Power – Mitigation of Market Power - Examples.

Available Transfer Capability (ATC) & Electricity Pricing

Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow.Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to ElectricityPricing – Construction of Forward Price Curves – Short-time Price Forecasting.

Power System Operation in Competitive Environment

Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets –Operational Planning Activities of a GENCO.

Transmission Cost Allocation Methods & Ancillary Services Management

Introduction - Transmission Cost Allocation Methods: Postage Stamp Rate Method - Contract Path Method – MWMileMethod – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service – a Review –Synchronous Generators as Ancillary Service Providers.

Total Hours :45

Text book(s):

1. Mohammad Shahidehpour and Muwaffaqalomoush, “Restructured Electrical Power Systems”, Marcel Dekker, Inc., 2001.
2. Loi Lei Lai, “Power System Restructuring and Deregulation”, John Wiley & Sons Ltd., England, 2012.

Reference(s):

1. Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder, “Operation of Restructured Power System”, Kulwer Academic Publishers, 2001.
2 https://nptel.ac.in/courses/108/101/108101005/
3 https://nptel.ac.in/content/syllabus_pdf/108101005.pdf
4 https://nptel.ac.in/content/storage2/courses/108101040/download/Lec-33.pdf

COURSE DESIGNERS

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

	SMART GRID TECHNOLOGIES	Category	L	T	P	C
		EC - PS	3	0	0	3

PREAMBLE

This subject deals with the general concept smart grid is an electricity network based on digital technology that is used to supply electricity to consumers via two-way digital communication.

PREREQUUISITE : Nil

COURSE OBJECTIVE

1.	To understand the concept of smart grid and its advantages over conventional grid.
2.	To provide Knowledge on smart metering technologies.
3.	To learn wide area measurement, monitoring and protection techniques
4.	To understand the concepts of power quality in smart grid.
5.	To acquire the basic knowledge on high performance computing.

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1: Appreciate the difference between smart grid & conventional grid	Understand
CO2: Apply smart metering concepts to industrial and commercial installations	Analysis
CO3: Formulate solutions in the areas of smart substations, distributed generation and wide area measurements, monitoring, protection and control	Analysis
CO4: Realize power quality management in smart grid	Analysis
CO5: Come up with smart grid solutions using modern communication technologies	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	-	-	S	S	S	M	-	-	S	-	M	-	M
CO2	S	S	-	-	M	S	S	M	-	-	L	-	L	-	L
CO3	S	S	L	-	S	S	S	-	-	-	M	-	M	L	L
CO4	S	M	-	S	S	S	M	M	-	-	-	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG ,M-MEDIUM,L-LOW

SYLLABUS

Introduction

Introduction to Smart Grid, Evolution of Electric Grid Concept of Smart Grid, Definitions, Need of Smart Grid,Concept of Robust & Self-Healing Grid Present development & International policies in Smart Grid – IEEE 37.118and IEC 61850 Standards.

Smart Grid Technologies

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), OutageManagement System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home &Building Automation, Smart Substations, Substation Automation, Feeder Automation.

Advanced Metering Infrastructure

Advanced Metering Infrastructure (AMI), Geographic Information System (GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro,Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phasor Data Concentrator (PDC),Phase Measurement Unit (PMU), Wide Area Monitoring, Protection and Control.

Power Quality Management in Smart Grid

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources PowerQuality Conditioners for Sm[illegible] onitoring Power Quality Audit.

.

High Performance Computing Fro Smart Grid Applications

Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee,GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of Cloud Computing & Cyber Securityfor Smart Grid Broadband over Power line (BPL), IP based protocols.

Total Hours :45

Text book(s):

1. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2015.

Reference(s):

1 Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2 Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions" CRC Press, 2012.
3 A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer, 2010.
4 SubirSen, Kothari, "Smart Grid:Fundamentals and Applications", New Age International, 2019

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

	ADVANCED MICRO-CONTROLLER BASED SYSTEMS	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

This course is to make the students to understand the architecture, programming and interfacing of system design of microcontrollers.

PREREQUISITE : Nil

COURSE OBJECTIVES

1	To introduce the architecture and programming of MSP 430 microcontroller.
2	To create an exposure to basic peripherals, data conversion and interfacing techniques.
3	To provide knowledge about the architecture of ARM Processor.
4	To enrich the learner with processor and controller design concepts on system-on-chip.
5	To acquire the knowledge about multi-core system design with reconfigurable.

COURSE OUTCOMES

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

CO1: Understand the insights and functionality of MSP430 microcontroller	Understand
CO2: Acquire knowledge on peripherals of MSP430	Understand
CO3: Appraise the blocks of ARM processor architecture	Apply
CO4: Adapt the concepts of SoC and hardware/software design	Create
CO5: Recognize the use of multi-core SoC	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

MSP 430 Microcontroller

Functional block diagram – memory – Interrupts and Resets – Input/ Output units – Instruction set – Addressing

modes – Constant generator and Emulated Instructions.

MSP 430 Timers

On-chip data conversion systems – ADC and DAC – on-chip communication peripherals –SPI, I2C, UART –

Programming concepts.

ARM7TDMI

Architecture overview - processor modes – data types – Registers – program status registers– Simple programs.

Introduction to Design of Systems on a chip

Core architectures for Digital media and compilation techniques – Microsystems technology and applications –
Hardware/ software co-design concepts.

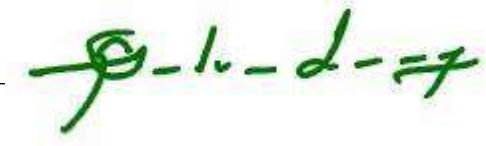
Multi-core System-on-Chip (McSoC) design

Application specific McSoC design – Queue Core Architecture– Synthesis and evaluation results – Reconfigurable
multi-core architectures.

Text Books

1. John H. Davies, 'MSP 430 Microcontroller Basics', Elsevier Ltd., 2010.
2. William Hohl, 'ARM Assembly Language, Fundamentals and Techniques', CRC Press, 2014.

References Books :



1. Abderazek Ben Abdallah, 'Multi-core systems on-Chip: Practical software and Hardware design', Atlantis
press, 2013.
2. Ricardo Reis, Marcelo Lubaszewski, Jochen A.G. Jess, 'Design of Systems on a chip: Design and Test'
Springer, 2006.
3. Singh.A.K.," Microcontroller and Embedded System", New Age International,2012
4. Jerrin Thomas, "A Textbook on Microcontroller Based system Design using 8051", LAP,2015

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	Mr. S. Prakash	Assistant Professor	EEE/AVIT	sprakash@avit.ac.in

	SCADA SYSTEM AND APPLICATIONS	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

This course aims to impart the students, in strong knowledge about automation technologies as, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, Petroleum Refining Process, Water Purification System, Chemical Plant. The course also includes SCADA protocols such as DNP3 protocol control net and also includes management and modeling, commissioning and operations.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	Learning of basics and configurations of SCADA System
2.	Learning the architecture and types of SCADA system
3.	Understand the vulnerability and security methods of SCADA system
4.	Gain the knowledge of communication protocols for SCADA interface
5.	Gain the Knowledge of various skills necessary for Industrial applications of SCADA

COURSE OUTCOMES

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

CO1: Describe the basics and configurations of SCADA systems applied to power systems	Understand
CO2: Explain the architecture and types of SCADA system	Understand
CO3: Describe and access the risk of vulnerability and security methods	Apply
CO4: Demonstrate the knowledge of communication protocols for data transmission	Apply
CO5: Design and analyze the general structure of an automated process for real time industrial applications using SCADA	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

UNIT - I	SCADA IN POWER SYSTEMS
Introduction to Supervisory Control and Data Acquisition, SCADA Functional requirements and Components, General features, Functions and Applications, Benefits. Configurations of SCADA, RTU (Remote Terminal Units) Connections, SCADA Communication requirements.	
UNIT - II	**ARCHITECTURE AND TYPES**
SCADA system architecture, interfacing SCADA with PLC; Types: First Generation: Monolithic or Early SCADA systems, Second Generation: Distributed SCADA systems, Third Generation: Networked SCADA systems and Fourth Generation: Internet of things technology, SCADA systems.	
UNIT - III	**EVOLUTION OF SCADA PROTOCOLS**
Background technologies of the SCADA protocols, Structure of a SCADA Communications Protocol, SCADA protocols: IEC 60870-5, the MODBUS model, the DNP3 protocols, RP 750, profibus, Conitel and the security implications of the SCADA protocols.	
UNIT - IV	**SCADA VULNERABILITIES AND ATTACKS & SECURITY METHODS AND TECHNIQUES**
The myth of SCADA invulnerability, SCADA risk management components, assessing the risk, mitigating the risk, SCADA threats and attack routes. SCADA Security Methods and Techniques: SCADA security mechanisms, SCADA intrusion detection systems and SCADA security standards.	
UNIT - V	**APPLICATIONS**
SCADA for Power Generating Stations, SCADA for Power Distribution Systems, Manufacturing Industries, Waste Water Treatment and Distribution Plants, SCADA in Power System, Power System Automation and Wireless SCADA.	

TEXT BOOKS

1. Ronald L Krutz, “Securing SCADA System”, Wiley Publication, 2015.
2. Stuart A Boyer, “SCADA Supervisory Control and Data Acquisition”, ISA, 4th Revised Edition, 2009.

REFERENCES

1. A.S. Pabla, ‘Electric Power Distribution’, Tata McGraw Hill Publishing Co. Ltd., Fourth Edition, 2004.
2. J. N, Green, R.Wilson, “Control & Automation of Electric Power Distribution Systems”, Taylor & Francis, 2007.
3. Tanuj Kumar Bisht, “SCADA and Energy Management System”, 2014.
4. Wood, A. J and Wollenberg, B. F, “Power Generation Operation and Control”, 2nd Edition John Wiley and Sons, 2006.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.P.Loganathan	Assistant Professor	EEE	loganathan@vmkvec.edu.in
2	Mrs. Saranya	Assistant Professor	EEE	saranya@avit.ac.in

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

PREAMBLE

The aim of this course is to make the students familiar with and increase their know about FACTS. At the end of the course the student should have a proper understanding of the different problems that can be encountered at the different power systems and how to approach and solve them.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	To understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits
2.	To learn the active and reactive power flow control in power system
3.	To recall the objectives of Shunt and Series compensation
4.	To understand the Co-ordination of multiple controllers using modern techniques.
5.	To develop the different control strategies used for compensation

COURSE OUTCOMES

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

CO1: Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.	Understand
CO2: Learn various Static VAR Compensation Schemes like Thyristor /GTO Controlled Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.	Understand
CO3: To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.	Apply
CO4: To learn about the Co-Ordination of FACTS Controllers.	Understand
CO5: To understand the basic concepts of custom power devices used in power quality issues.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

UNIT - I	INTRODUCTION
Reactive power control in electrical power transmission lines -Uncompensated transmission line – series compensation - Basic concepts of Static Var Compensator (SVC) -Thyristor Switched Series capacitor (TCSC) - Unified power flow controller (UPFC). Benefits of FACTS Transmission line compensation.	
UNIT - II	**STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS**
Voltage control by SVC – Advantages of slope in dynamic characteristics - Influence of SVC on system voltage - Design of SVC voltage regulator -Modeling of svc for power flow and transient stability - Applications: Enhancement of transient stability - Steady state power transfer - Enhancement of power system damping - Prevention of voltage instability.	
UNIT - III	**THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS**
Operation of the TCSC - Different modes of operation – Modeling of TCSC - Variable reactance model - Modeling for Power Flow and stability studies. Applications: Improvement of the system stability limit -Enhancement of system damping-SSR Mitigation.	
UNIT - IV	**VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS**
Static Synchronous Compensator (STATCOM) - Principle of operation - VI Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow -Modeling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation-UPFC and IPF.	
UNIT - V	**CO-ORDINATION OF FACTS CONTROLLERS**
Controller interactions - SVC - SVC interaction - Co-ordination of multiple controllers using linear control techniques - Control coordination using genetic algorithms. Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners –IEEE standards on power quality.	

TEXT BOOKS

1. Mohan Mathur.R, Rajiv Varma.K, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc 2002.
2 Padiyar.K.R," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.

REFERENCES

1. John.A.T, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999
2 V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004, Kluwer Academic Publishers.
3. G T Heydt , "Power Quality", McGraw-Hill Professional, 2007.
4. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Wiley-IEEE Press,December, 1999.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.P.Loganathan	Assistant Professor	EEE	loganathan@vmkvec.edu.in
2	Mrs. Saranya	Assistant Professor	EEE	saranya@avit.ac.in

	POWER SYSTEM RELIABILITY	Category	L	T	P	Credit
		EC - PS	3	0	0	3

PREAMBLE

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	Learn the basic concepts of reliability models
2.	Understand the basic concepts of reliability approaches
3.	Estimate the reliability levels for various systems
4.	Know the basic concepts of reserve and evaluation of reliability in single system
5.	Understand the generation of reserve and to implement it for the reliability evaluation

COURSE OUTCOMES

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

CO1: Acquire basic knowledge in reliability function for a system	Understand
CO2: Learn to implement the models in suitable fields with the knowledge of its parameters.	Understand
CO3: Calculate reliability levels with different approaches.	Apply
CO4: Evaluate the reliability values in simple system with various indices.	Analyze
CO5: To understand the basic concepts of reserve and evaluation of reliability in multiple	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

UNIT - I	Introduction
The General reliability function, The exponential distribution – Mean time to failure – series and parallel systems– State space approach – Markov process – continuous Markov processes	
UNIT - II	**Reliability Models**
Markov applications – Simple series and parallel system Models - conclusion - Capacity outage probability method – Loss of load probability method – Load forecast uncertainty.	
UNIT - III	**Reliability Approaches**
Loss of energy probability method -frequency and duration approach - conclusion spinning capacity evaluation Load forecast uncertainty - derated capacity levels – Reliability calculations.	
UNIT - IV	**Reliability Evaluation to Simple System**
Average interruption rate method – The frequency and duration method - stormy and normal weather effects - The Markov process approach - system studies – Service quality criterion – The conditional probability approach - simple system application, Two plant single load system, Twoplant – two load system - networked system approach- Comparison of reliability indices.	
UNIT - V	**Reliability Evaluation for Multiple System**
The probability array for two systems – The loss of load approach – Load forecast uncertainty - Reliability evaluation in more than two systems – interconnection benefits – The system modes of failure – The loss of load approach – The frequency and duration approach – spare value assessment – Multiple Bridge equivalents- Reserve value- valuation of reserve-Reliability evaluation and capacity reserve.	
TEXT BOOKS	
1. Roy Billinton, Power System Reliability Evaluation, Gordon and Breach Science Publishers, NewYork,1970. 2. Marko Cepin, “Assesment of Power System Reliability”, Springer, 2014	
REFERENCES	
1. N Highman “Handbook of Writing for the Mathematical Sciences”, SIAM. Highman’sbook.1999. 2. Adrian Wallwork, “English for Writing Research Papers:, Springer New York Dordrecht Heidelberg London, 2011 3. Singh Bhakar, “Hand Book for Writing Research Paper”, Bharati Publications, New Delhi, 2014. 4. Steven D. Krause, “The Process of Research Writing”, Steven D. Krause Publisher, 2004	

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Mr.P.Loganathan	Assistant Professor	EEE	loganathan@vmkvec.edu.in
2	Mrs. Saranya	Assistant Professor	EEE	saranya@avit.ac.in

	POWER SYSTEMS SECURITY	Category	L	T	P	C
		EC-PS	3	0	0	3

Preamble

Analytical frame work is needed and is used to control the bulk power systems in such a fashion to improve power system security. Power system practices try to control and operate power systems in a defensive posture so that the effects of these inevitable failures are minimized. In any energy management/ operations control centre, knowledge of security analysis, state estimation and optimal power flow is essential

COURSEOBJECTIVES

1	To Assess the security level status of the large power system
2	To Analyse the large power system in terms of real power performance index
3	To Estimate the state of the power system in terms of its measured values
4	To familiarize with the fundamentals of smart grids To get exposed to Smart Grid technologies
5	To familiarize with the fundamentals of smart grids To get exposed to Smart Grid technologies

COURSEOUTCOMES

Onsuccessfulcompletionofthecourse,thestudentswillbeable to

CO1	Assess the security level status of the large power system, if n-1 contingency takes place in the system	Understand
CO2	Analyse the large power system in terms of real power performance index (PI) or other PIs	Analyze
CO3	Optimise the power flow in terms of real and reactive power with the possible various objectives and constraints involved in energy management system	Apply
CO4	Use appropriate OPF technique depending on the formulation of optimisation which involves non-linear objective and constraints	Analyze
C05	To know about the various stability assessment tools for smart grid	Analyze

MappingwithProgrammeoutcomesandProgrammeSpecificOutcomes

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

SYLLABUS

UNIT-I	OPERATIONS IN POWER SYSTEM SECURITY	**9**

Introduction, Factors Affecting Power System Security, Contingency Analysis, An Overview of Security Analysis, Linear Sensitivity Factors, Generation shift sensitivity factor, Line outage Distribution Factor, Line flow after outage, AC Power Flow Security Analysis, AC Power Flow Security Analysis With Contingency Case Selection, Concentric Relaxation, Bounding Area method.

UNIT-II	STATE ESTIMATION	

Introduction, Method of Least Squares, Simple DC circuit example with suitable derivation, Maximum Likelihood Weighted Least-Squares Estimation, Matrix Formulation, Estimation formulae, State Estimation by Orthogonal Decomposition, The Orthogonal Decomposition Algorithm, Detection and Identification of Bad Measurements, Network Observability and Psuedo-Measurements

UNIT-III	OPTIMAL POWER FLOW	**9**

Introduction, Optimal Power Flow (OPF) Formulation, Economic Load Dispatch (ELD) problem formulation, Optimal Reactive Power Dispatch (ORPD), Economic Emission Dispatch (EED), Security Constrained OPF (SCOPF), OPF solution techniques, Lagrangian Multiplier Method, Linear Programming Method, Interior Point Method.

UNIT-IV	STABILITY ASSESSMENT FOR SMART GRID	**9**

Introduction to Stability - Strengths and Weaknesses of Existing Voltage Stability Analysis Tools - Voltage Stability Assessment - Voltage Stability Assessment Techniques - Voltage Stability Indexing - Analysis Techniques for Steady-State Voltage Stability Studies - Angle Stability Assessment

UNIT-V	SMART METERING	**9**

Introduction – Smart metering – Comparison of Conventional and smart metering – Benefits of smart meters- Functional block diagram of a smart meter-stages in Smart meter architecture- – Communication infrastructure and protocols for smart metering – Demand side integration.

TEXTBOOK

1. A.J.Wood and B.F. Wollenberg., Power generation, operation and control, John Wiley and sons, 1996
2. James Momoh, “Smart Grid: Fundamentals of design and analysis”, John Wiley & sons Inc, 2012

REFERENCES

1. *John J. Graignaer and William D. Stevenson, Power system analysis, Tata Mc Graw Hill, 2003.*
2. *P.Venkatesh, B.V.Manikandan, S.Charles raja and A.Srinivasan, ―Electrical power systems analysis, Security and Deregulation‖, PHI 2012.*
3. *Krzysztof Iniewski, “Smart Grid Infrastructure & Networking”, Tata McGraw Hill, 1st edition, 2012.*
4. *Stuart Borlase,“Smart Grids: Infrastructure, Technology, and Solutions”, CRC press, 2013*

COURSEDESIGNERS

SlNo	NameoftheFaculty	Designation	Department	MailID
1	Dr.K.Boopathy	Asso. Prof.	EEE/AVIT	boopathyk@avit.ac.in
2	Dr.R.Sathish	Assistant Professor	EEE/ VMKVEC	sathish@vmkvec.edu.in

	BIO MEMS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The rapid development of the integrated circuit (IC) industry has led to the emergence of micro electronics process engineering as a new advanced discipline. The combination of MEMS and integrated intelligence has been put forward as a disruptive technology.Gives brief knowledge about applications of Bio-MEMS technology for therapeutics and diagnostics.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To train the students in the design aspects of Bio MEMS devices and Systems.
2	To learn the basic principles of BioMEMS/Microfluidic device manufacturing.
3	To make the students aware of applications in various medical specialists especially the Comparison of conventions methods and Bio MEMS usage.
4	To Classify the different mechanisms of micro sensors and actuators.

COURSE OUTCOMES

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

CO1. Understand the Micro fluidic Principles and study its applications.	Understand
CO2. Explain the principles and applications of Micro Total Analysis.	Understand
CO3. Discuss and realize the MEMS applications in Bio Medical Engineering	Understand
CO4. Classifying the principles of Micro Actuators and Drug Delivery system	Apply
CO5.Utilizing the concept of MEMS with biological 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	L	L	L	L	-	-	-	-	-	-	-	-	-	-
CO2	S	L	L	L	M	-	-	-	-	-	-	-	-	-	-
CO3	S	L	M	L	M	-	-	-	-	-	-	-	-	L	-
CO4	S	M	M	L	M	-	-	-	-	-	-	L	L	L	-
CO5	S	S	M	L	M	-	-	-	-	-	-	L	L	L	-
S- Strong; M-Medium; L-Low															

SYLLABUS

Unit I

Introduction-The driving force behind Biomedical Applications – Biocompatibility - Reliability Considerations-Regularity Considerations – Organizations - Education of Bio MEMS-Silicon Micro fabrication-Soft Fabrication techniques

Unit II

Micro fluidic Principles- Introduction-Transport Processes- Electro kinetic Phenomena-Micro valves –Micro mixers-Micro pumps.

Unit III

SENSOR PRINCIPLES and MICRO SENSORS: Introduction-Fabrication-Basic Sensors-Optical fibers-Piezo electricity and SAW devices-Electrochemical detection-Applications in Medicine

Unit IV

MICRO ACTUATORS and DRUG DELIVERY: Introduction-Activation Methods-Micro actuators for Micro fluidics-equivalent circuit representation-Drug Delivery

Unit V

MICRO TOTAL ANALYSIS: Lab on Chip-Capillary Electrophoresis Arrays-cell, molecule and Particle Handling-Surface Modification-Microsphere-Cell based Bioassay Systems Detection and Measurement Methods-Emerging Bio MEMS Technology-Packaging, Power, Data and RF Safety-Biocompatibility, Standards

Text Books/ References Books :

1. 1. Steven S. Saliterman, Fundamentals of Bio MEMS and Medical Micro devices, Wiley Interscience, 2006.
2. Albert Folch , Introduction to Bio MEMS, CRC Press, 2012
3. Gerald A. Urban, Bio MEMS, Springer, 2006
4. Wanjunwang, steven A. Soper, Bio MEMS, 2006.
5. M. J. Madou, “Fundamentals of Micro fabrication”,2002.
6. G.T. A. Kovacs, “Micro machined Transducers Sourcebook”, 1998.

COURSE DESIGNERS				
S.No	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Mrs.A.Malarvizhi	Assistant Professor	ECE	malarvizhi@vmkvec.edu.in
2	Dr.T.Muthumanickam	Professor & Head	ECE	muthumanickam@vmkvec.edu.in

	BIOMEDICAL PRODUCT DESIGN AND DEVELOPMENT	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To understand the global trends and development methodologies of various types of products and services.
2	To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
3	To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
4	To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
5	To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

COURSE OUTCOMES

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

CO1. Define, formulate and analyze a problem for the product design.	Apply
CO2 Obtain the domain knowledge of product development and regulatory requirements for the design of prototype.	Apply
CO3.Explain the process of manufacturing, testing and validation for scalable product development.	Apply
CO4 Gain knowledge of the Innovation & Product Development process in the Business Context.	Apply
CO5 Discuss the economics in product development and business strategies for turnover from commercialization.	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	--	--	--	M	S	L	M
CO2	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO3	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO4	S	S	S	L	--	--	--	M	--	--	--	M	S	L	M
CO5	S	S	S	L	--	--	--	M	--	--	--	M	S	L	M

S- Strong; M-Medium; L-Low

SYLLABUS

PRODUCT DESIGN

Definition, History and Modern Practice – Designs; Design and Product Life Cycle; Design Process; What is a medical device, Challenges in medical device, Understanding the innovation cycle, Good Design Practice. Understanding, analyzing and validating user needs, Screening Needs, Technical Requirements, Concept Generation – Innovation Survey Questionnaire, Morphological Matrix, QFD, Concept Analysis and validation, Concept Modelling, Concept Screening & Validation.

PRODUCT DEVELOPMENT AND REGULATORY

Breakthrough Products, Platform Products, Front End of Innovations / Fuzzy Front End, Generic Product Development Process (Concept Development, System Design, Detailed Design, Test & Refinement, Production Ramp-up), Variants of Development Processes (Market Pull, Technology Push, Platform, Process-Intensive, Customized, High-Risk, Quick Build, Complex Systems), Good Documentation Practice, Prototyping Specifications, Prototyping, Medical Device standards, Quality management systems, Medical Device Classification, Design of Clinical Trials, Design Control & Regulatory Requirements, Documentation in Medical Devices, Regulatory pathways.

CALABLE PRODUCT DEVELOPMENT

Design for manufacturing, Design for assembly, Design for Serviceability, Design for usability, Medical Device Verification & Validation, Product Testing & Regulatory compliance, Clinical trial & validation, Device Certification.

MANUFACTURING AND BUSINESS STRATEGIES

Lean Manufacturing – Toyota Production System, Good Manufacturing Practices, Framework for Product Strategy – Core Strategic Vision (CSV), Characteristics of good CSV, Opportunity Identification Process & Generating Opportunities, Quality of Opportunities – Real-Win-Worth It (3M RWW), Product Planning Process, Technology S-Curve, Evaluating and Prioritizing Projects, Product-Process Change Matrix, Resource Planning, Total Available Market (Segmentation, Targeting & Positioning), Served Available Market, Product Platform Strategy, Market Platform Plan (Product Platform Management, Product Line Strategy).

PRODUCT ECONOMICS AND MARKET INFUSIONS

Economics/Finance in Product Development (Sales Forecasting – ATAR Model/ Bases Model, Pricing the product, Cash flow in Product Development, Categorizing the costs, Structuring Manufacturing Costs, Prototyping Costs, Development Costs, Cost Volume Profit Analysis, Breakeven Analysis, Common Return Metrics – Payback/ NPV/ IRR, Common Comparison Metrics – WACC/ RRR/ MARR). Business Model Canvas, Marketing Channels, Sales Models, Post Commercialization Surveillance, End of Life support.

REFERENCES:

1. Jones, J.C., Design Methods, John Wiley, 1981.
2. Cross, N., Engineering Design Methods, John Wiley, 1994.
3. Pahl, G., and Beitz, W., Engineering Design, Design Council, 1984.
4. Michael E. McGrath, Product Strategy for High-Technology Companies, 2nd Edition, McGraw Hill.
5. Ulrich, K.T., and Eppinger, S.D., Product Design and Development, Tata McGraw Hill, India.
6. Ehrelspiel. K, and Lindemann U Cost Efficient Design, Springer,2007.
7. Paul H king, Richard C. Fries, Arthur T. Johnson, Design of Biomedical Devices and Systems. Third edition, ISBN 9781466569133.

8. Peter J. Ogrodnik, Medical Device Design: Innovation from Concept to Market, Academic Press Inc; Edition (2012), ISBN- 10:0123919428.
9. StefanosZenios, Josh Makower, Paul Yock, Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel, Biodesign: the Process of Innovating Medical Technologies, Cambridbge University press; Edition (2009), ISBN- 10:0521517427.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.L.K.Hema	Professor& Head	BME& ECE	hodbme@avit.ac.in
2	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
3	Dr.R.Ezhilan	Assistant Professor	BME	ezhilan@vmkvec.edu.in

	METAL ADDITIVEMANUFACTURING	Category	L	T	P	Credit
		OE-EA	3	0	0	3

Prerequisite:-Nil

CourseObjective

1	Understand the basic principles, methods, areas of usage, possibilities and limitations and the environmental effects of the metal additive manufacturing
2	Select suitable materials for developmentof parts using additive manufacturing with sound mechanical properties
3	Select suitable processes from various metal additive manufacturing processes as per the product requirement
4	Develop and select suitable parameter for manufacturing and post processing techniques for metal additive manufacturing parts
5	Design the parts for metal additive manufacturing

CourseOutcomes:On thesuccessfulcompletionof thecourse,studentswillbeableto

CO1.	Understand the basic principles, applications and limitations metal additive manufacturing system	Understand
CO2.	Understand how to select suitable materials from the existing or develop new materials for additive manufacturing	Understand
CO3.	Understand the working principle of various methods in MAM and their applications and limitation	Understand
CO4.	Produce a defect free MAM parts with suitable material selection and post processing techniques	Apply
CO5.	Understand the design and optimization techniques to design and develop parts using MAM techniques	Apply

MappingwithProgrammeOutcomesandProgrammeSpecificOutcomes

CO	PO1	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO1	M	-	-	-	M	-	M	-	-	-	-	L	L	-	-
CO2	M	-	-	-	M	-	M	-	-	-	-	L	L	-	-
CO3	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M
CO4	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M
CO5	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M

S-Strong;M-Medium;L-Low

Syllabus

Module 1	Introduction	9
Introduction to metal additive manufacturing – classification and challenges – applications- CAD for additive manufacturing – file formats, CAD CAM software, modelling and data processing – STL format – slicing – design consideration- machine set up		
Module 2	**Materials and properties of AM printed parts**	9
Manufacturing of metallic materials - Conventional vs AM process - Solidification of Metals Equilibrium and Non-equilibrium phases for solidificationfor AM Phase diagrams - Iron-Carbon - Aluminum alloy - Titanium alloy - Nickel alloy Methods of Powder Particles Productionand Powder Properties- Wire Properties for Direct Energy Deposition - Mechanical properties of AM printed parts		
Module 3	**Basic processes in metal additive manufacturing**	9
Powder bed fusion – direct energy deposition – binder jetting – metal extrusion – material jetting - sheet lamination Laser theory - Continuous vs pulsed laser - Laser types - Laser beam properties Basics of electron beam - Electron beam powder bed fusion and mechanism Powder feeders and their classification - Delivery Nozzles - Powder bed delivery and spreading systemWire Fed Systems - Positioning Devices - Print-heads		
Module 4	**AM process parameters**	9
Beam Scanning Strategies and Parameters for PBF and DED - Powder Properties for PBF, DED, and BJ- Ambient Parameters for PBF and DED - Geometry-Specific Parameters, Support Structures (PBF) Defects in AM Printed Parts - Need of Post Processing - Need for Surface Finishing Common Post Processing for MAM - Potential Hazards of Additive Manufacturing – economics of MAM		
Module 5	**Design for Additive Manufacturing**	9
Fundamentals and principle -design techniques and steps - design optimization, material selection and consideration in application field- Part decomposition and Decomposition methods Topology optimization techniques - Overhangs, and Bridging and cavities in design Key characteristics and considerations in topology optimization - Topology optimization under material uncertainty and manufacturability - Industry 4.0 future with AM		

TextBooks	
1	Milewski, J.O., 2017. Additive manufacturing of metals. Cham: Springer International Publishing.
2	Balasubramanian, K.R. and Senthilkumar, V. eds., 2020. Additive Manufacturing Applications for Metals and Composites. IGI Global.
ReferenceBooks	
1	Leach, R. and Carmignato, S. eds., 2020. Precision Metal Additive Manufacturing. CRC Press.
2	Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003

3	Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
4	Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

CourseDesigners

S.No	**FacultyName**	**Designation**	**Department/ College**	**Emailid**
1	Mr.A.Elanthirayan	Asst. Prof. G-II	AVIT	aleanthirayan@avit.ac.in

	WASTE TO ENERGY	Category	L	T	P	Credit
		OE-EA	2	0	0	2

PREAMBLE

This course is to provide insights into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To enable students to understand of the concept of Waste to Energy.
2	To link legal, technical and management principles for production of energy form waste.
3	To learn about the best available technologies for waste to energy.
4	To analyze of case studies for understanding success and failures.

COURSE OUTCOMES

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

CO1: Understand the knowledge about the operations of Waste to Energy Plants.	Understand
CO2: Analyse the various aspects of Waste to Energy Management Systems.	Analyze
CO3: Carry out Techno-economic feasibility for Waste to Energy Plants	Apply
CO4: Evaluate planning and operations of Waste to Energy plants.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO1 2	PSO 1	PS O2	PSO3
CO1	M	-	-	L	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	L	L	-	M	-	-	-	-	-	-	L	-	-
CO3	S	M	S	M	-	L	-	M	-	-	-	-	M	L	-
CO4	S	M	S	-	L	-	-	-	-	-	-	-	M	L	-
CO5	L	L	-	L	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

WASTE SOURCES & CHARACTERIZATION

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc.

Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

TECHNOLOGIES FOR WASTE TO ENERGY

Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

WASTE TO ENERGY OPTIONS

Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Conversion of wastes to fuel resources for other useful energy applications Energy from Plastic Wastes – Non-recyclable plastic wastes for energy recovery. Energy Recovery from wastes and optimization of its use, benchmarking and standardization. Energy Analysis.

CASE STUDIES - WASTE TO ENERGY PLANTS

Success/failures of waste to energy Global Best Practices in Waste to energy production distribution and use. Indian Scenario on Waste to Energy production distribution and use in India. Success and Failures of Indian Waste to Energy plants. Role of the Government in promoting 'Waste to Energy'. Waste activities – collection, segregation, transportation and storage requirements. Location and Siting of 'Waste to Energy' plants. Industry Specific Applications – In-house use – sugar, distillery, pharmaceuticals, Pulp and paper, refinery and petrochemical industry and any other industry. Centralized and Decentralized Energy production, distribution and use. Comparison of Centralized and decentralized systems and its operations.

REFERENCES

1. Lee, James M., "Biochemical Engineering." PHI, 1st Edition, 1992. Yeh W.K., Yang H.C., James R.M., "Enzyme Technologies: Metagenomics, Biocatalysis and Biosynsthesis", Wiley- Blackwell, 1st Edition, 2010.

   Blanch H.W., Clark D. S., "Biochemical Engineering", Marcel Dekker, Inc. 2nd Edition, 1997.
2. Palmer, Trevor. "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry." 2nd Edition, East West Press, 2008.

Course Designers

S.No.	Name of the faculty	Designation	Department	Mail ID
1.	Dr.R. Kirubakaran	Assistant Professor	Department of Biotechnology	kirubakaran@vmkvec.edu.in
2	Dr.M.Sridevi	Professor	Biotechnology	hodbte@vmkvec.edu.in

	SUSTAINABLE BUILT ENVIRONMENT	CATEGORY	L	T	P	C
		OE-EA	3	0	0	

PREAMBLE

Approaches towards energy saving methods through utilization of sustainable materials. Energy managem monitoring of CO2 consumption and emission in buildings.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	Explaining the role of sustainable architecture to avoid soil erosion & pollution control measures.
2	Efficiency of waste management with respect to water balance and water efficiency.
3	Impartknowledgeongreenconceptsindesign,construction&operationofbuildings.
4	Intending the exposuretothelatestGreenBuildingtrends&technologies to the students.
5	To learn about the importance and Need of Indoor air quality management.

COURSE OUTCOMES

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

CO1.Understand the importance of site selection in achieving sustainable environment.	Understand
CO2. Applying the efficient water balance concept to achieve the water efficiency.	Apply
CO3. Applying the energy efficiency methods to achieve energy efficiency in building.	Apply
CO4. Analyzing the sustainable building materials in achieving energy efficiency in building.	Analyze
CO5.Analyzing the Internal air quality with respect to the Indian Codes and its Standards.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I

INTRODUCTION TO GREENBUILDINGDESIGN:

UniversalDesign:KeyaccessibilityissuesandDesignguidelines - IntegratedApproachforGreenBuildingdesign:FactorsforSiteselection,Understandingthe importance of SiteEcology&SiteAnalysis - Microclimate:Factorsaffectingmicroclimate&heatIslands - Strategiestohandleheatisland in built environment, Designing Green Spaces and Enhancing Biodiversity inb environment.

UNIT II

WATER RESOURCE AND WASTEWATER MANAGEMENT

Rainwaterharvestingandutilization,Groundwaterrechargetechniques:Designconsiderations - WaterBalanceandapproachforwaterefficiency:3RApproachforwaterefficiency– Efficiency towards waste water management - Wastewatertreatment&reuse,wastewatertreatmenttechnologies.

UNIT III

ENERGY EFFICEINECY IN SUSTAINABLE BUILDINGS

Introduction,PerformanceEvaluationandApproachfor EnergyEfficiencyinBuildings EnergyEfficiencyStandards&Codes:ECBC2017&EPI,ASHRAE90.1,ASHRAE62.1,ASHRAE 55,ASHARE 170, ISHRAE100 labelling for appliances - EfficientBuildingEnvelope:Heatingloads inbuildings,Building orientationandform,Envelop Transfer&Material Specifications.

UNIT IV

SUSTAINABLEBUILDINGMATERIALS

Attributes of Sustainable Building Materials: Recycled content, Regional material,Renewable m Embodiedenergy,Embodiedcarbon, Material performance,Recyclability,Eliminationofhazardous materials - management during construction & post-occupancy: Segregation strategies,Types ofwastemanagem organic,inorganic,e-waste,hazardouswaste.

UNIT V

INDOORENVIRONMENTALQUALITY

Indoor Air quality: Codes and Standards, Fresh air requirements, Designconsiderations ApproachforimprovingIndoorairquality:Measurestoreducesickbuildingsyndrome,Demandcontrolventilation,CO2mon nbuildings,Airqualitymonitoring - EnhancingoccupantsComfort,HealthandWellbeing:ThermalComfor Comfort,Acoustics,Ergonomics,OlfactoryComfort.

TEXT BOOKS:

1. Guide on Green BuiltEnvironment, IGBC, 2021.
2. IGBC Green Homes ratingsystem, IGBC, 2019.
3. IGBC Green New Buildingsratingsystem, IGBC, 2016.

REFERENCES:

1. ECBC, Bureau ofEnergyEfficiency, 2017.
2. NationalBuildingCode, Bureau ofIndianStandards, Bureauof IndianStandards, 2016.
3. ASHRAE 90.1, 62.1, 55, ASHRAE, 2010.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.S.P.Sangeetha	Professor	Civil	sangeetha@avit.ac.in

	ADVANCED 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 basic terminologies related to cyber security and current cyber security threat landscape.
2.	To understand the cyber attacks that target computers, mobiles and persons
3.	To understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes
4.	To study the data privacy and security issues related to Social media platforms.
5.	To understand the main components of cyber security plan

COURSE OUTCOMES

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

CO1: able to understand the basic terminologies related to cyber security and current cyber security threat landscape.	Understand
CO2: Able to complete u n d e r s t a n d i n g of the cyber attacks that target computers, mobiles and persons	Apply
CO3: able to understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes, It will also expose students to limitations of existing IT Act,2000 legal framework that is followed in other countries and legal and ethical aspects related to new technologies.	Apply
CO4: Able to get insight into the Data Protection Bill,2019 and data privacy and security issues related to Social media platforms.	Apply
CO5: Able to understand the main components of cyber security plan.	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

Overview of Cyber security	**9 hours**
Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.	
Cyber crimes	**9 hours**
Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Crypto jacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.	
Cyber Law	**9 hours**
Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.	
Data Privacy and Data Security	**9 hours**
Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.	
Cyber security M a n a g e m e n t , Compliance and Governance	**9 hours**
Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	

REFERENCES

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.

2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.

3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.

4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.

5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.

6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett

Learning.

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	Associate Professor	CSE	sundharamurthy@vmkvec.edu.in

	PROJECT WORK PHASE I	Category	L	T	P	C
		EE-P	0	0	12	6

PREAMBLE

The primary emphasis of the project work phase-I is to understand and gain the knowledge of the principles of Computer Science and Engineering practices, so as to participate and manage main projects in future.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To import the practical knowledge to the students and also to make them to carry out the technical procedures in their project work.
2	To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work and placing this as their beginning stage for their final presentation.
3	To understand and gain the knowledge of the principles of engineering practices.
4	To Get good exposure and command in one or more application areas and on the software.
5	To participate and manage an innovative, social and economic engineering projects in future.

COURSE OUTCOMES

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

1. Survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.	Analyze
2. Use different experimental techniques/different software/ computational/analytical tools.	Apply
3. Design and develop an experimental set up/ equipment/test rig.	Analyze
4.Conduct tests on existing setups/equipments and draw logical conclusions from the results after analyzing them.	Analyze
5. Work in a research environment or in an industrial environment.	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

The Project Work will start in semester III and should preferably be a problem with research potential and

should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M.E/M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

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	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	PROJECT WORK PHASE II	Category	L	T	P	C
		EE-P	**0**	**0**	**24**	**12**

PREAMBLE

This course enables the students to exercise some of the knowledge and/or skills developed during the programme to new situation or problem for which there are number of engineering solutions. This course include planning of the tasks which are to be completed within the time allocated, and in turn, helps to develop ability to plan, use, monitor and control resources optimally and economically. By studying this course abilities like creativity, imitativeness and performance qualities are also developed in students. Leadership development and supervision skills are also integrated objectives of learning this course.

PREREQUISITE – Nil

COURSE OBJECTIVES

	This enables and strengthens the students to carry out the project on their own and to implement their innovative ideas to forefront the risk issues and to retrieve the hazards by adopting suitable assessment methodologies and staring it to global.

COURSE OUTCOMES

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

1.Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will.	Analyze
2.Write technical reports and research papers to publish at national and international level.	Analyze
3.Develop strong communication skills to defend their work in front of technically qualified audience	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

S- Strong; M-Medium; L-Low

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare adetailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc.

As decided by the Head and PGcoordinator. The candidate has to be in regular contact with his guide.

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	Mr.S.Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	INTERNSHIP/ INDUSTRIAL TRAINING	Category	L	T	P	Credit
		EE-P	0	0	2	1

PREAMBLE

The Engineering Internship course is a Canvas-based course that offers students the opportunity to explore and develop their careers through professional practice. The structured plan of education impacts student work readiness through a number of professional development skill-building activities, including goal setting; analysis and reflection; feedback from employer; informational interviewing and debriefing their experience.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	An understanding of how liberal arts coursework ties to professional careers of interest.
2	Gain insight into a possible career path of interest while learning about the industry in which the organization resides, organizational structure, and roles and responsibilities within that structure.
3	Develop professional connections and identify a strategy for maintaining those connections
4	Identify and articulate next steps in their career trajectory.

COURSE OUTCOMES

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

CO1. Add details about your experience including new skills developed and results obtained.	Understand
CO2. Analyze your internship experience, reflecting on lessons learned and how your liberal arts education prepared you for the internship.	Apply
CO3. Identification of additional skills that will need to be developed to ensure career readiness.	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	-	L	L	S	L	S	-	M	M	M
CO2	S	S	M	M	S	M	L	L	M	M	M	-	S	S	S
CO3	L	M	M	L	M	M	L	L	M	L	L	-	M	M	M

S- Strong; M-Medium; L-Low

General Procedure

Final Reflection Report:

I. General Information Section

Explain your role and how your work contributed to the company

II. Technical Skills

Document the technical experiences you had during your work experience and discuss technical problems that you assisted in solving

III. Development of Professional Skills

Describe team and leadership building opportunities on the job

IV. Assessments

- Discuss whether or not you met goals set out by your supervisor or that you set for yourself
- Evaluate your performance of assigned projects, noting both areas of strength and improvement

V. Conclusion

- Summarize by addressing the impact of the work experience on your education and career goals
- Provide two "lessons learned" to share with any student that is considering an internship

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.	Dr. L. Chitra	Professor& Head	EEE/AVIT	chitra@avit.ac.in.
4.	Mr. S. Prakash	Assistant Professor	EEE/AVIT	sprakash@avit.ac.in.

Course Code	Course Title	Category	L	T	P	C
	English for Research Paper Writing	**AC**	**0**	**0**	**2**	**0**

Course Objectives:

1. To understand research problem formulation.
2. Need to analyze research related information
3. Evaluate and Follow research ethics

Unit I Research

Meaning of research problem - Sources of research problem- Criteria Characteristics of a good research problem - Errors in selecting a research problem - Scope and objectives of research problem

Unit II Data Analysis

Approaches of investigation of solutions for research problem - data collection, analysis, interpretation - Necessary instrumentations

Unit III Plagiarism

Effective literature Reviews - approaches, analysis Plagiarism – Definition of Plagiarism – Consequences of Plagiarism – Unintentional Plagiarism – Forms of Plagiarism - Related Issues - Research ethics

Unit IV Research Paper Format

Effective technical writing, how to write report, Paper Developing a Research Proposal

Unit V Format

Format of research proposal – Margin – Text Formatting - Heading and Title – Page Numbers –Tables and Illustrations – Corrections and Insertions –Binding – Bibliography

Total: 45 Periods

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”

COURSE DESIGNERS			
COURSE INSTRUCTOR	**DESIGNATION**	**NAME OF THE INSTITUTION**	**MAIL ID**
Dr. Premkishor	Assistant Professor	AVIT	PREM.ENGLISH@avit.ac.in
Dr.Jennifer G Joseph	HoD-H&S	AVIT	jennifer@avit.ac.in

	DISASTER MITIGATION AND MANAGEMENT	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To study about the Disaster Management Cycles
2	To Study about the Disaster Community and planning
3	To Understand the Challenges posed by Disasters to the community
4	To study about coping concepts for both natural and manmade disasters
5	To study about strengthening techniques for structural and nonstructural measures

COURSE OUTCOMES

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

CO1. Understanding Disasters, man-made Hazards and Vulnerabilities	Understand and Apply
CO2. Understanding disaster management mechanism	Apply
CO3 To gain knowledge about organizations involved in disaster community	Apply
CO4. To build skills to respond to disasters	Apply
CO5. Understanding capacity building concepts and planning of disaster managements	Understand and 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	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

UNIT I INTRODUCTION

Overview of Disaster Management – Distinguishing between an emergency and a Disaster situation. Disaster Management Cycle – Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans- Phase I: Mitigation, and strategies; hazard Identification and vulnerability analysis. Disaster Mitigation and Infrastructure, impact of disasters on development programmes, vulnerabilities caused by development, developing a draft country-level disaster and development policy Phase II: Preparedness, Disaster Risk Reduction(DRR), Emergency Operation Plan (EOP) Phases III and IV: Response and recovery, Response aims, Response Activities, Modern and traditional responses to disasters, Disaster Recovery, and Plan

UNIT II DISASTER PLANNING

Disaster Planning-Disaster Response Personnel and duties, Community Mitigation Goals, Pre-Disaster Mitigation Plan, Personnel Training, Volunteer Assistance, School-based Programmes, Hazardous Materials, Ways of storing and safely handling hazardous materials, Coping with Exposure

.

UNIT III DISASTER COMMUNITY

Disaster Community-Community-based Initiatives in Disaster management, need for Community-Based Approach, categories of involved organizations: Government, Nongovernment organizations (NGOs), Regional And International Organizations, Panchayaths, Community Workers, National And Local Disaster Managers, Policy Makers, Grass-Roots Workers, Methods Of Dissemination Of Information, Community-Based Action Plan, Advantages/Disadvantages Of The Community Based Approach

UNIT IV COPING WITH DISASTER

Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT V CAPACITY BUILDING

Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Ayaz,. "Disaster Management: Through the New Millennium", Anmol Publications. (2009)
3. Dave, P. K.. "Emergency Medical Services and Disaster Management: A Holistic Approach", New Delhi: Jaypee Brothers Medical Publishers (P) Ltd., 2009
4. Disaster Management by Mrinalini Pandey Wiley 2014.
5. Goel, S. L., "Disaster Management", New Delhi: Deep & Deep Publication Pvt. Ltd. ,2008

REFERENCE BOOKS:

1. Narayan, B. "Disaster Management", New Delhi: A.P.H. Publishing Corporation ,2009
2. Kumar, N.. "Disaster Management". New Delhi: Alfa Publications. ,2009
3. Ghosh, G. K., "Disaster Management", New Delhi: A.P.H Publishing Corporation.

S.No	Name of the Faculty	Designation	Name of the College	Mail ID
1	MrsJ.Srija	Assistant Professor - I	AVIT	srija.civil@avit.ac.in

	VALUE EDUCATION	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

The course highlights the importance of values and ethics for human life and organization.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To understand value of education and self- development
2	To inculcate good values in students to make them patriotic with humanity
3	To groom the personality with positive thinking with universal brotherhood and religious tolerance.
4	To impart the value of true friendship and happiness
5	To enhance the character and competence for developing into self-control person

COURSE OUTCOMES

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

CO1. Identify the value of education and self- development with work ethics	Remember
CO2. Interpret sense of duties with good values in students to make them patriotic with humanity	Understand
CO3. Explain the integration, scientific attitude, overall personality with labor dignity	Understand
CO4. Discuss the value of true friendship and happiness	Understand
CO5. Paraphrase the character and competence for developing into self-control person	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	-	-	-	-	-
CO2	L	L	-	-	-	-	-	M	-	-	-	-	-	-	-
CO3	L	L	M	-	-	-	-	M	-	-	-	L	L	L	-
CO4	L	S	-	-	-	-	-	M	-	-	-	-	-	-	-
CO5	L	S	M	-	-	-	-	M	-	L	-	-	L	L	-

S- Strong; M-Medium; L-Low

SYLLABUS

Unit I

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moraland non- moral valuation. Standards and principles, value judgements

Unit II

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism, Love for nature, Discipline

Unit III

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline., Punctuality, Love and Kindness, avoid fault Thinking, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance

Unit IV

True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation,doing best for saving nature

Unit V

Character and Competence –Holy books vs Blind faith, Self-management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, all religions and same message, mind your Mind, Self-control, Honesty, Studying effectively

Text Books/ References Books:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, NewDelhi

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID

Course Code	Course Title	Category	L	T	P	C
	CONSTITUTION OF INDIA	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.

6 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 - Chief Minister and Council of Ministers- State Legislature

UNIT IV – Local Government

The New system of Panchayats, 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	Principal	AV School of Law	Sudheersurya18@gmail.com

	PEDAGOGY STUDIES	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

The course is designed to provide pedagogical practices towards academic, research activities and professional developments.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To provide theories and methodologies related to curriculum development and research framework
2	To familiarize with pedagogical practices in formal and informal classrooms in developing countries
3	To identify evidence on the effectiveness of the pedagogical practices for enhancing teaching and learning methods
4	To understand the learning and resource barriers while handling large classes
5	To identify critical evidence gaps to guide the development

COURSE OUTCOMES

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

CO1.Identify theories and methodologies related to curriculum development and research framework	Remember
CO2.Interpret pedagogical practices in formaland informal classrooms in developing countries	Understand
CO3.Draw a chart on the effectiveness of the pedagogical practices for enhancing teaching and learning methods	Apply
CO4.Explore the learning and resource barriers while handling large classes	Analyze
CO5.Examine critical evidence gaps to guide the development	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	-	-	-	-	-
CO2	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	L	M	-	-	-	-	-	-	-	-	L	L	L	-
CO4	L	S	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	L	S	M	-	-	-	-	-	-	L	-	-	L	L	-

S- Strong; M-Medium; L-Low

SYLLABUS

Unit I

Introduction and Methodology,Aims and rationale, Policy background, Conceptual framework andterminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and searching.

Unit II

Thematic overview: Pedagogical practices are being used by teachers in formaland informal classrooms in developing countries, Curriculum, Teacher education.

Unit III

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the schoolcurriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogicalpractices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Unit IV

Professional development: alignment with classroom practices and followupsupport, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit V

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Text Books/ References Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher educationresearch project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.

COURSE DESIGNERS				
Sl.No	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**

	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTEN SKILLS	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

The main objective of the course is to develop the personality and achieve the highest goal in life so as to lead the nation with mankind and prosperity

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To learn to achieve the highest goal happily
2	To become a person with stable mind, pleasing personality and determination
3	To awaken wisdom in students

COURSE OUTCOMES

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

CO1. Classify the development of versatile personality of students	Understand
CO2. Extract the information from Bhagwad-Geeta to lead the nation and mankind with peace and prosperity	Understand
CO3. Paraphrase the information from Neetishatakam to develop inter-personality skills	Understand
CO4. Articulate the highest goal in life	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2	PSO 1	PSO 2	PSO3
CO1	L	M	-	-	-	-	-	-		-	-	-	-	-	S
CO2	L	M	-	-	M	-	-	-	M	-	-	-	-	-	S
CO3	L	M	-	-	M	-	-	-	M	-	-	-	-	-	S
CO4	L	M	-	-	M	-	-	-	M	-	-	-	-	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

Unit I

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism),Verses- 26,28,63,65 (virtue)

Unit II

Approach to day to day work and duties, Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21,27, 35, Chapter 6-Verses 5,13,17,23, 35, Chapter 18-Verses 45, 46, 48.

Unit III

Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14,15,16,17, 18, Personality of Role model.

Unit IV

Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18- Verses 37,38,63

Unit V

Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's)

Text Books/ References Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE DESIGNERS

Sl.No	Name of the Faculty	Designation	Department	Mail ID