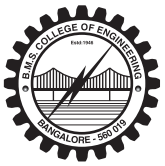

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Scheme and Syllabus

PG Power Electronics

Scheme and Syllabus for I– IV Semester

(2022-2023)

December - 2022

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು–560 019

B.M.S. COLLEGE OF ENGINEERING

Bull Temple Road, Bangalore - 560 019

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

INSTITUTE MISSION

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society

DEPARTMENT VISION

Facilitating the development of competent professionals capable of adapting to the constantly changing global scenario in the field of Electrical Sciences.

DEPARTMENT MISSION

- Impart quality technical education and encourage research in the field of Electrical Sciences.
- Empower every individual to develop as a professional with an ability to apply his/her knowledge and skills to adapt to the evolving technological requirements of society.

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The PEOs of the program are as under:

PEO-1	Excel professionally in Power Electronics and allied domains.
PEO-2	Undertake research and development that addresses technological requirements of Industry and Institutes of higher learning
PEO-3	Adapt to the changing needs of Industry/Society through lifelong learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Programme Outcomes (POs) are as under:

PO-1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO-2	Ability to write and present a substantial technical report/ document.
PO-3	Students should be able to demonstrate a degree of mastery over the areas as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

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Distribution of Credits among various Curricular Components

Curricular Component / Semester	I	II	III	IV	Total
Basic Science Course (BS)	3				3
Engineering Science Course (ES)					
Professional Core Course (PC)	14	11			25
Professional Elective Course (PE)		6	3	3	12
Open Elective Course (OE)	3	3			6
Project/ Mini-Project (PW)		2	7	13	28
Internship (IN)			6		
Humanities and Social Sciences, Management Course (HS)	2				2
Ability Enhancement Course / Mandatory Course(AEC)	2	2			4
Non-Credit Mandatory Course (NCMC)			2	2	4 units
Total Credits	24	24	16	16	80

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HS - Humanities and Social Science Course
BS - Basic Science Course
ES - Engineering Science course
PC - Professional Core
PE - Professional Elective
OE - Open Elective
PW - Project Work
IN - Internship
AEC - Ability Enhancement Course
NCMC - Non credit mandatory course

Typical Structure of Curriculum – M.Tech.

Semester	Institute Core (HS)	Basics of Science (Maths)	Professional Core	Professional Elective	Open Elective	Project/Mini Project	Ability Enhancement Course	Industrial Training/ Internship	Non-credit Mandatory Course	Total Credits
I	2	3	14	-	3	-	2	-	-	24
II	-	-	11	6	3	2	2	-	-	24
III	-	-	-	3	-	7	-	6	02 Unit	16
IV	-	-	-	3	-	13	-	-	02 Unit	16
Total: Credits	02	03	25	12	6	22	4	6	–	80

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Semester-I

Course Type	Code	Course Title	Credits			Total	Hours
			L	T	P		
HS-1	22HSMCICRM	Research Methodology	**2**	**0**	**0**	**2**	**2**
AS-1	22EEPEBSMT	Applied Mathematics	**2**	**1**	**0**	**3**	**4**
PC-1	22EEPEPCPS	Power Semiconductor Devices	**3**	**0**	**0**	**3**	**3**
PC-2	22EEPEPCSP	Solid State Power Converters	**3**	**0**	**1**	**4**	**5**
PC-3	22EEPEPCMS	Modelling and simulation of power electronic systems	**3**	**0**	**1**	**4**	**5**
PC-4	22EEPEPCES	Embedded system design	**3**	**0**	**0**	**3**	**3**
OE-1	22EEPEOERE	Renewable Energy and Photovoltaics	**3**	**0**	**0**	**3**	**3**
	22EEPEOEMS	Micro and Smart Systems					
	22EEPEOEIS	Industrial Safety					
AE-1	22EEPEAEPY	Python Programming		**1**	**1**	**2**	**4**
TOTAL			**19**	**2**	**3**	**24**	**29**

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Semester-II

Course Type	Code	Course Title	Credits			Total	Hours
			L	T	P		
PC-5	22EEPEPCAD	AC-DC drives	**3**	**0**	**1**	**4**	**5**
PC-6	22EEPEPCSM	Switched Mode Power Conversion	**3**	**0**	**1**	**4**	**5**
PC-7	22EEPEPCPW	PWM converters and applications	**3**	**0**	**0**	**3**	**3**
PE-1	22EEPEPEPD	Power Electronics System design using ICs	**3**	**0**	**0**	**3**	**3**
	22EEPEPEPQ	Power quality enhancement using custom power devices					
	22EEPEPEAC	Advanced control systems					
PE-2	22EEPEPEHF	HVDC and FACTS	**3**	**0**	**0**	**3**	**3**
	22EEPEPEPG	Power Electronics in Smart Grid					
	22EEPEPEAN	Microcontrollers					
OE-2	22EEPEOEMC	HVDC and FACTS	**3**	**0**	**0**	**3**	**3**
	22EEPEOEHE	Hybrid Electric Vehicles					
	22EEPEOESC	System-On-Chip and FPGA System Design					
PW	22EEPEPCMP	Mini Project	**0**	**0**	**2**	**2**	**4**
AE-2	22EEPEAEKC	Ki CAD software		**1**	**1**	**2**	**4**
TOTAL			**18**	**1**	**5**	**24**	**30**

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Semester-III

Course Type	Code	Course Title	Credits			Total	Hours
			L	T	P		
PE-2	22EEPEPEEC	Electromagnetic Compatibility	**3**	**0**	**0**	**3**	**3**
	22EEPEPEME	Modelling of Electrical Machines					
	22EEPEPEDS	DSP Applications to drives					
PC-8	22EEPEPCP1	PROJECT PHASE-I	**0**	**0**	**7**	**7**	**14**
PC-9	22EEPEPCIN	INTERNSHIP	**0**	**0**	**6**	**6**	**12**
***NCMC -1**	22EEPENCC1	NC-I (8 Weeks –(MOOC/NPTEL/ Coursera Certification Course in PE Domain)	**0**	**0**	**0**	**0**	**0**
TOTAL			**3**	**0**	**13**	**16**	**29**

* NCMC – Non Credit Mandatory Course

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Semester-IV

Course Type	Code	Course Title	Credits			Total	Hours
			L	T	P		
PE-4	22EEPEPESS	Soft Switching Techniques for Converters	3	0	0	3	3
	22EEPEPEEV	Electric Vehicles					
	22EEPEPEAT	Advanced Control Techniques to Power Electronics					
PC-10	22EEPEPCP2	PROJECT PHASE-II	0	0	13	13	26
*NCMC -2	22EEPENCC2	NC-II (8 – Week Certification Course in Yoga/Music/Dance/ any Interested Domain)	0	0	0	0	0
TOTAL			3	0	13	16	29

Percentage compliance with old (2020) scheme:

Autonomous 2020 curriculum structure:

: 55% (Core +Elective courses)

: 45% (Internship+Projects+Seminar)

Autonomous NEP 2022 curriculum structure:

: 60% (Core +Elective courses)

: 40% (Internship+Projects+AEC)

	Core courses	Elective courses	ICC	IEC	Seminar	Ability Enhancement Course	Internship	Project	Total credits	% Core (Core+ICC)	% Elective (Elective+ IEC)	% Project + Internship + AEC
Autonomous 2020 syllabus	26	16	02	04	02	-	10	28	88	**32%**	**23%**	**45%**
Autonomous 2022 NEP Syllabus	25	12	02 (Basic Science -03)	06	-	04	06	22	80	**37.5 %**	**22.5 %**	**40%**

The percentage core courses in NEP 2022 autonomous scheme is comparatively higher with respect to the old (2020) autonomous curriculum. Percentage of Elective courses offered in proposed PG curriculum is retained approximately similar to the old scheme. In the new NEP curriculum, Ability Enhancement courses (4 credits) are introduced to provide an opportunity for students to learn state-of-the-art skills. Further, mini project work (2 credits) is introduced in order to equip the students to carry out internship (6 credits) and project work (22 credits) in third and fourth semester respectively.

Contribution from other departments : Mathematics (3-0-0)

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CO-PO Mapping Summary table for M. Tech Power Electronics Courses
(with Strength of Mapping)

COURSE TITLE	PO1	PO2	PO3
Research Methodology			3
Applied Mathematics			3
Power Semiconductor Devices			3
Solid State Power Controllers	2	2	3
Modeling & Simulation of Power Electronics Systems	2	2	3
Embedded System Design			3
Renewable Energy and Photovoltaics			3
Micro and Smart Systems			3
Industrial Safety			3
Python Programming		3	3
AC-DC Drives	2	2	3
Switched Mode Power Conversion	2	2	3
PWM converters and applications			3
Power Electronics System design using ICs			3
Power quality enhancement using custom power devices			3
Advanced control systems			3
HVDC and FACTS			3
Power Electronics in Smart Grid			3
Analysis and Design of Artificial Neural Networks			3
Microcontrollers			3

Hybrid Electric Vehicles			3
System-On-Chip and FPGA System Design			3
Mini Project	3	3	3
Ki CAD software		3	3
Electromagnetic Compatibility			3
Modelling of Electrical Machines			3
DSP Applications to drives			3
PROJECT PHASE-I	3	3	3
INTERNSHIP	3	3	3
Soft Switching Techniques for Converters			3
Electric Vehicles			3
Advanced Control Techniques to Power Electronics			3
PROJECT PHASE-II	3	3	3

List of courses introduced in the NEP Syllabus

COURSE TITLE
Python Programming (Ability Enhancement course)
PWM converters and applications (Introduced as core course)
Analysis and Design of Artificial Neural Networks
System-On-Chip and FPGA System Design
Mini Project
Ki CAD software (Ability Enhancement course)
Hybrid Electric Vehicles
Microcontrollers
Soft Switching Techniques for Converters
Electric Vehicles
Advanced Control Techniques to Power Electronics

I Semester Syllabus

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	RESEARCH METHODOLOGY		
Course Code	22HSMCICRM	CIE MARKS	50
Credits	02	SEE MARKS	100
L–T-P	(2:0:0)	EXAM HOURS	03

UNIT I

Meaning and sources of research problem, , Objectives and Characteristics of research – Errors in selecting research problem, Research methods Vs Methodology - Types of research-Criteria of good research – Developing a research plan. **05Hrs**

Teaching - Learning Process	Chalk and talk /PPT Presentation

UNIT II

Investigations of a research problem - Selecting the problem - Necessity of defining the problem – Data collections-analysis- Importance of literature review in defining a problem - Survey of literature -Necessary instrumentations. **05Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT III

How to write paper-conference articles-poster preparation, thesis report writing, inclusion of references, journal reviewing process, journal selection process, filling about journal template, developing effective research proposal-plagiarism-research ethics

05Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT IV

Nature of Intellectual property, IPRs- Invention and Creativity - Importance and Protection of Intellectual Property Rights (IPRs) – procedure for grant of patents and patenting under PCT-types of patents-technological research and innovation- international cooperation on IP. **05Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT V

A brief summary of : Patents-Copyrights-Trademarks, patent rights-licensing and transfer of technology-patent databases-case studies on IPR-Geographical indications-new developments in IPR-protection of IPR rights**.** **05Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

Course outcomes (Course Skill Set):

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

CO1: Able to write and present a substantial technical report/document

CO2: Able to demonstrate a degree of mastery over the area of specialization

TEXT BOOKS

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	An introduction to Research Methodology	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal	RBSA Publishers U.K	2002.
2	An Introduction to Multivariate Statistical Analysis	Anderson, T. W.	Wiley Eastern Pvt., Ltd. New Delhi	
3	Research Methodology: Methods and Techniques	Kothari, C.R.	New Age International	1990, 418p
4	Research Methodology,	Sinha, S.C. and Dhiman, A.K.	Ess Ess Publications	2002, 2

Reference Books:

1	Handbook of Intellectual property law and practise	Subbarau NR	S Viswanathan Printers and Publishing Private Limited	1998

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	APPLIED MATHEMATICS		
Course Code	22EEPEBSMT	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(2:1:0)	EXAM HOURS	03

UNIT - 1

Numerical Methods: Solution of algebraic and transcendental equations- General iteration method, acceleration of convergence, iterative methods based on second degree equation–Muller method, system of non-linear equations and complex roots - Newton-Raphson method, solution of ordinary differential equations - Numerov method. Polynomial equations - Birge – Vieta method and Bairstow's method **05 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Numerical Solution of Partial Differential Equations: Classification of second order equations, parabolic equations- solution of one - dimensional heat equation, explicit method, Crank-Nicolson method and Du Fort-Frankel method, hyperbolic equations-solution of one - dimensional wave equation. **05 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

System of Linear Algebraic Equations: Gauss-Seidal method, **Eigen value problems**: Eigen values and Eigen vectors of real symmetric matrices - Jacobi method, Givens method. **Interpolation:** Hermite interpolation, Spline interpolation. **05Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT –4

Graph Theory: Basic terminologies, types of graphs, sub graphs, graphs isomorphism, connected graphs-walks, paths, circuits, connected and disconnected graphs, operations on graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, applications of graphs. **05Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT- 5

Optimization: Linear Programming - Introduction, Formulation of the problem, Graphical method, General Linear programming problem, Standard form of LPP, Simplex method, Artificial varable technique – M-method. **05Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Apply the concepts of solving polynomial equations, transcendental equations, ordinary differential equations, partial differential equations and non-linear equations for Engineering problems.

CO2 Apply the concepts of system of algebraic equations, graph theory, eigen value problems, interpolation and Optimization to deal with projects.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Numerical Methods for Scientific and Engineering Computations	M K Jain, S R K Iyengar and R K Jain	New Age Internationa Publications	6th Edition, 2012
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
3	Graph Theory with Applications to Engineering and Computer Science	Narsingh Deo	PHI	2012
4	Numerical methods for Engineers	Steven C. Chapra and Raymond Canale	McGraw-Hill Education	7th Edition, 2014

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	POWER SEMICONDUCTOR DEVICES		
Course Code	22EEPEPCPS	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Power Diodes: Basic Structure and I-V Characteristics. Breakdown Voltages and Control. On State Losses, Switching Characteristics. Turn on Transient. Turn off Transient. Reverse Recovery Transient. Schottky Diodes. Snubber Requirements for Diodes and Diode Snubbers. Modelling and simulation of Power Diodes.Numerical problems. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

a) **Thyristors:** - Basic Structure. V-I Characteristics. Turn on Process. On State operation. Turn off process, Switching Characteristics .Turn on Transient and di/dt limitations. Turn off Transient. Turn off time and dv/dt limitations. Ratings of Thyristors. Snubber Requirements and Snubber Design. Modeling and simulation of Thyristors. Numerical problems.

b) **Gate Turnoff Thyristor (GTO):** Basic Structure and Operation. GTO Switching Characteristics. GTO Turn on Transient. GTO Turn off Transient Minimum ON and OFF State times .Maximum Controllable Anode Current Overcurrent protection of GTOs Modeling and simulation of GTOs. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

a) **Power BJTs**: . Basic Structure and I-V Characteristics, Switching Characteristics.

b) **MOSFETs** - Basic Structure . V-I Characteristics. Turn on Process. On State operation. Turn off process. Switching Characteristics Resistive Switching Specifications. Clamped Inductive Switching Specifications - Turn on Transient and di/dt limitations. Turn off Transient Turn off time. Switching Losses. Effect of Reverse Recovery Transients on Switching Stresses and Losses - dv/dt limitations. Gating Requirements Gate Charge - Ratings of MOSFETs. FBSOA and RBSOA

Curves. Device Protection -Snubber Requirements. Modelling and simulation of Power MOSFETS. Applications of MOS devices. Numerical problems.

c) **Insulated Gate Bipolar Transistors (IGBTs):** Basic Structure and Operation. Latch up IGBT Switching Characteristics. Resistive Switching Specifications. Clamped Inductive Switching Specifications - IGBT Turn on Transient. IGBT Turn off Transient- Current Tailing. FBSOA and RBSOA Curves. Switching Losses - Minimum ON and OFF State times - Switching Frequency Capability - Overcurrent protection of IGBTs . Short Circuit Protection. Snubber Requirements and Snubber Design. Applications of IGBT. Numerical problems. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Thermal design of power electronic equipment:

Heat transfer by conduction, transient thermal impedance - heat sinks .Heat transfer by radiation and convection - Heat Sink Selection for Power Semiconductor Devices. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Emerging Trends:

New power semiconductor devices: MOS Gated Thyristors, MOS Controlled Thyristors, emitter turn-off thyristor (ETOs), Integrated Gate Commutated Thyristor (IGCT), Static induction transistor (SIT), Emitter Switched Thyristor. Silicon Carbide, Power Integrated Circuits, New Semiconductor Materials for Power Devices **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Apply knowledge of physics of semiconductor and electronic devices to develop Describe, analyze characteristics and compare various types of power semiconductor devices to control power electronic systems.

CO2 Identify and prioritize the use of power devices along with the concept of

thermal design for various power electronic equipment's in various power electronic systems and control applications.

CO3 Develop skills and apply the principles to explore the possibility of emerging power semiconductor devices in different areas and prepare a technical report.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics Converters, Applications, and Design.	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt Ltd, 2011.	3rd Edition. 2004
2	Power Electronics: Circuits, Devices, and Applications	M.H. Rashid	Prentice Hall	3rd Edition.
3	Semiconductor Device Modeling with Spice,	G. Massobrio, P. Antognetti	McGraw-Hill	2nd Edition, 2010
4	Power Semiconductor Devices	B. Jayant Baliga	PWS Publication	1st Edition, 1995

Reference Books

1	NPTEL: Electrical Engineering - Power Electronics – for Power Semiconductor Devices	nptel.ac.in/ downloads/ 108105066/		
2	Discrete and Integrated Power Semiconductor Devices: Theory and Applications	Benda, J. Gowar, and D. A. Grant	John Wiley &Sons	1999.

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Course Title	SOLID STATE POWER CONVERTERS		
Course Code	22EEPEPCSP	CIE MARKS	50
Credits	04	SEE MARKS	100
L–T-P	(3:0:1)	EXAM HOURS	03

UNIT - 1

Diode Rectifiers: Half wave rectifier with R load, R-L load and capacitor filter, single phase full wave rectifier with R load, RL load, Capacitor filter, LC filter, Effect of source inductance, three-phase rectifier

Controlled Converters: Single phase full converter with R load, RL load (continuous and discontinuous current modes) , three phase fully controlled converter, **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT - 2

DC-DC Converters: Principle of operation, analysis of step-down and step-up converters, classification of chopper & chopper circuit design.

AC-AC Converters: AC Voltage Controllers, Cyclo-converters **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT - 3

Inverters: Principle of operation, performance parameters, single phase bridge inverters and three phase inverters. Voltage Control of Single Phase Inverters: Single/multiple, pulse/SPWM/ modified SPWM methods, voltage control of three phase inverter, SPWM/third harmonic PWM, harmonic reduction, current source inverter, comparison between VSI & CSI. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT - 4

Multilevel Inverters: Introduction, types, diode clamped, flying capacitor, cascaded multilevel inverters, features & applications. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT - 5

Power factor improvement methods: Power factor improvement in controlled converters, Generation of current harmonics in utility, need for improved utility interface, Improved single phase and three-phase utility interface, design of active front end converter **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

Lab experiments:

Experimental and simulation studies on

- Converters
- Inverters and
- Choppers

Course outcomes (Course Skill Set):

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

CO1 Interpret the working principles of AC- DC, DC-DC, AC-AC and DC-AC converters

CO2 Analyze and evaluate the performance of AC- DC, DC-DC, AC-AC and DC-AC converters in all the modes of operation.

CO3 Identify and design a power converter based on the application

CO4 Conduct experiment / simulation studies on single phase and three phase power electronic converters and prepare a technical report.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt Ltd,	3rd Edition, 2011
2	Power Electronics: Circuits Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011

Reference Books

1	Power Converter,	William Shepherd, Li Zhang	Circuits Marcel Dekker Inc.	2004
2	Modern Power Electronics & AC Drives	B. K. Bose	PHI	2012

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS		
Course Code	22EEPEPCMS	CIE MARKS	50
Credits	04	SEE MARKS	100
L–T-P	(3:0:1)	EXAM HOURS	03

UNIT - 1

Modeling of Systems: Input-Output relations, differential equations and linearization, state space representation, transfer function representation, modeling of an armature controlled DC Motor, poles and zeroes circuit averaging method of modeling approach for switched power electronic circuits. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation,

UNIT - 2

Control System Essentials: Representation of system in digital domain, Z transform, Mapping between s- plane and Z- plane, Continuous to Discrete domain conversion, Hold equivalence **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation,

UNIT - 3

Digital Controller Design: Controller design techniques, Bode diagram method, PID controller, design, root locus method, state space method.Controlling voltage- Flyback converter Controlling current-Unity Power Factor converter, Single phase Front End Converter **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation,

UNIT - 4

Discrete Computation Essentials: Numeric formats, fixed -point numeric format, floating -point numeric format, tracking the base point in the fixed point system, addition of numbers, subtraction of numbers, multiplication of numbers, normalization and scaling, multiplication algorithm, arithmetic algorithm reciprocal, square root, sine and cosine exponential. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Implementation examples: PI controller, sine and cosine, pulse width modulation

09 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation,

Lab experiments:

- Modeling using state space representation, transfer function representation of a system.
- Modeling of an armature controlled DC motor
- Modeling of a Buck converter
- Three phase to two phase transformations
- Modeling of three phase Induction motors
- Controllers design techniques – Bode and root locus method
- PID controllers for voltage and current control

Course outcomes (Course Skill Set):

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

CO1 Apply mathematical skills and modelling methods to represent a physical system.

Co2 Design, develop and analyze the performance of digital controllers and various Power Electronics circuits.

CO3 Develop various Power Electronics circuits using modern engineering software tools and prepare a technical report.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics Converters, Applications, and design	Ned Mohan, Tore M. Undel and, William P. Robbins	John Wiley & Sons	3rd Edition, 2009
2	Power Electronics Essentials and Applications	L. Umanand	John Wiley & Sons	1st Edition, 2009.

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	EMBEDDED SYSTEM DESIGN		
Course Code	22EEPEPCES	CIE MARKS	50
Credits	03	SEE MARKS Total MARKS	50 100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction to Embedded System: An embedded system, processor, hardware unit, software embedded into a system, example of an embedded system, OS services, real time and embedded OS. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT - 2

Processor and Memory Organization: Structural unit in a processor, processor selection for an embedded systems, memory devices, memory selection for an embedded system, allocation of memory to program segments and blocks, and direct memory accesses. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT - 3

Real Time System: Types, real time computing, design issues, ARM system architecture, high performance processors - strong ARM processors, addressing modes, instruction set, and few basic assembly language programs. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT - 4

Real Time Operating System: Fundamental requirements of RTOS, real time kernel, schedulers, various scheduling modules, latency (interrupt latency, scheduling latency and context switching latency), tasks, state transition diagram, task control block. Inter-task communication and synchronization of tasks. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT - 5

Building real time applications. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

Course outcomes (Course Skill Set):

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

CO1 Apply the basic concepts and design an embedded system for real time applications

CO2 Evaluate and select a high performance processor to develop a real time system.

CO3 Present and prepare a technical report for a specific real time embedded system

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Embedded System Architecture: Programming & Design	Rajkamal	TMH	2010.
2	An Embedded Software Primer	David E. Simon	Pearson Education	1990,
3	Real-Time Systems Design and Analysis- An Engineer's Handbook	Philip. A. Laplante	Pearson	2nd Edition

Reference Books

1	Embedded Real Time Systems: Concepts Design and Programming	K.V.K K Prasad	Dreamtech Press New Delhi	2003
2	Real-Time Systems	Jane W.S. Liu	Pearson Education Inc	2012

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	RENEWABLE ENERGY & SOLAR PHOTOVOLTAICS SYSTEM		
Course Code	22EEPEOERE	CIE MARKS	50
Credits	03	SEE MARKS Total MARKS	50 100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction: Energy sources and their availability, commercial or conventional energy sources- thermal, hydro and nuclear, renewable energy sources, Concept of co-generation, prospects of renewable energy sources. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.

UNIT - 2

Physics of Photovoltaic Systems: Review of diodes, construction, p-n junction, solar cell manufacturing process, photo voltaic effect, equivalent circuit model of PV cells, characteristic of diode, I-V and P-V characteristics, solar cell efficiency, fill factor, shading effect on cell and module, effect of temperature on PV cell characteristics, classification of solar cells. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT - 3

Solar energy conversion and solar thermal: Solar radiation and measurements, solar constant, basic sun earth angles-definitions and their representation, solar thermal system, physical principles of the conversion of solar radiation into heat, flat plate collectors: construction, principle of operation and applications. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT - 4

Solar electric system: Basics of converters, simplified model of battery, Charge controllers, Maximum power point tracking, design of roof top solar PV systems, inverter types and plant design, standalone photo voltaic systems, economic analysis of PV systems. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT - 5

Application of solar energy and photovoltaic: Solar water pumping system, solar water heating, rural electrification, grid integration, different topologies for single phase and three phase grid integration, future developments. **08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

Course outcomes (Course Skill Set):

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

CO1 Acquire in depth knowledge about different types of renewable & non-renewable sources, the physics of photovoltaic systems, fabrication of solar photovoltaic system, application of solar energy system, MPPT concept and grid integration.

CO2 Apply knowledge of mathematics to solve problems related to semiconductor physics, solar radiation, basic sun earth angles, and economic aspects of PV systems. Design of charge controller, cells & modules for roof top PV systems.

CO3 Learn and explain in the form of presentation and report about different renewable and non-renewable energy sources.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Non- Conventional Energy Sources	G.D. Rai	Khanna publishers.	
2	Solar Cells from Basics to Advanced Systems	Chenming Hu and R.M. White	McGraw Hill Book Co.	
3	Non-Conventional Energy Resources	B.H. Khan	Tata MsGraw Hill Education Private Limited	

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	MICRO & SMART SYSTEMS		
Course Code	22EEPEOEMS	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction and Scaling effects in microsystems: Review of material science, Microsystem versus MEMS, smart materials, structures and systems, integrated microsystems, applications of smart materials and microsystems. Scaling in the mechanical domain, electrostatic domain, magnetic domain, thermal domain, scaling in diffusion, scaling in fluids, scaling effects in the optical domain, scaling in biochemical phenomena. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Micromachining Technologies: Silicon as a material for micromachining, vacuum pumps, thin film deposition, ion implantation, lithography, etching, silicon micromachining, specialized materials for micro systems, advanced processes for micro fabrication. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 3

Micro Sensors, Actuators, Systems and Smart Materials: Silicon Capacitive Accelerometer, piezoresistive pressure sensor, conductometric gas sensor, electrostatic comb drive, magnetic microrelay, portable blood analyzer. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 4

Characterization techniques: Introduction, film thickness, scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-Ray diffraction (XRD), X-ray energy dispersive analysis (EDX). **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Electronic Circuits and Control for Micro and Smart Systems: Practical signal conditioning circuits for microsystems, circuits for conditioning sensed signals, introduction to control theory, implementation of controllers. Integration of microsystems and microelectronics, microsystems packaging, case studies of integrated microsystems.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Course outcomes (Course Skill Set):

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

CO1 Understand the concept of sensors and actuators, micromachining technologies, deposition techniques, lithography and integration of microsystems.

CO2 Acquire in depth knowledge on characterization techniques like SEM, XRD and TEM and further analyse different electronic circuits used to control micro systems.

CO3 Demonstrate in the form of presentation and report about the effects of scaling in different domain in Micro Systems.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Micro and Smart Systems	G V.K. Aatre., K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat	Wiley- India.	
2	Materials Science of Thin Films"	Milton Ohring	ELSEVIER	2nd Edition, 2012.
3	MEMS Lecture Series (CDS) by Shanthiram Kal.			

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	INDUSTRIAL SAFETY		
Course Code	22EEPEOEIS	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 2

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 3

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 4

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 5

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Maintenance Engineering Handbook	Higgins & Morrow,	Da Information Services.	
2	Maintenance Engineering	H. P. Garg	S. Chand and Company	
3	Pump-hydraulic Compressors	Audels	Mcgrew Hill Publication.	
4	Foundation Engineering Handbook	Winterkorn, Hans	Chapman & Hall London	

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	Python Programming		
Course Code	22EEPEAEPY	CIE MARKS	50
Credits	02	SEE MARKS	100
L–T-P	(0:1:1)	EXAM HOURS	03

Course Overview

Introduction to programming basics (what it is and how it works), binary computation, problem-solving methods and algorithm development. Includes procedural and data abstractions, program design, debugging, testing, and documentation. Includes data types, control structures, functions, parameter passing, library functions, arrays, inheritance and object oriented design. Laboratory sessions using Python.

CO1: Acquire programming skills in Python and develop the ability to write and debug the Python code.

CO2: Apply the knowledge of Python programming for various applications.

CO3: Design Python programs to solve real time problems.

II Semester Syllabus

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	AC - DC DRIVES		
Course Code	22EEPEPCAD	CIE MARKS	50
Credits	04	SEE MARKS	100
L–T-P	(3:0:1)	EXAM HOURS	03

UNIT - 1

Electric Drives: Introduction – block diagram-classification of electrical drives-choice of electrical drives-fundamental torque equation- components of load torque- steady state stability. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT - 2

DC Drives: Single Quadrant Drive: 1-Phase semi and half wave converter drives, Two quadrant Drive: 1phase and 3-phase full converter drive. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT - 3

Two and Four Quadrant drive: 1-phase and three- phase dual converter drive, different braking methods and closed loop control of DC drives. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

AC Drives: Voltage and current source inverter - inverter control-six step and PWM operation, Control of Induction motor drive -V/f and field oriented control – direct and indirect vector control, voltage and current source inverter fed induction motor drives, stator and rotor voltage control methods, slip energy recovery drives. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Closed Loop Control of AC Drives: Stator voltage control, V/f control, Slip regulation, speed control of static Kramer's drive, current control, brushless DC motor, stepper motor and variable reluctance motor drives, Applications of AC drives, Synchronous motor drives. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

Lab experiments:

Experimental/Simulation studies on

- Converter fed separately excited DC drives
- Chopper drives
- Speed control of 3 phase Induction motor
- Chopper/Inverter Circuit design using TL 494 CHIP.
- Chopper/Inverter Circuit design using SG 3524 CHIP.
- Recent IEEE paper review, analysis and simulation study of concept
- presented in the paper followed by presentation and report submission.

Course outcomes (Course Skill Set):

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

CO1 Analyze and choose the appropriate converter topology for different AC-DC drives circuits.

CO2 Develop simulation models for AC-DC drives systems prescribed in the curriculum.

CO3 Apply design tools to conduct experiments, compare and analyze the hardware results with that of simulation results and prepare a technical report.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Power Electronics & AC Drives	Bose B. K	PHI	2011
2	Thyristor Control of AC Motors,	Murphy JMD, Turnbull F.G.,	Pergamon Press Oxford	1998
3	Electric Motor Drives	R. Krishanan	PHI	2010

Reference Books

1	High Performance Control of AC Drives	Haitham Abu - Rub, AtifIqbal, Jaroslaw Guzinski	Wiley,	2012
2	Power Electronics, Circuits, Devices & Applications	M.H Rashid	PHI, New Delhi	Third Edition, 2004.

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	SWITCHED MODE POWER CONVERSION		
Course Code	22EEPEPCSM	CIE MARKS	50
Credits	04	SEE MARKS	100
L–T-P	(3:0:1)	EXAM HOURS	03

UNIT - 1

DC – DC Converters (Non isolated Converters): Principle of operation and analysis of buck converter analysis, inductor current ripple and output voltage ripple, capacitor resistance effect, synchronous rectification, design considerations, buck converter for discontinuous current operation, principle of operation and analysis of buck-boost converter analysis, inductors current ripple and output voltage ripple, design considerations, buckboost converter for discontinuous current operation, principle of operation and analysis of CUK converter , inductor current ripple and output voltage ripple, capacitor resistance effect, design considerations, single ended primary inductance converter (SEPIC). **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.

UNIT - 2

Isolated Converters: Introduction, transformer models, principle of operation and analysis of fly back converter-continuous and discontinuous current mode of operation, design considerations, principle of operation and analysis of forward converter, design considerations, double ended(Two switch) forward converter, principle of operation and analysis of push-pull converter, design considerations, principle of operation and analysis of full bridge and half-bridge DC-DC converters, design considerations, current fed converters, multiple outputs. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.

UNIT - 3

Control of DC-DC Converter: Modeling of DC-DC converters, power supply control, control loop stability, small signal analysis, switch transfer function, filter transfer function, PWM transfer function, Type-2 error amplifier with compensation, design, Type-3 error amplifier with compensation, design. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.

UNIT - 4

Resonant Converters: Introduction, resonant switch ZCS converter, principle of operation and analysis, resonant switch ZVS converter, principle of operation and analysis, series resonant inverter, series resonant DCDC converter, parallel resonant DC-DC converter, series- parallel resonant DC-DC converter, resonant converters comparison, resonant DC link converter. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.

UNIT - 5

Introduction on design of Inductors and transformers: Design of inductor for Buck converter and transformer design for Forward converter as case studies.

Design of power supplies to meet the specifications: Input filter, bulk capacitor and hold-up time, Limiting inrush current, ESR considerations, EMI considerations **08 Hrs**

Lab experiments:

Experimental/Simulation studies on

- Buck converter
- Boost converter
- Buck/Boost converter for CCM & DCM mode
- Flyback and forward converter
- Resonant converter

Course outcomes (Course Skill Set):

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

CO1 Illustrate the working of DC-DC converters.

CO2 Analyse and evaluate the performance of basic and derived switched mode power converters.

CO3 Design magnetic components for high frequency SMPS and submit a report.

CO4 Conduct experiment/simulation studies on basic converters and derived converters for CCM/DCM operation and prepare a technical report.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics	Daniel W Hart	Tata McGraw Hill	2011
2	Power Electronics – Circuits, Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011
3	DC-DC Switching Regulator Analysis	D M Mitche	McGraw-Hill Ltd1	l988

Reference Books

1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt. Ltd	3rd Edition, 2010
2	Design of Magnetic Components for Switched Mode Power Converters	Umanand L and Bhatt SR	NewAge International, New Delhi,	2011

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	PWM Converters and Applications		
Course Code	22EEPEPCPW	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

AC/DC and DC/AC Power Conversion: Overview of applications of voltage source converters **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

PWM Techniques: Pulse modulation techniques for I – phase bridges, bus clamping PWM, space vector based PWM, advanced PWM techniques. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Loss Calculations: Practical devices in converters, calculation of switching and conduction losses, compensation for dead time and DC voltage regulation. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Modeling: Dynamic model of PWM converters; constant V/F induction motor drives; estimation of current ripple and torque ripple in inverter fed drives. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Electric Utility application of Converters: STATIC var Compensators, Interconnection of energy storage systems for utility load levelling, wind and small Hydro interconnections **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Develop and analyze various PWM Techniques for converters

CO2 Analyze & estimate the various losses in converters**.**

CO3 Model the PWM Converters and Induction motor drives

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics: Converter, Applications and Design	Mohan, Undeland and Robbins	Wiley India	2011
2	Fundamentals of Power Electronics	Erickson RW	Chapman Hall	1997
3	NPTEL lectures by Dr. G. Narayanan, Department of EE, IISc, Bangalore			

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	POWER ELECTRONICS SYSTEM DESIGN USING ICs		
Course Code	22EEPEPEPD	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Switching Regulator Control Circuits: Introduction, isolation techniques of switching regulator systems, PWM systems. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.

UNIT - 2

Switching Power Supply Ancillary, Supervisory & Peripheral Circuits and Components: Introduction, Opto-couplers, self-biased techniques used in primary side of reference power supplies, Soft/Start in switching power supplies, current limit circuits, over voltage protection, AC line loss detection, Implementation of different gating circuits. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.

UNIT - 3

Microcontroller and Digital ICs for control of Power Electronic Systems: Microcomputer control of Power Electronic Systems, Digital vs Analog control, Real time control using Microcomputer, Advanced Microprocessor and DSP based control of P. E Systems, ASICs for control, Digital control using FPGA & PLDs, Design of Microprocessor based Control Systems, Application examples. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.

UNIT - 4

Commercial PWM Control ICs and their Applications: TL 494 PWM Control IC, UC 1840 Programmable off line PWM controller, UC 1524 PWM control IC, UC 1846 current mode control IC, UC 1852 resonant mode power supply controller. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.

UNIT - 5

Programmable Logic Controllers (PLC): Basic configuration of a PLC, Programming using Ladder diagram for PLC, program modification, power plant control using PLCs.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.

Course outcomes (Course Skill Set):

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

CO1 Design high performance power electronic circuits using different ICs for various applications.

CO2 Design a Power Electronic System using Microcomputer and DSP Control.

CO3 Think laterally and originally to solve power electronic circuits, and evaluate problems for Practical switching power supplies.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Thyristorised Power Controllers	G. K. Dubey, S. R. Doradla, A. Johsi, and R. M. K. Sinha	New Age International	2nd Edition, 2010.
2	High Frequency Switching Power Supplies	Chryssis	MGH	2nd Edition, 1989
3	Unitrode application notes:		http://www.smps.us/Unitrode.html'	

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES		
Course Code	22EEPEPEPQ	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction and Characterization of Electric Power Quality: Electric Power Quality, Power Electronic applications in Power Transmission Systems, Power Electronic applications in Power Distribution Systems. Power Quality terms and Definitions, Power Quality Problems.

Analysis and Conventional Mitigation Methods: Analysis of Power Outages, Analysis of Unbalance, Analysis of Distortion, Analysis of Voltage Sag, Analysis of Voltage Flicker, Reduced Duration and Customer impact of Outages, Classical Load Balancing Problem, Harmonic Reduction, Voltage Sag or Dip Reduction. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Custom Power Devices: Introduction, Utility-Customer Interface, Custom Power Devices, Custom Power Park, Status of Application of CP Devices, Closed-Loop Switching Control, Second and higher order Systems. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Solid State Limiting, Breaking and Transferring Devices: Solid State Current Limiter, Solid State Breaker, Issues in Limiting and Switching operations, Solid State Transfer Switch, Sag/Swell Detection Algorithms. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Generation of Reference Parameter : Generating Reference Currents Using Instantaneous PQ Theory, Generating reference currents using instantaneous Symmetrical Components, General Algorithm for generating reference currents, Generating Reference currents when the Source is Unbalanced. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Active Power Filters: Series Active Filter**,** Shunt Active Filter, UPQC Configurations, Right-Shunt UPQC Characteristics, Left-Shunt UPQC Characteristics, Structure and Control of Right-Shunt UPQC, Structure and Control of Left-Shunt UPQC. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Analyze the Power quality issues and concerns of the country.

CO2 Identify the type of Power quality problems with reference to IEEE/IET standards.

CO3 Analyze, evaluate and realize the control techniques for power quality problems.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Quality Enhancement Using Custom Power Devices	Arindam Ghosh et.al	Kluwer Academic Publishers	2002
2	Understanding Power Quality Problems, Voltage Sags and Interruptions	Math H J Bollen	Wiley India	2011

3	Electrical Power Systems Quality	Roger C Dugan, et.al	TMH	3rd Edition, 2012
4	Electrical Power Quality	G T Heydt	Stars in Circle Publications	1991

Reference Books

1	Power Quality in Power System and Electrical Machines	Ewald F Fuchs,et. el	Academic Press, Elsevier	2009
2	Power Quality	C. Shankaran	CRC Press	2013
3	Power Quality in Power System and Electrical Machines	Ewald F Fuchs, et. el	Academic Press, Elsevier	2009

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	ADVANCED CONTROL SYSTEM		
Course Code	22EEPEPEAC	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Digital Control Systems: Review of difference equations and Z - transforms, Z- transfer function (Pulse transfer function), Z - Transforms analysis, sampled data systems.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Stability analysis (Jury's Stability Test and Bilinear Transformation), pulse transfer functions and different configurations for closed loop discrete-time control systems.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Modern Control Theory: State model for continuous time and discrete time systems, solutions of state equations (for both continuous and discrete systems), concepts of controllability and observability (for both continuous and discrete systems), pole placement by state feedback (for both continuous and discrete systems), full order and reduced order observes (for both continuous and discrete systems), dead beat control by state feedback.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Optimal control problems using state variable approach, state regulator and output regulator, concepts of model reference control systems, adaptive control systems and design.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Non Linear Control Systems: Common nonlinearities, singular points, stability of nonlinear systems - phase plane analysis and describing function analysis, Lyapunov's stability criterion, Popov's criterion. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Create state models for continuous and discrete time systems

CO2 Identify appropriate techniques to analyze both continuous and discrete systems for controllability and observability

CO3 Apply relevant concepts to design continuous and discrete systems with state feedback to meet the specifications.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Control Engineering	Ogata. K	PHI	5th Edition, 2010.
2	Discrete Time Control Systems	Ogata K	PHI	2nd Edition, 2011
3	Control Systems Engineering	Nagarath and Gopal	New Age International Publishers	2012
4	Modem Control System Theory	M Gopal	New Age International	20011

Reference Books

1	Digital Control & State Variable Methods	M Gopal	TMH	20011

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	HVDC & FACTS		
Course Code	22EEPEPEHF	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction: Basics of power transmission networks - control of power flow in AC - transmission line- flexible AC transmission system controllers – application of FACTS controllers in distribution systems. Analysis of uncompensated AC Line – passive reactive power compensation - compensation by a series capacitor connected at the midpoint of the line; shunt compensation connected at the midpoint of the line; comparison between series and shunt capacitor.

Static Var Compensator: Analysis of SVC - Configuration of SVC- SVC Controller **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 2

Static Synchronous Compensator (STATCOM): Introduction - principle of operation of STATCOM - a simplified analysis of a three phase six pulse STATCOM; multi-pulse converters control of type I Converters - Multilevel Voltage Source Converters; Applications of STATCOM.

Unified Power Flow Controller (UPFC) – Introduction, Operation of a UPFC, Control of series and shunt converters. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 3

Custom Power Devices: Introduction, Active filters.

Dynamic Voltage Restorer: Introduction, Dynamic voltage restoration, Open loop controller for DVR. **Load Compensation and DSTATCOM:** Introduction, Compensation using DSTATCOM for a three phase three wire system, Expression for current and power components using Phase coordinates. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 4

DC Power Transmission Technology: Introduction, comparison with AC transmission, application of DC transmission, description of DC transmission system, modern trends in DC transmission, operating problems.

HVDC Converters: Analysis of 6 pulse Graetz bridge converter without overlap, effect of smoothing reactor, Analysis of 6 pulse converter in two and three, and three and four valve conduction modes, Analysis of a twelve pulse converter.

Voltage sourced converter based HVDC: Two and Three level voltage source converters, Pulse Width Modulation, HVDC transmission based on Voltage Source Converters. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 5

Converter and HVDC system control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Power control, Control of Voltage Source Converter.

Harmonics and filters: Characteristics and Non characteristics harmonics (Excluding derivation), Design of AC filters: criteria of design, single tuned passive AC filter, passive DC filters.

Multi Terminal DC Systems: Introduction, applications, types. Basic concepts of Multi-infeed DC systems **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation,

Course outcomes (Course Skill Set):

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

CO1 Develop shunt, series compensators for a transmission and distribution system

CO2 Design various types of converters, controllers and filters for HVDC systems and FACTS.

CO3 Analyze the effects of FACTS controllers on Transmission and Distribution systems.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems	Narain G Hingorani and L. Gyugyi	Wiley India	2011
2	Direct Current Transmission	E.W. Kimbark	Wiley Inter-Science, London	Vol.1, 2006.
3	Multilevel converters for Industrial applications	Sergio Alberto Gonzalez Santiago Andres Verne Maria Ines Valla (z-lib.org)		

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	POWER ELECTRONICS IN SMART GRID		
Course Code	22EEPEPEPG	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction: Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, fundamental problems of electrical power systems, attributes of the smart grid, alternate views of a smart grid. Power quality and EMC, power quality issues, monitoring, legal and organizational regulations, mitigation methods, and EMC related phenomena in smart system. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

High frequency AC Power Distribution Platforms: High frequency in space application, high frequency in telecommunications, high frequency in automotive and motor drives, high frequency in micro grids, future prospects. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Integration of Distributed Generation with Power System: Distributed generation past and future, interconnection with a hosting grid, integration and interconnection concerns, distributed generation contribution to power quality problems and current challenges, power injection principle, injection using static compensators and advanced static devices. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Active Power Controllers: Dynamic static synchronous controllers, D – STATCOM, Dynamic static synchronous series controllers, dynamic voltage restorer, AC/AC voltage regulators. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Aenergy Storage Systems: Introduction, structure of power storage devices, pumped – storage hydroelectricity, compressed air energy storage system, flywheels, battery storage, hydrogen storage, super conducting magnet energy storage, super capacitors, applications of energy storage devices. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Acquire in-depth knowledge about smart grid, power quality problems, high frequency AC power distribution platforms, distributed generation and their integration with existing grid and importance of energy storage system in smart grid.

CO2 Analyse process of installation and operation of different active power controllers in smart grid network

CO3 Learn and explain in the form of presentation and report about different components and recent advancement in smart grid.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics in Smart Electrical Energy Networks	Strzelecki Benysek	Springer	2008
2	The Smart Grid: Enabling Energy Efficiency and Demand Side Response	Clark W Gellings	CRC Press	2009

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	ANALYSIS AND DESIGN OF ARTIFICIAL NEURAL NETWORK		
Course Code	22EEPEPEAN	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector

Quantization, Adaptive Patter Classification **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm Hopfield Models – Hopfield Models, restricted boltzmen machine. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Create different neural networks of various architectures both feed forward and feed backward.

CO2 Perform the training of neural networks using various learning rules.

CO3 Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Artificial neural network.	B. Yegnanarayana	PHI Publication	
2	Neural networks, Fuzzy logic and Genetic Algorithms	S. Raj sekaran, Vijayalakshmi Pari		
3	Artificial neural networks: An Introduction	Kevin L. Priddy, Paul E. Keller	SPIE Press	2005
4	Fundamentals of artificial neural networks	Mohammad H. Hassoun	MIT Press	1995

Reference Books

1	Journal of Artificial neural networks		Ablex Publishing corporation	Volume 1 –, 1994
2	Artificial neural network: Electronic Implementations	Nelson Morgan	IEEE Press	1990

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	MICROCONTROLLERS		
Course Code	22EEPEOEMC	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction to Microprocessors, 8 bit and 16 bit Microcontrollers, 8096 Microcontroller, 8096 Features and Architecture, Memory Organization, Special Function Registers, Pins and Signals, Clock, Input/Output Ports, CPU Structure and Architecture, I/O ports, Functional block-diagram and Units. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 2

8096 INSTRUCTION SET AND PROGRAMMING: Introduction, Programmer's Model of the 8096, Arithmetic Group, Logical Group, Shift Group, Branch Group, Stack Group, Special Control Group, Other Instructions, Example programs **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 3

PROGRAMMING OF THE 8096 RESOURCES: I/O Control Registers, I/O Status Registers, Timers, Serial Input/Output, Multiprocessor Communications, Analog-to-Digital-Converter, Watchdog Timer. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 4

TIMERS, INTERFACING and INTERRUPTS: Memory Interfacing, I/O Interfacing, Interrupts, Example Programs **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 5

8096 MICROCONTROLLER-BASED SYSTEM DESIGN-CASE STUDIES: Various Case

studies for sustainable development **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Course outcomes (Course Skill Set):

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

CO1 Analyze and apply the knowledge of instructions and programming model of 8096 to develop programs.

CO2 Design a system by interfacing 8096 to external memory, I/O devices, and external devices.

CO3 Develop a suitable programming model for addressing societal and environmental challenges through various case studies.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Microprocessors and microcontrollers : architecture, programming and system design 8085, 8086, 8051,8096	Krishna Kant	PHI Learning	
2	8096: 16-bit Microcontroller Architectural Specification and Functional Description	Intel Corporation		
3	Intel Application note & data sheet			
4	Design with Microcontrollers	Design with Microcontrollers	Mc.Graw -Hill International Ed.	

Reference Books

1	Microprocessors and Interfacing —Programming and Hardware	Douglas, V. Hall	Tata McGraw-Hill	
2	Embedded Controllers and Processors Vol. I and Vol. II		Intel Corporation, Santa Clara.	

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	HYBRID ELECTRIC VEHICLES		
Course Code	22EEPEOEHE	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Environmental impact and history of modern transportation: Air pollution, global warming, importance of different transportation, history of electric vehicles. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 2

Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives (Only Block Diagram Approach), Basic converters for battery charging.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Super capacitors. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 5

Fundamentals of HEV and PHEV:

Types of HEV, series hybrid vehicle, parallel hybrid vehicle

Introduction to PHEVs: PHEV architectures, equivalent electric range of blended PHEVs, fuel economy of PHEVs, power management of PHEVs, HEV to PHEV conversions, vehicle to grid technology **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Course outcomes (Course Skill Set):

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

CO1 Acquire in depth knowledge of the electric vehicle system and its components and various modes of operation.

CO2 Estimate and analyze the performance parameters of an electric vehicle under different conditions of operation.

CO3 Analyze various energy storage technologies used in electric vehicles

CO4 Present a technical report on modelling and operation of Electric vehicles.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals,	M. Ehsani, Y. Gao, S. Gay and Ali Emadi	CRC Press	2005
2	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	2003

Reference Books

1	Energy Management Strategies for Electric and Plug-in Hybrid Electric	Sheldon S. Williamson	Springer	2013
2	Modern Electric Vehicle Technology	C.C. Chan and K.T. Chau	Oxford University	2001

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	SYSTEM-ON-CHIP AND FPGA SYSTEM DESIGN		
Course Code	22EEPEOESC	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction to the System Approach:

Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Processors

Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 2

Memory Design for SOC

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 3

Interconnect Customization and Configuration:

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration

Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 4

Verilog Modelling of Combinational and Sequential Circuits: Behavioral, Data Flow and Structural Realization – Adders – Multipliers- Comparators - Flip Flops - Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO –Single port and Dual port RAM – Pseudo Random LFSR – Cyclic Redundancy Check. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT - 5

Synchronous Sequential Circuit: State diagram-state table –state assignment-choice of flipflops – Timing diagram –One hot encoding Mealy and Moore state machines – Design of serial adder using Mealy and Moore state machines - State minimization – Sequence detection- Design examples: Sequence detector, Serial adder, Vending machine using One Hot Controller. System Design Examples using Xillinx FPGAs – Traffic light Controller, Real Time Clock -Interfacing using FPGA **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Course outcomes (Course Skill Set):

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

CO1 Identify various SoC design structures.

CO2 Realize SoC system design models in computation, co design and prepare a technical report.

CO3 Design FPGA based systems

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer System Design System-on-Chip	Michael J. Flynn and Wayne Luk,	Wiley India Pvt. Ltd.	
2	ARM System on Chip Architecture	Steve Furber	Addison Wesley Professional	2nd Edition, 2000
3	The Design Warriors's Guide to FPGAs	Clive Maxfield	Elsevier	2004
4	FPGA Based System Design	Wayne Wolf	Prentices Hall, Modern Semiconductor Design Series	

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	MINI PROJECT		
Course Code	22EEPEPCMP	CIE MARKS	50
Credits	02	SEE MARKS	100
L–T-P	(0:0:2)	EXAM HOURS	03

Course outcomes:

CO1: Carry out literature survey from reputed journal/conference publications, and formulate a complex engineering problem.

CO2: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components.

CO3: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation /analytical studies, carry out projects leading to a logical solution.

Co4: Design a system/system component, simulate and test its functioning as a solution to a complex engineering problem.

CO5: Present the work carried out before the expert committee.

CO6: Prepare the Mini-Project report.

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	KiCAD Software		
Course Code	22EEPEAEKC	CIE MARKS	50
Credits	02	SEE MARKS	100
L–T-P	(0:1:1)	EXAM HOURS	03

Syllabus:

1. Introduction to KiCad ,
2. KiCad Workflow overview, Forward and backward annotation,
3. Draw electronic schematics, Bus connections in KiCad,
4. Layout printed circuit boards Using Pcbnew, Generate Gerber files Using GerbView,
5. Make schematic components in KiCad, Export, import and modify library, Make schematic components with quicklib, make a high pin count schematic component, Make component Using Footprint Editor.

Course outcomes (Course Skill Set):

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

CO1 To familiarize KiCAD software for circuit rig up and simulation

CO2 To analyse electrical circuits using KiCAD software

CO3 To design various electrical circuit and construct PCB layout

III Semester Syllabus

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	ELECTROMAGNETIC COMPATIBILITY		
Course Code	22EEPEPEEC	CIE MARKS	50
Credits	02	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Review of EMI Theory: Sources of EMI, noise pick up modes and reduction techniques for analog circuits. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Emissions and Reduction Techniques: Use of co-axial cables and shielding of signal lines, conducted and radiated noise emission in power electronic equipment and reduction techniques. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

EMI induced failure mechanisms for power electronic equipment, EMC in design of digital circuits **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Electrostatic Discharge: ESD and switching interference reduction, susceptibility aspects of power electronic and digital equipment **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Shielding of electronic equipment **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Analyse the fundamentals and reasons for noise in Analog electronics, Power electronics and Digital electronics circuit

CO2 Design and develop filters for Analog electronics, Power electronics and Digital circuits for reduction of noise.

CO3 Design the various types of grounding systems and get familiarised with handling electro static discharge systems, testing standards and Regulations.

CO4 Acquire knowledge about testing standards and regulations.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Noise Reduction Techniques in Electronic Systems	Otto H. W	John Wiley and Sons	2nd Edition, 1988.
2	Introduction to Electromagnetic Compatibility	Paul Clayton	Wiley Inter science	2nd Edition, 1988.
3	Electrostatic Damage in Electronics Devices and Systems	William B. Greason	John Wiley and Sons	1986
4	Digital Bus Hand Book	Joseph Di Giacomo	McGraw Hill Publishing Company	1990

Reference Books

1	Handbook Series of Electromagnetic Interference and Compatibility	White, R. J	Don White consultants Inc	1981

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	MODELLING OF ELECTRICAL MACHINES		
Course Code	22EEPEPEME	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Basic Concepts of Modeling: Basic two pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine - voltage, current and torque equations.

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

DC Machine Modeling: Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Reference Frame Theory: Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, power equivalence.

Dynamic Modeling of Three Phase Induction Machine: Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Small Signal Equations of the Induction Machine: Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Modeling of Synchronous Machines: Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Apply basic concepts of modeling for DC Machines, three phase induction machine and synchronous machines.

CO2 Model a single phase & three phase transformers, autotransformers and transmission line**.**

CO3 Carry out the dynamic performance analysis of synchronous machines**.**

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Generalized Theory of Electrical Machines	P.S.Bimbra	Khanna Publications	5th Edition, 1995
2	Electric Motor Drives - Modeling, Analysis & Control	R. Krishnan	PHI Learning Private Ltd	2009

3	Analysis of Electrical Machinery and Drive Systems	P.C.Krause, Oleg Wasynczuk, Scott D. Sudhoff	Wiley (India)	2nd Edition, 2010
4	Power System Analysis	Arthur R Bergen and Vijay Vittal	Pearson	2nd Edition, 2009.

Reference Books

1	Power System Stability and Control	PrabhaKundur	TMH	2010
2	Dynamic Simulation of Electric Machinery using MATLAB / Simulink	Chee-MunOng	Prentice Hall	1998

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	DSP APPLICATIONS TO DRIVES		
Course Code	2EEPEPEDS	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction To Digital Controller: Digital Signal Controller (A micro-controller with a DSP engine): Comparison of microprocessor and digital signal controller (Block diagram approach), TMS320F2x family,

Architecture of TMS320F28335, Functional Units, pipelining processing of instructions, memory map and code security modules **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstrations through DSP kits.

UNIT - 2

Numbering Systems: Fixed and Floating point Formats,

Digital Input/Output: GPIO input qualifications and Registers. Clock Modules, System Control and Status Register

Interrupt: Interrupt Sources, Core Interrupt Lines, Maskable Interrupts, Peripheral Interrupt Expansion Unit, Hardware Interrupt Response, CPU Timers

PWM, Capture and Encoder Units: Block Diagram, PWM Time base units, Timer Operating Modes, Time Base Registers, PWM Compare Units, PWM Action Qualification Unit, Dead Band Module, Capture Module, Enhanced QEP Module **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstrations through DSP kits.

UNIT - 3

ADC Module: ADC Module Overview, Operating Modes, ADC Conversion Time, ADC Register Block

Communication Modules: SCI, SPI, I2C and CAN Modules: Data Formats, Register Sets and Data Transfer **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstrations through DSP kits.

UNIT - 4

Multi Channel Buffered Serial Port (McBSP): Block Diagram, Data Frame Diagram, Companding Data. Clocking, Transmission and Receiving, Module Registers

Flash Programming: Flash Memory Sectors, Configuration Registers, Flash Programming Procedure

BOOT-ROM and BOOT Loader: Memory Map, Timeline, Boot Loader data stream, Init Boot Assembly Function

Flash Application Program Interface (API): API Fundamentals, General Guidelines, FLASH-API checklist **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstrations through DSP kits.

UNIT - 5

Digital Motor Control: Motor Control Principles, Field Oriented Control (FOC), F28335 features for motor control, Example of control of PMSM Motor

Digital Power Supply: Introduction to digital power supply design, driving power stages with PWM waveforms, Controlling power stage with feedback, Tuning the loop for good transient response . **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstrations through DSP kits.

Course outcomes (Course Skill Set):

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

CO1 Identify the functionality of TMS320LF2407 DSP Controller

CO2 Analyze various DSP based DC-DC Converters

CO3 Design and develop DSP based control for various motors

CO4 Prepare and present a technical report on the application of DSP processor to control a power converter

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	DSP-Based Electromechanical Motion Control	Hamid Toliyat and Steven Campbell	CRC Press	2011
2	Analysis of Electrical Machinery and Drive Systems	P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff	Wiley India	2nd Edition, 2010
3	Dynamic Simulation of Electric Machinery using MATLAB / Simulink	Chee-Mun Ong	Prentice Hall	1998
4	Technical Reference Manual for TMS320F28335, Texas Instruments,	Web link: https://www.ti.com /product/TMS320F 28335		

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Title	PROJECT PHASE 1		
Course Code	22EEPEPCP1	CIE MARKS	50
Credits	07	SEE MARKS	100
L–T-P	(0:0:7)	EXAM HOURS	03

Course outcomes:

CO1: Carry out literature survey from reputed journal/conference publications, and formulate a complex engineering problem.

CO2: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components.

CO3: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation /analytical studies, carry out project phase 1work leading to a logical solution.

CO4: Design a system/system component, simulate and test its functioning as a solution to a complex engineering problem.

CO5: Prepare a technical report for the Project Phase 1 work.

CO6: Communicate effectively and present the work carried out before the Project Evaluation committee.

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	INTERNSHIP		
Course Code	22EEPEPCIN	CIE MARKS	50
Credits	06	SEE MARKS	100
L–T-P	(0:0:6)	EXAM HOURS	03

Course outcomes:

CO1: Get an insight into the company profile and understand the organizational structure.

CO2: Apply and correlate theory and practice.

CO3: Communicate effectively regarding complex Engineering activities.

CO4: Demonstrate knowledge and understanding of Engineering & Management principles of the company.

Co5: Engage in life-long learning with a commitment to improve knowledge and competence continuously.

CO6: Acquire professional & intellectual integrity and its impact on the society.

CO7: Prepare and present a technical report for the Internship carried out.

CO8: Communicate effectively before the expert panel and develop Technical reports.

CO9: Respond to the Queries raised by the Evaluation Committee and audience.

IV Semester Syllabus

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	SOFT SWITCHING TECHNIQUES FOR CONVERTERS		
Course Code	22EEPEPESS	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Theoretical Basis of Soft Switching for PWM Full-Bridge Converters: Introduction to soft switching, PWM Strategies for Full-Bridge Converters, PWM strategies, Classification of Soft-Switching PWM Full-Bridge Converters, **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Zero-Voltage-Switching PWM Full-Bridge Converters: Topologies and Modulation Strategies of ZVS PWM Full-Bridge Converters, Operating Principle of ZVS PWM Full-Bridge Converter, ZVS Achievement of Leading and Lagging Legs, Commutation of the Rectifier Diodes, Simplified Design Procedure and Example **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Zero-Voltage-Switching PWM Full-Bridge Converters with Auxiliary-Current-Source Networks, Current-Enhancement Principle, Auxiliary Current-Source Network, Operating Principle, Conditions for Achieving ZVS in the Lagging Leg, Parameter Design, Secondary Duty Cycle Loss and Selection of Dead Time for the Drive Signals of the Lagging Leg **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Zero-Voltage-and-Zero-Current-Switching PWM Full-Bridge Converters: Modulation Strategies and Topologies of a ZVZCS PWM Full-Bridge Converter, Operating Principle, Theoretical Analysis, Simplified Design Procedure and Example **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Zero-Voltage-Switching PWM Full-Bridge Converters with Clamping Diodes, Causes of Voltage Oscillation in the Output Rectifier Diode in ZVS PWM Full-Bridge Converters, Zero-Voltage-Switching PWM Full-Bridge Converters with Current Transformers to Reset the Clamping Diode Currents, Zero-Voltage-Switching PWM Full-Bridge Converters with Current-Doubler Rectifiers **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Demonstrate the working of different topologies of soft switching converters.

CO2 Analyze and evaluate the performance of different topologies of soft switching converters

CO3 Design the components for different topologies of soft switching converters.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Soft-Switching PWM Full-Bridge Converters: Topologies, Control, and Design	Xinbo Ruan	Science Press, Wiley	
2	Power Electronics –Circuits, Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011
3	DC-DC Switching Regulator Analysis	D M Mitchel.	McGraw-Hill Ltd	1988

Reference Books

1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt. Ltd	3rd Edition, 2010
2	Design of Magnetic Components for Switched Mode Power Converters	Umanand L and Bhatt S R	New Age International, New Delhi,	2001

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	ELECTRIC VEHICLES		
Course Code	22EEPEPEEV	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor drives for Electric Vehicles, Configuration and control of Drives. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Power Electronics in HEV: Rectifiers used in HEV, DC-DC converters used in HEV, PWM Rectifier in HEV, EV and PHEV battery chargers, Thermal management of HEV power electronics **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Energy Storage: Introduction to Battery Parameters, Types of batteries, Li-Ion battery cells, SoH and SoC estimation, battery pack development for a given vehicle specification, Battery Management System (BMS) Design **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Modeling: Dynamic model of PWM converters; constant V/F induction motor drives; estimation of current ripple and torque ripple in inverter fed drives. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Renewable Energy for EV applications, Solar Powered Electric Vehicle Charging Station - Calculation and Selection - Components of Charging Station - Earth protection system for charging stations - Requirement to prevent fire for EVs Charging Stations. Basic charging Block Diagram of Charger - Difference between Slow charger and fast charger

08 Hrs

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

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

CO1 Estimate and analyze the performance parameters, power converters & machines used in EVs and the energy storage systems

CO2 Choose and design suitable power electronic converter and various types of electric drive systems suitable for electric vehicle operation.

CO3 Design a battery operated hybrid electric vehicle for a given specification.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hybrid Electric Vehicles, Principles And Applications With Practical Perspectives	Chris Mi, M. Abdul Masrur, David Wenzhong Gao	Wiley	
2	Hybrid Electric and Fuel Cell Vehicles;Fundamentals Theory and Design	Mehrdad Ehsani, Yimin CRC Press Gao, Ali Emadi, "Modern Electric	Second Edition	
3	Electric and Hybrid Vehicles-Design Fundamentals	Iqbal Husain	CRC Press	
4	Fundamentals of Electric vehicles:Technology & Economics	NPTEL Course		

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	ADVANCED CONTROL TECHNIQUES TO POWER ELECTRONICS		
Course Code	22EEPEPEAT	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Introduction to state space modeling, modeling of physical systems. Solution to vector differential equations and state transition matrix. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 2

Stability analysis of linear systems. Controllability and Observability definitions and Kalman rank conditions. Detectability and Stabilizability, Kalman decomposition State feedback controller design using pole placement. **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 3

Control of rectifiers. State space modeling of single phase and three phase rectifiers. State feedback controllers and observer design for output voltage regulation for nonlinear loads. Analysis of continuous and discontinuous mode of operation **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 4

Vector control of three-phase AC/DC front-end converter, design of inner and outer control loop, Hysteresis control, control of three phase motor with single phase inverter **08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 5

Overview of control techniques for grid connected converters under unbalanced grid voltage conditions, control of grid converters under grid faults, control structures for unbalanced current injection, power control under unbalanced grid condition, flexible power control with current limitation. **08 Hrs**

Course outcomes (Course Skill Set):

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

CO1 Demonstrate various control topologies for power electronic converters.

CO2 Analyze and evaluate the performance of intelligent control topologies converters

CO3 Design the control circuit for power electronic converters using intelligent topologies.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Control Engineering,	Ogata, K.	Prentice Hall of India	2010
2	Power Electronics – Circuits, Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011
3	DC-DC Switching Regulator Analysis	D M Mitchel	McGraw-Hill Ltd	1988

Reference Books

1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt. Ltd	3rd Edition, 2010

B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19
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Course Title	PROJECT PHASE 2		
Course Code	22EEPEPCP2	CIE MARKS	50
Credits	13	SEE MARKS	100
L–T-P	(0:0:13)	EXAM HOURS	03

Course outcomes:

CO1: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components.

CO2: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation/analytical studies, carry out work leading to a logical solution.

CO3: Design a system, simulate and test its functioning as a solution to a complex engineering problem.

CO4: Develop a prototype model or Hardware Implementation for the simulated work.

CO5: Communicate effectively the work carried out before the expert committee.

CO6: Prepare the Project report in compliance with Plagiarism requirement.

CO7: Publish the results in a reputed International IEEE conference / journal.