SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Electrical and Electronics Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
VII Semester													
1.	HSMC	NHS06	Management and Entrepreneurship	ME, IM, MBA	3	0	0	3.5	3	50	50	100	3
2.	PEC	NEE7PE2x	Professional Elective Course-II		3	0	0	3.5	3	50	50	100	3
3.	PEC	NEE7PE3x	Professional Elective Course-III		3	0	0	3.5	3	50	50	100	3
4.	OEC	N7OEXX	Open Elective Course-II		3	0	0	3.5	3	50	50	100	3
5.	AEC	RMIP	Research Methodology & Intellectual Property Rights		2	0	0	2.5	3	50	50	100	2
6.	Project	EEP	Project Work		Monday to Thursday shall be earmarked for carrying out Project work				3	100	100	200	10
			Total							**350**	**350**	**700**	**24**
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									
VIII Semester													
1.	Seminar	EETS	Technical Seminar		One contact hour /week for interaction between the faculty and students.					100	--	100	1
2.	Internship	N8CCA0x	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty and students.					100	100	200	15
3.	NCMC	NMC01	National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.					50	50	100	0
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	NCC	NCC									
			Total							**250**	**150**	**400**	**16**
		AAP	AICTE Activity Points							**100**	**---**	**100**	**0**

Professional Elective -II		**Professional Elective - III**	
N7EEPE21	Smart Grid	N7EEPE31	Electric Power Quality
N7EEPE22	Soft computing	N7EEPE32	Testing and Commissioning of Electrical Equipment
N7EEPE23	Nano Science and Nano Technology	N7EEPE33	Advanced Power Electronics
N7EEPE24	FPGA based system design	N7EEPE34	HVDC Transmission & FACTS

Note: **PCC**: Professional Core Course, **PEC**: Professional Elective Course, **OEC** –Open Elective Course, **AEC** –Ability Enhancement Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

PROJECT WORK (XXP): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instill responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of Project Work Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the project. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of Project Work Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work:

SEE for project work will be conducted by the two examiners appointed by the Chairman-BoE. The SEE marks awarded for the project work, shall be as per the Table mentioned below:

Project Report	25
Presentation & Demonstration	30
Quality of Work	25
Viva-Voce (Q&A Session)	20
Total	**100**

Note: VII and VIII semesters of IV year of the programme

(1) Departments can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

TECHNICAL SEMINAR (XXTS):

The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(vi) Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-

confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded by Department Seminar Evaluation Committee DSEC (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course is as shown in Table below:

Relevance of the topic	10 marks
Report	20 marks
Presentation	30 marks
Viva-Voce	20 marks
Guide Assessment	20 marks
Total	**100 marks**

No SEE component for Technical Seminar.

Non-Credit Mandatory Course (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.
(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.
(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.
(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.
(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points:

Apart from technical knowledge and skills, to be successful as professionals, students should have excellent soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. In order to match these multifarious requirements, AICTE has created a unique mechanism of awarding minimum 100 Activity Points for regular students and 75 Activity Points for Lateral Entry students over and above the academic grades.

The activities can be spread over entire duration of the programme and it will be reflected in the Student's VIII Semester Grade Card. It shall not be considered for computation of SGPA/CGPA and for vertical progression. The total duration of the activities for entire programme is 320 hours for regular students and 240 hours for lateral entry students.

Break-up of CIE marks for activity points:

Evaluation by the Proctor	50 marks
Evaluation by DSEC	
(i) Report	20 marks
(ii) Presentation	20 marks
(iii) Outcome	10 marks
Total	**100 marks**

1. No SEE for AICTE Activity Points.
2. Students will be awarded either NP or P grade based on marks obtained.
3. Students will be awarded 'Degree' only on earning P grade in the Activity Points.

VISION of the Institute

To develop young minds in a learning environment of high academic ambience by synergising spiritual values and technologies competence.

MISSION of the Institute

To continuously strive for the total development of students by educating them in state-of the-art-technologies and helping them imbibe professional ethics and societal commitment, so that they emerge as competent professionals to meet the global challenges.

VISION of the Department

To be the premier center for education and research in Electrical and Electronics Engineering and to produce globally competent engineers with ethical values.

MISSION of the Department

- Develop as a center of Excellence for Electrical and Electronics Engineering education by providing the state-of –the-art infrastructure, industry relevant curriculum and effective teaching learning process.
- Contribute to the development of nation by pursuing research and development in the thrust areas of Electrical and Electronics Engineering such as Power Systems, Electrical Machines, Power Electronics and Renewable Energy Systems.
- Enable graduates to be professionally competent with strong ethical values.

PROGRAM EDUCTAIONAL OBJECTIVES (PEOs)

1. Pursuing successful career in the Electrical and Electronics Engineering and allied fields and opt for higher studies, research and to be an entrepreneur.
2. Designing solutions to Power System Engineering, Electrical Machines, Power Electronics and Renewable Energy Systems for specific industry applications and real-life problems using broad engineering knowledge.
3. Demonstrating professionalism, Ethical behavior and lifelong learning.

SCHEME & SYLLABUS
OF
VII & VIII SEMESTERS
B.E. ELECTRICAL & ELECTRONICS ENGINEERING
2024-25

(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

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

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Analyze, Design and Assess the performance of Electrical Power System and its constituent equipment
2. Analyze, Design and Develop Power Electronic Systems

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			Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SE
			L	T	P	S			
HS06	Management and Entrepreneurship	ME, IM, MBA	3	0	0	3.5	3	50	
7PE2x	Professional Elective Course-II		3	0	0	3.5	3	50	
7PE3x	Professional Elective Course-III		3	0	0	3.5	3	50	
OEXX	Open Elective Course-II		3	0	0	3.5	3	50	
RMIP	Research Methodology & Intellectual Property Rights		2	0	0	2.5	3	50	
EP	Project Work		Monday to Thursday shall be earmarked for carrying out Project work				3	100	
	Total							**350**	
AP	AICTE Activity Points		40 hours community service to be documented and produced for the examin						

ETS	Technical Seminar		One contact hour /week for interaction between the faculty and students.					100	
CA0x	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty and students.					100	
MC01	National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.					50	
MC02	Physical Education (PE) (Sports and Athletics)	PE							
MC03	Yoga	Yoga							
MC04	NCC	NCC							
	Total							**250**	
AP	AICTE Activity Points							**100**	

Professional Elective -II		**Professional Elective - III**	
mart Grid		N7EEPE31	Electric Power Quality
oft computing		N7EEPE32	Testing and Commissioning of Electrical
ano Science and Nano Technology		N7EEPE33	Advanced Power Electronics
PGA based system design		N7EEPE34	HVDC Transmission & FACTS

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– Tutorial, P- Practical/ Drawing, S – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

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ject Work:

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	25
Demonstration	30
c	25
A Session)	20
tal	**100**

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CIE of the course is as shown in Table below:

topic	10 marks
	20 marks
	30 marks
	20 marks
nt	20 marks
	100 marks

Technical Seminar.

Course (NCMC):

e/Physical Education (Sport and Athletics)/Yoga:

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vertical progression. The total duration of the activities for entire programme is 320 hours for regular students and 240 hours for la

rks for activity points:

Proctor	50 marks
EC	
	20 marks
	20 marks
	10 marks
	100 marks

TE Activity Points.

SMART GRID

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE21		

Course Objectives: This course will enable students to:

1. Develop the practical insight about the modernization of Electrical Power System.
2. Understand several issues involved in realization of Smart Grid.

Unit-I

Introduction to Smart Grid

Evolution of Electric Grid, Evolution of Indian National Grid, Regulatory authorities in Indian Power sector, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Present development & International policies in Smart Grid.

8 Hrs.

Unit-II

Smart Substations

Substation Automation equipment-block diagram, Intelligent electronic devices: Bay controller, Remote terminal units, Faults in the distribution system, Components for fault isolation and restoration, Fault location, isolation and restoration, Voltage regulation

8Hrs

Unit-III

Sensing, Measurement, Control and Automation Technologies:

Smart metering: Key components of smart metering, overview of the hardware used, Signal acquisition, Signal conditioning, Analogue to digital conversion, Computation, Input/output, Communication.

Communications infrastructure and protocols for smart metering: Home-area network, Neighbourhood area network, Data concentrator, Meter data management system, Protocols for communications, Demand-side integration, Services provided by DSI, Implementations of DSI ,Hardware support to DSI implementations, Flexibility delivered by consumers from the demand side.

9 Hrs

Unit-IV

Renewable energy and storage: Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues. **Power Quality Management in Smart Grid:** Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Power Quality monitoring, Power Quality Audit.

8 Hrs

Unit-V

Micro Grid: Power system resilience, The concept of micro-grids, Types of micro grids, Autonomous and non-autonomous grids, Sizing of micro-grids, Microgrid Modelling & Analysis, Micro-grids with multiple DGs. Standards and regulation issues associated with AC & DC microgrids, Comparison between AC and DC Micro grids.

9 Hrs

TEXT BOOKS:

1	Janaka Ekanayake Kithsiri Liyanage Jianzhong Wu Akihiko Yokoyama	Smart Grid: Technology and Applications, Wiley (2015), 1st Edition, ISBN-13: 978-8126557356

REFERENCE BOOKS:

1.	James Momoh	Smart Grid, Fundamentals of Design and Analysis Wiley 1st Edition, 2012, ASIN: B01JXWU4U6
2.	NPTEL LINK	https://nptel.ac.in/courses/108107113/

Course Outcomes: After the completion of this course, students will be able to:

1. **Identify** progress made by different stakeholders in the design and development of smart grid.
2. **Classify** measurement techniques using Phasor Measurement Units and smart meters.
3. **Explain** tools for the analysis of smart grid and design, operation and performance.
4. **Categorize** classical optimization techniques and computational methods for smart grid design, planning and operation and explain predictive grid management and control technology for enhancing the smart grid performance.
5. **Develop** cleaner, more environmentally responsible technologies for the electric system.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)&Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	3	2											**3**	1
	CO2	3	3											**3**	1
	CO3	3	3											**3**	1
	CO4	3	3											**3**	1
	CO5	3	2											**3**	1

SOFT COMPUTING

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE22		

Course Objectives: This course will enable students to:

1. Understand the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.
2. Interpret the concepts of hybrid computing systems in engineering applications.

Unit-I

Introduction: AI Definitions, history and evolution, essential abilities of intelligence, AI applications. Basic components of Expert system, forward and backward chaining. Applications of ES. Evolution of Soft Computing Difference between Hard and Soft computing, Requirement of Soft computing, applications of Soft Computing. **8 Hrs**

Unit-II

Neural Networks: Introduction to Neural Network, biological inspiration, BNN&ANN, classification. Learning rules and various activation functions. Single layer and multi-layer perceptrons, Back Propagation networks, Architecture and learning of Backpropagation (BP) Networks, Backpropagation. Radial Basis Function network, Support Vector machines (SVM) and illustrative problems. **9 Hrs**

Unit-III

Fuzzy Systems: Introduction, Fuzzy Set theory, classical set and fuzzy set, fuzzy set operations, fuzzy relations, fuzzy compositions. Defuzzification Methods, Fuzzy Rule based inference systems, illustrative problems. **9 Hrs**

Unit-IV

Genetic Algorithm: Introduction, evolutionary programming, working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA. Illustrative problems **8 Hrs**

Unit-V

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems. Illustrative problems. **8 Hrs**

TEXT BOOKS:

1.	Simon O. Haykin	Artificial Neural Network, PHI, 2003, ISBN 0131471392, 9780131471399
2.	Dan W. Patterson	Introduction to AI and Expert System, PHI, 2009, ISBN 0876927770, 9780876927779

REFERENCE BOOKS:

1.	Timothy J. Ross	Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997, ISBN 0470748516, 9780470748510
2.	Davis E.Goldberg	Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989, ISBN 817758829X, 9788177588293
3.	S. Rajasekaran and G.A.V.Pai	Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, 2nd edition, 2003,
4.	R.Eberhart, P.Simpson and R.Dobbins	Computational Intelligence - PC Tools, AP Professional, Boston, 1996, ISBN 3642017991, 9783642017995
5.	NPTEL link	https://onlinecourses.nptel.ac.in/noc22_cs54/preview

Course Outcomes: After the completion of this course, students will be able to:

1. **Apply** the knowledge of hard and soft computing techniques
2. **Apply** the concepts of Artificial neural networks to various applications
3. **Analyze** the concepts of approximate reasoning using Fuzzy logic concepts to solve real world problems.
4. **Solve** optimization problems using Evolutionary algorithms or Genetic algorithms.
5. **Classify** the hybrid computing techniques to solve real world problems.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	3	3	3			-	-	-	-	-	-	-	2	2
	CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	2
	CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	2
	CO4	3	3	2	2	2	-	-	-	-	-	-	-	2	2
	CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	2

NANO SCIENCE AND NANO TECHNOLOGY

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE23		

Course Objectives: This course will enable students to:

1. Understand the foundational knowledge of the Nanoscience and related fields.
2. Illustrate the synthesis methods of nanomaterials and their application and the impact of nanomaterials on environment.

Unit-I

Introduction: Definition of Nano, Scientific Revolution-Atomic Structure & atomic size, emergence & challenges of nanoscience, carbon age-new form of carbon (CNT- Graphene), influence of nano over

micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties. **8 Hrs**

Unit-II

Physico-Chemical Methods of Nanostructured Materials: Solution growth techniques of 1D-2D nano structures:- Synthesis of metallic, semiconducting and oxide nanoparticles – homo- and hetero-nucleation growth methods – template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) – Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the Need for Gas/vapor State Processing – Main Stages of Gas Phase Synthesis – Applicability of the methods. **8 Hrs**

Unit-III

Characterization of Nanophase Materials: Fundamentals of the techniques – experimental approaches and data interpretation – applications/limitations of X-ray characterization: – X-ray sources – wide angle, extended x-ray absorption technique – Electron microscopy: SEM/TEM – high resolution imaging – defects in nanomaterials – Spectroscopy: – electron energy-loss mechanisms – electron filtered imaging – prospects of scanning probe microscopes – optical spectroscopy of metal/semiconductor nanoparticles **9 Hrs**

Unit-IV

Nanoscale Properties: Magnetism:- Magnetic Moment in clusters/Nanoparticles – Magnetic Order – coercivity – Magneto crystalline Anisotropy – thermal activation and Superparamagnetic effects – Electronics and Optoelectronics:- Quantum Confinement of Superlattices and Quantum Wells – Dielectric Constant of Nanoscale Silicon – Doping of a Nanoparticle – Excitonic Binding and Recombination Energies – Capacitance in a Nanoparticle – Diffusion in Nanocrystalline Materials – Diffusion In Grain Boundaries Of Metals. **9 Hrs**

Unit-V

Optical Properties: Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence. Magnetic Materials: Basic Magnetic Phenomena; Diamagnetism, Para magnetism, Ferromagnetism, Anti-ferromagnetism, Application of Nanomaterial molecular electronics, biological and environmental, membrane-based application, polymer-based applications in electrical engineering **8 Hrs**

Text books:

1.	Ajoy K. Ghatak, S. Lokanathan	Quantum Mechanics: Theory and Applications, 1st Edition, Macmillan Publisher, ISBN-13 978-9350591970
2.	T. Pradeep	Nano The essentials, Understanding Nano science and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, NEW DELHI, 2007, DOI: 10.1036/0071548297, ISBN:9780071548298
3.	Wesley Crowell Sanders	Basic Principles of Nanotechnology, CRC Press; Taylor & Francis, 2018, 1351054406, ISBN 13: 9781351054409

Reference books:

1.	G. Schmidt	Nanoparticles: From theory to applications 2nd ed., Wiley-VCH Verlag, Weinheim, 2010, ISBN: 978-3-527-32589-4
2.	Geoffrey A Ozin, André	Nano-chemistry: A Chemical Approach to Nanomaterials, Royal Society of

	Arsenault, Ludovico Cademartiri	Chemistry, Cambridge UK 2005.

Course Outcomes: After the completion of this course, students will be able to:

1. **Explain c**oncepts of Nanoscience, challenges of Nanoscience and Nanotechnology, advantages of nanotechnology over microtechnology.
2. **Interpret** the structural, mechanical-physical-chemical properties of nanomaterials.
3. **Summarize** the electronic properties of nanomaterials.
4. **Discuss** the Optical properties of nanomaterials**.**
5. **Apply** the concept of nanotechnology in electrical, mechanical, electronics, bio and environmental engineering fields.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	2	2	2										1	1
	CO2	3	2	2										1	1
	CO3	3	2	1										1	1
	CO4	3	2	1										1	1
	CO5	3	2	1										1	1

FPGA BASED SYSTEM DESIGN

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE24		

Course Objectives: This course will enable students to:

1. Interpret FPGA architecture, interconnect and technologies and implementation methodologies.
2. Configure and implement digital embedded system on FPGA**.**

Unit-I

FPGA based system design: Introduction, The Role of FPGAs, FPGA Types, FPGAs vs. Custom VLSI, FPGA-Based System Design- Goals and Techniques, Hierarchical Design, Combinational Circuits, Sequential Circuits, Timing, Electrical Characteristics, Power Dissipation. **8 Hrs**

Unit-II

FPGA Fabrication: FPGA Architectures, SRAM-Based, Logic Elements, Interconnection Networks, Configuration, Permanently Programmed FPGAs, Circuit Design of FPGA Fabrics, Interconnect Architecture.

Current state of the field: SoC, IP Design, SoPC, Design methodology, System Modeling, Hardware Software Co-design, Device Technology, Application Domains **8 Hrs**

Unit-III

Programmable Logic Devices: Introduction, Evolution of PROM, PLA, PAL, Architecture of PAL's, Applications. Programming PLD's, Design Flow, Programmable Interconnections, Complex PLD's (MAX - 7000, APEX), Architecture, Resources, Applications, Tools. **9 Hrs**

Unit-IV

VHDL for Synthesis: Introduction. Behavioral, Data flow, Structural Models, Simulation Cycles, Process, Concurrent Statements, Sequential Statements, Loops, Delay Models, Sequential Circuits, FSM Coding, Library, Packages, Functions, Procedures, Operator Inferencing, Test bench. **8 Hrs**

Unit-V

DFPGA's: Introduction, Logic Block Architecture, Routing Architecture, Programmable Interconnections, Design Flow, Xilinx Virtex-II, Altera Stratix, Actel 54SX Architecture. Static Timing Analysis, Applications. **9 Hrs**

Text books:

1.	W.Wolf	"FPGA based system design", Pearson, 2004. ISBN-13: 978-8131724651

Reference books:

1.	Clive Max-field	The Design Warriors's Guide to FPGAs", Elsevier, 2004. ISBN-13: 978-0750676045
2.	NPTEL LINK	https://nptel.ac.in/courses/117108040/

Course Outcomes: After the completion of this course, students will be able to:

1. **Design** a configurable digital system using FPGA

2. **Interpret** the FPGA Architecture and fabrication.

3. **Design** and model digital circuits with PLD's

4. **Implement** digital circuits in FPGA processor using VHDL.

5. **Describe** the architecture and features of DFPGA.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	2	2	3											3
	CO2	3	2												2
	CO3	3	2	3											3
	CO4	3	2	3											3
	CO5	3	2												2

ELECTRIC POWER QUALITY

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE31		

Course Objectives: This course will enable students to

1. Characterize the different Power Quality disturbance and impact on power system equipment.
2. Evaluate the harmonics and design the suitable harmonic mitigation technique.
3. Characterize the voltage variation events and asses their impact on power system components.

Unit-I

Introduction to Power Quality Disturbances: Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances

8 Hrs

Unit-II

Harmonics: Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics, Radio interference, supply standards, elimination/suppression of harmonics, classical solutions & their drawbacks, passive input filters, transformer connections **8 Hrs**

Unit -III

Active Filters: Elimination/suppression of harmonics using active power filters - topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter, constant tolerance band control, variable tolerance band control **9 Hrs**

Unit-IV

Short Interruptions and Voltage Sag:

Short Interruptions: Introduction, terminology, origin of short interruptions, monitoring of short interruptions, influence on equipment, single phase tripping, stochastic prediction of short interruptions.

Voltage Sags - Characterization: Introduction, voltage sag magnitude, voltage sag duration, three phase unbalance, phase angle jumps, magnitude and phase angle jump for three phase unbalanced sags, other characteristic of voltage sags, load influence on voltage sags, sag due starting of induction motors. **9 Hrs**

Unit-V

Mitigation of Interruptions and Voltage Sags:

Voltage Sags – Equipment Behavior: Introduction, computers and consumer electronics, adjustable speed AC drives, adjustable speed DC drives, other sensitive load.

Overview of mitigation methods, power system design – redundancy through switching and parallel operation, system equipment interface. **8 Hrs**

Text book:

1.	Mahesh Kumar Mishra	Power Quality in Power Distribution Systems Concepts and Applications, CRC Press, Taylor and Francis Group, A Chapman and Hall Book 1st edition, 2023, ISBN-13-978-0367750916, ISBN-10-0367750910.

Reference books:

2.	R.C. Dugan	Power Quality, McGraw-Hill Education, 2nd edition, ISBN:9780071501910, 0071501916
3.	A.J. Arrillga and Watson	Power system harmonics, John Wiley and Sons, 2004 Print ISBN:9780470851296
4.	Math H J Bollen	Understanding Power Quality Problems; Voltage Sags and Interruptions, Wiley-IEEE Press, ISBN: 978-0-780-34713-7 September 1999

Course Outcomes: After the completion of this course, students will be able to:

1. **Interpret** the Electrical power quality issues, their Characterization, causes and consequences on power system
2. **Interpret** the Characterization of harmonics and its effect on power system, suppression of harmonics by classical methods and Design suitable filters

3. **Analyze** the principle of suppression of harmonics by Active filters, Interpret the configuration and operation of Active filters
4. **Interpret** the Characterization of Short Interruptions and Voltage Sag and its effect on power system
5. **Analyze** the principle of Elimination/ suppression techniques of interruption and voltage sag

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
COs	**CO1**	2	3											2	2
	CO2	2	3	3										2	2
	CO3	2	3											2	2
	CO4	2	3											2	2
	CO5	2	3											2	2

TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE32		

Course Objectives: This course will enable students to:

1. Understand the methods of testing electrical equipment as per national and international standards.
2. Identify various steps in erection and commissioning of electrical equipment.

Unit-I

Transformer Specifications: Power and distribution transformers as per BIS standards.

Erection and Commissioning: Dispatch, Inspection upon arrival at site, Handling, Installation: Location and site preparation, Oil filling, Drying of transformers, Commissioning: Checks before commissioning

Testing of Power Transformers: (i) Preliminary tests (ii) Routine tests: Measurement of winding resistance, measurement of voltage ratio and check of voltage vector relationship, Measurement of

impedance voltage and load loss, measurement of no-load loss and current, measurement of insulation resistance.

8 Hrs

Unit-II

TRANSFORMERS

Routine tests (contd.): Separate source voltage withstand test, induced over-voltage withstand test, Type test: Temperature rise test. **Impulse Testing**: Lightning impulse test circuit, switching impulse test, Measurement and recording of impulses, Fault detection. **Short circuit testing of Power Transformers**. **Transformer auxiliaries**: Gas operated relay, Temperature indicators, Pressure relief valve **8 Hrs**

Unit-III

INDUCTION MOTORS:

Specifications: Site conditions, Enclosures, Cooling, rated conditions of voltage, frequency and output of motors, Duty, I.P. protection, dimensions, Performance values, overload, temperature rise, efficiency and power factor, tolerance, markings, information to be given at the stage of enquiry and placing order for supply.

Installation and commissioning: Location of the motors (including the foundation details) & its control apparatus, Foundation and leveling, Insulation resistance, Alignment, fitting of pulleys & coupling. Checks before commissioning, Commissioning of motor, Temperature rise. **Tests on Induction motor:** Insulation resistance test, High voltage test, resistance test, reduced voltage running up test **9 Hrs**

Unit-IV

Induction motors (contd.): **Tests on Induction motor**: Performance characteristics: No load test, Open circuit test, Locked rotor test, pull up and pull-out torque, Speed-torque and speed-current curves, Load test. Temperature-rise test. **Synchronous machines: Specifications**: As per BIS standards. **Installation**: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out. **Tests:** Measurement of Insulation resistance, tests for short circuited field turns, Polarity test for field poles, Resistance of windings, High voltage test.

9 Hrs

Unit-V

Synchronous machines (contd.): Tests: Checking of shaft current and bearing insulation resistance, Determination of irregularities of voltage waveform, Overspeed test, Line charging capacity, Measurement of open-circuit and short-circuit characteristics, zero power factor characteristics, Determination of synchronous machine quantities from tests, Temperature-rise tests, Instantaneous short-circuit withstand test.

8 Hrs

Text books:

1.	BHEL	Transformers, BHEL, TMH, 2nd ed, 2003 ISBN: 9780070483156 McGraw Hill Education (India) Private Limited

Reference books:

1.	Indian standards	Relevant Bureau of Indian Standards

2.	H. N. S. Gowda,	A Handbook on Operation and Maintenance of Transformers, Published by H. N. S. Gowda, 2006
3.	Martin Heathcote	J and P Transformer Book, 13th Edition, Elsevier Publication.2011 Hardback ISBN: 9780750681643, 978-0-7506-8164-3 eBook ISBN: 9780080551784

Course Outcomes: After the completion of this course, students will be able to

1. **Explain** specifications of transformers, induction and synchronous machines.
2. **Interpret** on tests performed on transformers at the manufacturer site, prior to commissioning.
3. **Differentiate** methods of installation of induction machines and synchronous machines.
4. **Interpret** tests performed on induction machines at the manufacturer site and prior to commissioning.
5. **Perform** required test procedure as per standards for different equipment commissioning using proper tools.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	2	2											2	
	CO2	2	3											2	
	CO3	2	3											2	
	CO4	3	2											2	
	CO5	3	3											2	

ADVANCED POWER ELECTRONICS

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE33		

Course Objectives: This course will enable students to:

1. Study advanced converters used in industrial applications.
2. Understand the design principles of power electronic converters.

Unit I

D.C-D.C Switched mode converter topologies: Buck, boost, buck-boost and CUK converters, Detailed theory, working principles, modes of operation, with detailed circuits and wave forms, applications, merits and demerits, design principle, boundary values, problems

8 Hrs

Unit II

Converters: Forward, fly back push pull converters working principles, Half bridge, full bridge D.C-D.C converter modes of operation, with detailed circuits and wave forms, applications.

8 Hrs

Unit III

DC-AC Switched mode inverters: single phase inverter, three phase inverters, Multi-Level Inverter: Introduction, Diode-Clamped, Flying-Capacitors, Cascaded Multilevel Inverters, SPWM inverter-detail theory, working principles, modes of operation with circuit analysis, applications, merits and demerits, design principle, problems.

9 Hrs

Unit-IV

Resonant converters: classification of resonant converters, Series and parallel loaded resonant converters, Z.V.S, and Z.C.S switching principle and working. High frequency D.C. link converters.

9 Hrs

Unit-V

Power supplies: Power conditioning and uninterruptible power supplies, Solar power based bidirectional inverter-Design principle, operation and problems. **8 Hrs**

Text books:

1.	Ned Mohan, T.M.Undeland, T.M.Robbins,	Power electronics converters, application & Design, John Wiley 2003
2.	P.C.Sen	Modern Power Electronics-, S Chand Ltd., 2005

Reference books:

1.	Dubey G.K. Asarbada, E.R.K	Power Electronics Devices, IETE book, series V .1 TMH 1986
2.	Murplhy J.M.D Turnnbull, F.G	Power Electronics Control in A.C. Motors Pergamon, 1988
3.	Rashid M.H.	Power electronics - circuits, devices, application/3rd ed, Prentice Hall India, 2003

Course Outcomes: After the completion of this course, students will be able to:

1. **Analyze** the working Principle of Non-Isolated converters.
2. **Analyze** the working principle of Isolated DC-DC converters.
3. **Analyze** the characteristics of DC-AC switched mode and Multilevel inverters.
4. **Analyze** resonant converters and high frequency inductors and transformers.
5. **Illustrate** uninterruptible power supplies and Solar power based bidirectional inverter.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	3	3	1	-	-	-	-	-	-	-	-	-	-	2
	CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	3
	CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
	CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	2

	CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	2

HVDC TRANSMISSION AND FACTS

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N7EEPE34		

Course Objectives: This course will enable students to:

1. Interpret various aspects of HVDC technology and the recent developments.
2. Understand the basics of HVDC system protection, harmonics, filters, basics of FACTS Devices like SVC and STATCOM.

Unit-I

Introduction to HVDC systems: DC Power transmission technology, Comparison of AC & DC Transmission (Economics, Technical Performance and Reliability), Application of DC Transmission, Types of HVDC Systems, Components of HVDC system, Modern trends in DC transmission. Description of different converter circuits, half wave, full wave, bridge rectifier circuits, 3 phase-1 way. **8Hrs**

Unit-II

Analysis of converter circuits: Analysis of 3 phase –1 way rectifier circuits. Choice of converter configuration. Analysis of 6 Pulse Graetz circuit, calculation of average direct voltage and current without overlap and with overlap less than 60^0. Numerical problems. Equivalent circuit of 6 Pulse rectifier circuit. Inverter operation, Voltage and current equations, commutation failure. **9 Hrs**

Unit-III

Control Strategies, Equivalent circuit of HVDC system, basic means of control and power reversal, Limitation of manual control, constant voltage verses constant current control, desired features of control and actual control characteristics, Modifications of control characteristics.

Firing Angle Controls individual pulse control, equivalent pulse control. **8 Hrs**

Unit-IV

Protection, Harmonics and Filter circuits. General introduction to protection, DC smoothing reactor, DC Breaker, Prevention of consequent commutation failure, converter faults, clearing of line faults and re-energizing the line, Surge arresters, over current and over voltage protection,

Harmonics: characteristic and non-characteristic harmonics, troubles caused by harmonics, means of reducing harmonics, telephone interference, performance indices, types of filters. **8 Hrs**

Unit-V

FACTS Devices. Review of basics of power transmission networks, Need for FACTS controllers. Effect of series and shunt compensation at the mid-point of the line on power transfer- types of FACTS controllers. **Static Var Compensator (SVC):** Analysis of SVC - Configuration of SVC, Applications of SVC. **Static Synchronous Compensator (STATCOM):** Introduction – principle of operation of STATCOM - a simplified analysis of a three phase six pulse STATCOM, Applications of STATCOM.

9 Hrs

Text books:

1.	K.R.Padiyar	HVDC Power Transmission Systems,3rd Edition, New Age International Publishers, 3rd Ed. 2015. ISBN-13 978-8122437850
2.	Narain G Hingorani and L.Gyugyi	Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley India, 2011. **ISBN:** 0-7803-3455-8

Reference books:

1	S. Kamakshaiah,V. Kamaraju	HVDC Transmission, Tata McGraw-Hill Edition. 2011.
2	Y. H. Song and A. T. Johns	"Flexible AC Transmission System", Institution of Engineering and Technology, 2009, ISBN: 978-1-62870-460-0

Course Outcomes: After the completion of this course, students will be able to

1. Interpret knowledge of HVDC technology.

2. Analyse converters and parameters to select converter configuration.

3. Analyse different controllers of HVDC technology.

4. Analyse faults, harmonics and filters of HVDC systems

5. Analyse different FACTS devices.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	2
	CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	3
	CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	2
	CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	2
	CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	2