



**Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore**  
**Shri Vaishnav Institute of Technology and Science**  
**Choice Based Credit System (CBCS) in the Light of NEP-2020**  
**B.Tech. in Electrical Engineering**  
**(Common to EE\EX)**  
**(2021-2025)**

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE502	DCC	POWER ELECTRONICS	60	20	20	30	50	2	1	2	4

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit.

**\*Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Educational Objectives (CEOs):**

This course aims to equip the students with a basic understanding of modern power semiconductor devices, various important topologies of power converter circuits for specific types of applications. The course also equips students with an ability to understand and analyze non-linear circuits involving power electronic converters.

**Course Outcomes (COs):**

Upon completion of the course, the student will be able to

1. Understand the principle of operation of commonly employed power electronic converters.
2. Analyze non-linear circuits with several power electronic switches.
3. Equipped to take up advanced courses in Power Electronics and its application areas.

**Syllabus**

**UNIT-I**

**9 Hrs.**

Power Semiconductor diodes and Transistors: Types of power diodes-General purpose diodes-Fast recovery diodes- Their characteristics and applications, Bipolar junction transistors, Power MOSFETS P-Channel, N-Channel, IGBTs- Basic Structure and working, Steady state and switching characteristics-Comparison of BJT, MOSFET and IGBT-Their applications.

**UNIT-II**

**10 Hrs.**

Principle of operation of SCR, Static and dynamic characteristics-Two transistor analogy, condition of turn on & off of SCR, Gate characteristics, GTO, DIAC, TRIAC, UJT, IGCT Characteristics.

Trigger circuits-R, RC and UJT triggering circuits. Various commutation methods of SCRs, Protection of SCRs, Series and Parallel operation of SCRs, String efficiency.

**UNIT-III**

**9 Hrs.**

AC-DC Converter: Principles of controlled rectification—Study of single phase and three phase half controlled and full controlled bridge rectifiers with R, RL, RLE loads Effect of source inductances. Dual Converters—circulating current mode and Non-circulating current mode, Control Strategies.

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**UNIT-IV**

**9 Hrs.**

DC-DC Converter: Classification of Choppers: A, B, C, D & E, Jones and Morgens chopper. Switching mode regulators - Study of Buck, Boost, Buck-Boost regulators.

AC-AC Converter: Principle of operation of Single Phase Bridge type cyclo-converters and their applications. Single phase and Three phase AC Voltage controllers with R & RL load.

**UNIT-V**

**9 Hrs.**

DC-AC Converter: Principle of operation of Single Phase Inverters-Three phase bridge inverters (180 and 120 Degree modes)-voltage control of invertors—Single Pulse Width Modulation-Multiple pulse width Modulation-Sinusoidal Pulse Width Modulation .Comparison of Voltage Source Inverter and Current Source Inverters.

**Textbooks:**

1. Rashid, M.H, 'Power Electronics - Circuits, Devices and Applications', Prentice Hall Publications, 3 rd Edition, 2003.
2. M.D.Singh and K.B.Kanchandhani, 'Power Electronics', Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2006.

**References:**

1. Ned Mohan, Tore M. Undeland, William P. Robbins, 'Power Electronics', John Wiley & Sons Publications, 3rd Edition, 2006.
2. Vedam Subramaniam, 'Power Electronics', New Age International (P) Ltd Publishers, 2001.
3. Philip T. Krein, 'Elements of Power Electronics', Oxford University Press, 1st Edition, 2012.
4. V. R. Moorthi, 'Power Electronics- Devices, Circuits and Industrial Applications', Oxford University Press, 1st Edition, 2005. 4. P.S. Bimbhra, 'Power Electronics', Khanna Publishers, 3rd Edition, 13th Reprint, 2004



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**List of Experiments:**

1. Show Static and dynamic characteristics of an SCR.
2. Examine Static and dynamic characteristics of TRAIC.
3. Examine Static and dynamic characteristics of DAIC.
4. Determine Characteristics of MOSFET and IGBT.
5. Analyze Single phase SCR Half controlled converter with R and RL load.
6. Analyze Single phase fully controlled (bridge) converter with R and RL load.
7. Design 3-phase SCR Half Controlled Converter (using simulation platform like MATLAB/Simulink)
8. Design of 3-phase SCR Fully Controlled Converter (using simulation platform like MATLAB /Simulink)
9. Recall of classes of commutation A, B, C, D, E, F.
10. Simulation of Chopper circuit using SCR.

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BTEE602	DCC	Renewable Energy	60	20	20	0	0	3	0	0	3

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

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**Course Educational Objectives (CEOs):**

The course will provide understanding of various renewable energy sources, systems and applications in the present context and its need.

**Course Outcomes (COs):**

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

1. Demonstrate the knowledge of solar energy and its applications
2. Demonstrate the knowledge of wind energy and its applications
3. Demonstrate the knowledge of bio energy and fuel cell.
4. Analyze economic aspect of renewable energy sources.

**Syllabus**

**UNIT I**

**8 hrs.**

**Solar Energy:** Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements, empirical equations for prediction of availability of solar radiation, radiation on tilted surface solar energy conversion into heat, types of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, air heater and cylindrical parabolic collector

**UNIT II**

**8 hrs.**

**Solar Energy Application:** solar energy thermal storage, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning, solar pond, heliostat, solar furnace photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages

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BTEE 602	DCC	Renewable Energy	60	20	20	0	0	3	0	0	3

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**UNIT III**

**8 hrs.**

**Wind Energy:** Energy available from wind, basics of lift and drag, basics of wind energy conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm

**UNIT IV**

**10 hrs.**

**Bio Energy :** Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages, biomass energy, energy plantation, gasification, types and applications of gasifiers.

**Hydrogen and Fuel Cell:** hydrogen as a renewable energy source, source of hydrogen, fuel for vehicle

**Hydrogen production:** direct electrolysis, direct thermal decomposition of water, biological and biochemical methods of hydrogen production. Storage of hydrogen: gaseous, cryogenic and metal hydride, utilization of hydrogen fuel cell- principle of working, construction and applications

**UNIT V**

**8 hrs.**

**Economic Analysis:** Initial and annual cost, basic definitions, present worth calculations, repayment of loan in equal annual installments, annual savings, cumulative saving and life cycle cost, economic analysis of add on solar system, payback period, clean development mechanism.

**Textbooks:**

1. G.D. Rai , “Non-Conventional Energy Sources “, Khanna Publishers New Delhi, 6<sup>th</sup> edition 2013.
2. S. P. Sukhatme and J. K. Nayak “Solar Energy: Principles of Thermal Collection and Storage ”, McGrawHill Education, 4<sup>rd</sup> edition 2017.

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BTEE 602	DCC	Renewable Energy	60	20	20	0	0	3	0	-0	3

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**References:**

1. G.N Tiwari and M .K Ghosal , “Renewable energy resources” Narosa Publication 2007.
2. Twidell & Wier, CRC Press ( Taylor & Francis) 3<sup>rd</sup> 2015
3. John A. Duffie, William A. Beckman , “Solar Engineering of Thermal Processes”, John Wiley, New York 4<sup>th</sup> Edition 2013
4. Shobh Nath Singh,” Non-conventional energy resources” , Pearson Education India 2017

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BTEE603	DCC	Utilization of Electrical Energy	60	20	20	30	20	3	1	2	5

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**Course Educational Objectives (CEOs):**

The course will provide a comprehensive idea in utilization of electrical power such as drives, electric heating, electric welding and illumination, electric traction, electrolysis, refrigeration air-conditioning and automobile electric system.

**Course Outcomes (COs):**

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

1. Identify a heating/ welding scheme for a given application.
2. Explain various lamps and fittings in use.
3. Explain different schemes of traction schemes and its main components.
4. Identify the job/higher education / research opportunities in electric utilization industry.

**Syllabus**

**UNIT-I**

**9 hrs.**

Electrical heating- resistance heating, Induction heating, dielectric heating, arc furnaces, design of heating elements. Different methods of electrical welding, resistance welding, arc welding, control devices and welding equipment. Review of electrolytic principles, laws of electrolysis, electroplating, anodizing-electro-cleaning, power supply for electrolytic process, current and energy efficiency.

**UNIT-II**

**9 hrs.**

Illumination Engineering, luminous efficiency, Incandescent lamps, arc lamps, gas discharge lamps- fluorescent lamp, effect of voltage variation on efficiency and life of lamps, Distribution and control of light, lighting calculations, solid angle, inverse square and cosine laws, methods of calculations, factory lighting, flood lighting and street lighting, Direct diffused and mixed reflection & transmission factor, refractors, light fittings.

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BTEE 603	DCC	Utilization of Electrical Energy	60	20	20	30	20	3	1	2	5

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

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**UNIT-III**

**8 hrs.**

Special features of Traction motors, selection of Traction Motor, Different system of electric traction, Mechanics of train movement: simplified speed time curves for different services, average and schedule speed, tractive effort, specific energy consumption, factors affecting specific energy consumption, acceleration and braking retardation, adhesive weight and coefficient of adhesion,

**UNIT-IV**

**8 hrs.**

Electric Drives Individual and collective drives- electrical braking, plugging, rheostat and regenerative braking load equalization use of fly wheel criteria for selection of motors for various industrial drives, calculation of electrical loads for refrigeration and air-conditioning, intermittent loading and temperature rise curve.

**UNIT-V**

**8 hrs.**

Introduction to Electric and Hybrid Vehicles, Configuration and performance of electrical vehicles, Traction motor characteristics, tractive effort ,transmission requirement, vehicle performance and energy consumption.

**Textbooks:**


1. Gupta, J.B., Utilization of Elect. Energy, S.K. Kataria & Sons; 2012 Edition (2012)
2. Rajput R.K., Utilisation of Electrical Power, Laxmi Publications, second Edition 2017

**References:**

1. H. Pratap, Art and Science of Utilization of Electrical Energy, Dhanpat Rai & co.,2017
2. Suryanarayan N.V., Utilization of Elect. Power: Electric Drives and Elect. Traction, New Age International, Second edition 2017.
3. Garg, G.C., Utilization of Elect. Power and Elect. Traction., Khanna publisher, New Delhi. Edition. 2019.



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BTEE603	DCC	Utilization of Electrical Energy	60	20	20	30	20	3	1	2	5

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\***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**List of Experiments:**

1. Perform measurement of light intensity of Fluorescent lamp by Lux meter.
2. Perform measurement of light intensity of HP mercury vapour lamp by Lux meter.
3. Perform measurement of light intensity of HP sodium vapour lamp by Lux meter.
4. Perform measurement of light intensity of Compact Fluorescent lamp (CFL) by Lux meter.
5. Analyze welding equipment along with its accessories.
6. Analyze Electrical circuit of a refrigerator.
7. To explain Power factor improvement of a single-phase load using capacitor bank.
8. Selection of motors for different types of domestic load.
9. Analyze Electrical circuit of an air conditioner.
10. Compare different braking methods of a three phase induction motor.

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BTEE 604N	SEC	Electrical Simulation Lab	0	0	0	30	20	0	0	4	2

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**Course Educational Objectives (CEOs):**

The course will provide knowledge of various softwares in field of Electrical Engineering.


**Course Outcomes (COs):**


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


1. Demonstrate the application of PSCAD in Electrical Engineering
2. Demonstrate the application of PowerWorld in Electrical Engineering
3. Demonstrate the application of Matlab and simulink in Electrical Engineering

**List of Experiments:**

1. Analyze reactive power and power factor in single-phase and three-phase circuits in PSCAD
2. Obtain the parameters of a 345 kV transmission line and modeling it in PSCAD.
3. Perform power flow calculations using MATLAB
4. Perform out power flow calculations using PowerWorld.
5. Obtain the current harmonics drawn by power electronics interface using Power World
6. Obtain the effect of sudden short-circuit on a synchronous generator output.
7. Analyze the effect of real and reactive powers on bus voltages.
8. Simulate various faults using MATLAB
9. Simulate transient stability in a 3-bus example power system using MATLAB.
10. Analyze the dynamic interaction between two control areas using Simulink modeling and economic dispatch using PowerWorld.

  
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BTEE609	SEC	Electrical Safety Lab	0	0	0	30	20	0	0	2	1

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

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#### Course Educational Objectives(CEOs):

To introduce the students with the

1. Electrical safety during installation of electrical equipment.
2. Hazardous zones in electrical safety.
3. IE rules and their standards.

#### Course Outcomes (COs):

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

1. Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
2. Summarize the Safety aspects during Installation of Plant and Equipment.
3. Describe the electrical safety in residential, commercial, and agricultural installations.
4. Describe the various Electrical Safety in Hazardous Areas
5. State the electrical systems safety management and IE rules.

#### List of Experiments:

1. Case study to understand primary and secondary electrical shocks.
2. Case study to understand safety during installation of electrical plant and equipment.
3. Case study to understand safety installation of power transformer and outdoor switchyard equipment.
4. Case study to understand safety during installation of electrical rotating machines.
5. To measure insulation resistance of rotating machines.
6. Case study to understand electrical safety in residential, commercial, and agricultural installation.
7. Case study to identify hazardous zones and classification of enclosures for hazardous zones.

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BTEE609	SEC	Electrical Safety Lab	0	0	0	30	20	0	0	2	1

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8. To study safety management policy and safety auditing.
9. Case study to understand objective and scope of ground clearances and section clearances of electrical equipment.
10. To study standards of safety, voltage and current limit as per IE rules (Electricity ACT 2003)

**Textbooks:**

1. S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi
2. [www.apeasternpower.com/downloads/elecact2003.pdf](http://www.apeasternpower.com/downloads/elecact2003.pdf)

**References:**

1. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi.

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**Choice Based Credit System (CBCS) in the Light of NEP-2020**  
**B.Tech. in Electrical Engineering**  
**(Common to EE\EX)**  
**(2021-2025)**

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE613	DE	Energy Auditing	60	20	20	0	0	3	0	0	3

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

**\*Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Educational Objectives (CEOs):**

To prepare the students to have a basic and practical knowledge of Energy Audit. To prepare the students to have a basic knowledge of pre-Audit and post Audit.

**Course Outcomes (COs):**

Upon completion of this course students will be able to:

1. Demonstrate various types of energy audit.
2. Conduct Different Strategies of energy audit.
3. Understand and analyze Energy Audit Instruments Combustion Analysis.
4. Methodologies of Conducting Energy Audit Preliminary Questionnaire.

**Syllabus**

**UNIT I**

**8 Hrs.**

**Energy Audit: Definition, Need and Objectives.**

**Types of Energy Audit** Internal Audit, External Audit, Walk through Energy Audit, Preliminary Energy Audit, Detailed Energy Audit, Investment Grade Energy Audit, Industrial Energy Audit, Utility (Services) Energy Audit, Commercial Energy Audit, Residential Energy Audit.

**UNIT II**

**8 Hrs.**

Energy Audit Strategies Monitoring and Control, Questioning the Need, Minimizing the Need of End Use, Minimizing the Losses, Operating the Equipment at Optimum Efficiency, Operating the Most Efficient Equipments from Set of Equipments, Minimizing the Idle Redundant Running, Proper Maintenance of the Equipment, Substitution with Efficient Equipment, Substitution with more Efficient Equipment, Substitution with more Efficient Process, Energy Storage, Fuel Substitutions, Quality Control and Recycling. Basic Components of Energy Audit Preparing for Audit Visit, Instrumentation, Data Collection Techno-economic Analysis, Safety Considerations.

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**UNIT III**

**7 Hrs.**

Energy Audit Instruments Combustion Analysis, Temperature Management, Pressure Measurement, Flow Measurement, Humidity Measurement, Energy and Power Measurement, Light Level Measurement, Infrared Equipment, Tachometer & Stroboscope, P.F. Meter, Ultrasonic flow meter, and Steam & Air Leak Detector.

**UNIT IV**

**8 Hrs.**

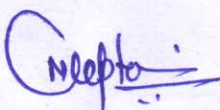
Important Survey Items Buildings, Lightings, HVAC, Furnaces & Ovens, Boilers and Steam Lines, Air Compressor and Compressed Air Distribution Lines, Chillers and Chilled Water Distribution Lines, Process Water Generation and Distribution Lines, Electrical Distributions Transformers and Lines, Pumps, Fans and Blowers, Cooling Towers, Electrical Motors, Waste Heat Sources, Material Transport, Peak Load Equipments.

**UNIT V**

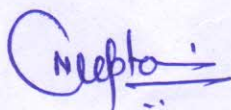
**8 Hrs.**

Methodologies of Conducting Energy Audit Preliminary Questionnaire, Review of Previous Records, Introductory Meeting, Walk through Tour, Flow Chart Construction for Detail Energy Audit, Identification of Required Audit Instruments, Finalization of Audit Schedule with the Company, Getting Detailed Data.

Post Audit Analysis Process Flow Diagram, Material and Energy Balance.. Audit Subsidy Scheme of PCRA, IDBI and IREDA.



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**Textbooks:**

1. Albert Thumann, P.E., C.E.M. , Plant engineers & Managers Guide To Energy Conservation edition-2011, Published By The Fairmont Press , Inc 700 Indian Trail Liburn, GA30047.
2. BEE Volume I –Second Edition 2005 S. G.G. Ranjan: Optimizing Energy Efficiencies in Industry ,Edition McGraw Hill

**References:**

1. Instructions to Energy Auditors, Vol. - I & Vol. - II – National Technical Information Services U. S. Deptt. Of Commerce Springfield, VA 22161.
2. Energy Auditing, The Fairmont Press Inc. Published by Atlanta, Georgia Commercial Energy Auditing Reference Handbook, Third Edition 2016, Steve Darty.

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