B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS)			
	SEMESTER -V	Ι	
ENERGY AUDIT AND DE	EMAND SIDE MANA	GEMENT (Professional Elective)	
Subject Code	15EE653	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80
	Credits - 03		
Course objectives:			
• To explain the importance of energy	rgy audit, its types and	energy audit methodology.	
• To explain the parameters require	ed for energy audit and	the working of the instruments used i	n the
measurement of the parameters.		C	
• To explain the energy audit of dif	ferent systems and equ	ipment and buildings	
• To explain electrical load manage	ement techniques harm	onics and their effects electricity tar	iffs and
nower factor improvement	ement teeninques, num	tomes and then encets, electricity tar	ins und
To explain the score of demand s	ida managamant ita ag	magnet and implementation issues and	stratagias
• To explain the scope of demand s	side management, its co	sicept and implementation issues and	strategies.
• To discuss energy conservation			
Module-1			Teaching Hours
Energy Scenarios: Energy Conservation	Energy Audit Energy	y Scenarios Energy Consumption	
Energy Security, Energy Strategy, Clean I	Development Mechanis	m.	Võ
Types of Energy Audits and Energy-A	udit Methodology: D	efinition of Energy Audit, Place of	
Audit, Energy - Audit Methodology, Fi	nancial Analysis, Sena	sitivity Analysis, Project Financing	
Options, Energy Monitoring and Training.			
Survey Instrumentation: Electrical Me	easurement, Thermal	Measurement, Light Measurement,	
Speed Measurement, Data Logger and Data – Acquisition System, Thermal Basis.■			
Revised Bloom's L_1 - Remembering, L_2 - Understanding, L_3 - Applying, L_4 - Analysing.			
Taxonomy Level			
Widdule-2			
Energy Audit of Boilers: Classification o	f Boilers, Parts of Boile	er, Efficiency of a Boiler, Role of	08
excess Air in Boiler Efficiency, Energy Sa	ving Methods.		
Energy Audit of Furnaces: Parts of a Fun	rnace, classification of	Furnaces, Energy saving Measures	
In Furnaces, Furnace Efficiency.	Understanding I. A	nnlying L. Analyzing	-
Revised Bloom's L_1 - Remembering, L_2 - Understanding, L_3 - Applying, L_4 - Analysing,			
Module-3			
Fnergy Audit of HVAC Systems: Introd	uction to HVAC Com	opents of Air - Conditioning	08
System Types of Air – Conditioning Systems	ems Human Comfort 7	one and Psychrometry Vapour –	Võ
Compression Refrigeration Cycle, Energy	Use Indices. Impact of	Refrigerants on Environment and	
Global Warming, Energy – Saving Measu	res in HVAC, Star Rati	ng and Labelling by BEE.	
Electrical-Load Management: Electrical	Basics, Electrical Load	Management, Variable- Frequency	
Drives, Harmonics and its Effects, Electric	city Tariff, Power Facto	or, Transmission and Distribution	
Losses.			
Revised Bloom's L ₁ - Remembering, L ₂ - Understanding, L ₃ - Applying, L ₄ - Analysing			
Module-4			
Energy Audit of Motors: Classification of Motors, Parameters related to Motors, Efficiency of a Motor, Energy Conservation in Motors, BEE Star Rating and Labelling. Energy Audit of Lighting			
Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting			
Opportunities.			
Revised Bloom's L ₁ - Remembering, L ₂ - Understanding, L ₃ - Applying, L ₄ - Analysing Taxonomy Level			
[_] I			L

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER -VI

SEMESTER -VI			
15EE653 ENERGY AUDIT AND DEMAND SIDE MANAGEMENT (Professional Elective)(con	ntinued)		
Module-5	Teaching		
	Hours		
Energy Audit Applied to Buildings: Energy – Saving Measures in New Buildings, Water Audit,	08		
Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.			
Demand side Management: Scope of DSM, Evolution of DSM concept, DSM planning and			
Implementation, Load management as a DSM strategy, Applications of Load Control, End use			
energy conservation, Tariff options for DSM, customer acceptance, implementation issues,			
Implementation strategies, DSM and Environment.			
Energy Conservation: Motivation of energy conservation, Principles of Energy conservation,			
Energy conservation planning, Energy conservation in industries, EC in SSI, EC in electrical			
EC in agriculture, EC logislation			
EC III agricultule, EC legislation.			
Texonomy Level L ₁ - Kemembering, L ₂ - Understanding, L ₃ - Applying, L ₄ - Analysing			
Course outcomore			
At the and of the course the student will be able to:			
At the end of the course the student will be able to:			
• Understand the need of energy audit and energy audit methodology.			
• Explain audit parameters and working principles of measuring instruments used to measure the			
parameters.	1 .		
• Conduct energy audit of boilers, furnaces, power plant, steam distribution system and compres	sed air		
systems.			
• Conduct energy audit HVAC systems, motors, pumps, blowers and cooling towers.			
• Explain load management techniques, effects of harmonics, electricity tariff, improvement of p	ower		
factor and losses in transmission.			
• Conduct energy audit of lighting systems and buildings.			
• Show an understanding of demand side management and energy conservation. ■			
Graduate Attributes (As per NBA)			
Engineering Knowledge, Problem Analysis, Conduct investigations of complex Problems, Environmen	t and		
sustainability, Ethics, Individual and Team work, Communication			
Question paper pattern:			
• The question paper will have ten questions.			
• Each full question is for 16 marks.			
• There will be 2full questions (with a maximum of four sub questions in one full question) from each			
module.			
• Each tull question with sub questions will cover the contents under a module.			
• Students will have to answer 5 full questions, selecting one full question from each module.■			
Textbook			

1	Handbook on Energy Audit	Sonal Desai	McGraw Hill	1 st Edition, 2015
2.	Generation of Electrical Energy	B R Gupta	S. Chand	1 st Edition, 1983

ENERGY AND ENVIRONMENT (OPEN ELECTIVE – I) [AS PER CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME] SEMESTER – V

Subject Code 15ME562 Teaching Hours / Week IA Marks 20 Lecture Tutorial Practical Exam Marks 80 03 00 00 Exam Hours 03

CREDITS - 03

Course Objectives

1. Understand energy scenario, energy sources and their utilization

- 2. Learn about methods of energy storage, energy management and economic analysis
- 3. Have proper awareness about environment and eco system.
- 4. Understand the environment pollution along with social issues and acts.

Course Outcomes

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

- 1. Summarize the basic concepts of energy, its distribution and general Scenario.
- 2. Explain different energy storage systems, energy management, audit and economic analysis.

3. Summarize the environment eco system and its need for awareness.

4. Identify the various types of environment pollution and their effects.

5. Discuss the social issues of the environment with associated acts.

Module – I

Basic Introduction to Energy: Energy and power, forms of energy, primary energy sources, energy flows, world energy production and consumption, Key energy trends in India: Demand, Electricity, Access to modern energy, Energy production and trade, Factors affecting India's energy development: Economy and demographics Policy and institutional framework, Energy prices and affordability, Social and environmental aspects, Investment. **8 Hours**

Module – II

Energy storage systems: Thermal energy storage methods, Energy saving, Thermal energy storage systems

Energy Management: Principles of Energy Management, Energy demand estimation, Energy pricing

Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries

Economic Analysis: Scope, Characterization of an Investment Project 10 Hours Module – III

Environment: Introduction, Multidisciplinary nature of environmental studies- Definition, scope

and importance, Need for public awareness.

Ecosystem: Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession. **8 Hours**

Module – IV

Environmental Pollution: Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards, Solid waste Management, Disaster management Role of an individual in

prevention of pollution, Pollution case studies. 8 Hours

Module – V

Social Issues and the Environment: Climate change, global warming, acid rain, ozone layer

depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. **8 Hours**

TEXT BOOKS:

1. Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education by University grant commission and Bharathi Vidyapeeth Institute of environment education and Research ,Pune

2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.

REFERENCE BOOKS:

1. Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.

2. Murphy, W. R., Energy Management, Elsevier, 2007.

3. Smith, C. B., Energy Management Principles, Pergamum, 2007

4. Environment pollution control Engineering by C S rao, New Age Inytermnational, 2006, reprint 2015, 2nd edition

5. Environmental studies, by Benny Joseph, Tata McGraw Hill, 2008, 2nd edition.

E- Learning

- India Energy Outlook 2015(www.iea.org/.../IndiaEnergyOutlook_WEO2015.pdf)
- Open courseware

Energy Auditing

Course Code Credits L-T-P Assessment Exam

SEE CIA Duration

Energy Auditing 15ME661 03 3-0-0 80 20 3Hrs

Course learning objectives is to

• Understand energy scenario and general aspects of energy audit.

- Learn about methods and concept of of energy audit
- Understand the energy utilization pattern including wastage and its management

Module – I

General Aspects: Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportunities, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies

8 Hours

Module – II

Energy Audit Concepts: Need of Energy audit - Types of energy audit - Energy management (audit) approach - understanding energy costs - Bench marking - Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements - Duties and responsibilities of energy auditors - Energy audit instruments - Procedures and Techniques.

8 Hours

Module – III

Principles and Objectives of Energy Management: Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.

8 Hours

Module – IV

Thermal Energy Management: Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps – HVC industries-Building Energy Management. **8 Hours**

o nours Modulo

Module – V Electrical Energy Mar

Electrical Energy Management: Supply side Methods to minimize supply-demand gap -Renovation and modernization of power plants - Reactive power management – HVDC -FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors.

8 Hours

Note: A case study involving energy audit may be taken up with suggestion for energy improvements as a part of assignment.

Course Outcomes

25

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

- Understand the basic concepts of energy audit and energy management
- Explain different types of energy audit, maximizing and optimizing system efficiency.

- Summarize energy management systems, prepare and present energy audit report
- Identify energy saving potential of thermal and electrical systems
- Discuss Energy audit instruments, Procedures and Techniques. **TEXT BOOKS:**
- 1. Murphy, W. R., Energy Management, Elsevier, 2007.
- 2. Smith, C. B., Energy Management Principles, Pergamum, 2007
- **REFERENCE BOOKS:**

1. Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.

2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.

3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley Interscience publication)

4. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)

5. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982

6. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

E-Learning

https://beeindia.gov.in/content/energy-auditors

Scheme of Examination: Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module

ENVIRONMENTAL STUDIES

[As per Choice Based Credit System (CBCS) scheme]

(Effective from the academic year 2015 -2016)

SEMESTER - I/II

Subject Code	15CIV18/15CIV28	IA Marks	10
Number of Lecture Hours/Week	02	Exam Marks	40
Total Number of Lecture Hours	25	Exam Hours	02

Course Objectives:

- 1. To identify the major challenges in environmental issues and evaluate possible solutions.
- 2. Develop analytical skills, critical thinking and demonstrate socio-economic skills for sustainable development.
- 3. To analyze an overall impact of specific issues and develop environmental management plan.

Module - 1

Introduction: Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. 2 Hours

Impacts of Agriculture & Housing Impacts of Industry, Mining & TransportationEnvironmental Impact Assessment, Sustainable Development.3 Hours

Module - 2

Natural Resources, Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. **2 Hours** Energy – Different types of energy, Conventional sources & Non Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy. **3 Hours**

Module -3

Environmental Pollution – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. 2 Hours

Global Environmental Issues: Population Growth, Urbanization, Land Management, Water& Waste Water Management.3 Hours

Module -4

Air Pollution & Automobile Pollution: Definition, Effects – Global Warming, Acid rain &Ozone layer depletion, controlling measures.3 HoursSolid Waste Management, E - Waste Management & Biomedical Waste Management -2 Hours

Module - 5

Introduction to GIS & Remote sensing, Applications of GIS & Remote Sensing in Environmental Engineering Practices. 2 Hours

Environmental Acts & Regulations, Role of government, Legal aspects, Role of Nongovernmental Organizations (NGOs), Environmental Education & Women Education.

3 Hours

Course Outcome:

Students will be able to,

- 1. Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
- 2. Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment,
- 3. Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components
- 4. Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues

Text Books:

- Benny Joseph (2005), "Environmental Studies", Tata McGraw Hill Publishing Company Limited.
- R.J.Ranjit Daniels and Jagadish Krishnaswamy, (2009), "Environmental Studies", Wiley India Private Ltd., New Delhi.
- R Rajagopalan, "Environmental Studies From Crisis to Cure", Oxford University Press, 2005,
- Aloka Debi, "Environmental Science and Engineering", Universities Press (India) Pvt. Ltd. 2012.

Reference Books:

- Raman Sivakumar, "Principals of Environmental Science and Engineering", Second Edition, Cengage learning Singapore, 2005
- P. Meenakshi, "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006
- 3. S.M. Prakash, "Environmental Studies", Elite Publishers Mangalore, 2007
- 4. Erach Bharucha, **"Text Book of Environmental Studies"**, for UGC, University press, 2005
- 5. G.Tyler Miller Jr., **"Environmental Science working with the Earth"**, Tenth Edition, Thomson Brooks /Cole, 2004
- 6. G.Tyler Miller Jr., **"Environmental Science working with the Earth"**, Eleventh Edition, Thomson Brooks /Cole, 2006
- Dr.Pratiba Sing, Dr.AnoopSingh and Dr.Piyush Malaviya, "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd. New Delhi.

Green Manufacturing

Course Code Credits L-T-P
Assessment
SEE CIA
Green Manufacturing 15ME834 3 3-0-0 80 20 3 Hrs
COURSE OBJECTIVES
Students will be able to
1. Acquire a broad understanding of sustainable manufacturing, green product and process
2. Understand the analytical tools, techniques in green manufacturing
3. Understand the structures of sustainable manufacturing, environmental and management practice.
Module- 1
Introduction to Green Manufacturing
Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental
Impact of
Manufacturing, Strategies for Green Manufacturing.
The Social, Business, and Policy Environment for Green Manufacturing
Introduction, The Social Environment—Present Atmosphere and Challenges for Green
Manufacturing, The
Business Environment: Present Atmosphere and Challenges, The Policy Environment—Present
Atmosphere
and Challenges for Green Manufacturing.
Module- 2
Metrics for Green Manufacturing
Introduction, Overview of Currently Used Metrics, Overview of LCA Methodologies, Metrics
Development
Methodologies, Outlook and Research Needs.
Green Supply Chain
Motivation and Introduction, Definition, Issues in Green Supply Chains (GSC), Techniques/Methods
of Green
Supply Chain, Future of Green Supply Chain.
Principles of Green Manufacturing
Introduction, Background, and Technology Wedges, Principles, Mapping Five Principles to Other
Methods and
Solutions.
Module -3
Closed-Loop Production Systems
15 Life Cycle of Droduction Systems, Economic and Ecological Deposits of Classed I. con Systems
Life Cycle of Production Systems, Economic and Ecological Benefits of Closed Loop Systems,
Machine Teols and Energy Consumption I CA of Machine Teols, Drasses Personator Ontimization, Dray
Machining and
Minimum Quantity Lubrication Domonufacturing Dayse Approaches for Systemable Factory
Design
Dosign. Somiconductor Manufacturing
Overview of Semiconductor Fabrication Micro fabrication Processes Facility Systems Green
Manufacturing

in the Semiconductor Industry: Concepts and Challenges, Use-Phase Issues with Semiconductors, Example of

Analysis of Semiconductor Manufacturing.

Module- 4

Environmental Implications of Nano-manufacturing

Introduction, Nano-manufacturing Technologies, Conventional Environmental Impact of Nanomanufacturing,

Unconventional Environmental Impacts of Nano-manufacturing, Life Cycle Assessment (LCA) of Nanotechnologies.

Green Manufacturing Through Clean Energy Supply

Introduction, Clean Energy Technologies, Application Potential of Clean Energy Supply in Green Manufacturing

Module- 5

Packaging and the Supply Chain: A Look at Transportation

Introduction, Background, Recommended Method to Determine Opportunities for Improved Pallet Utilization,

Discussion.

Enabling Technologies for Assuring Green Manufacturing

Motivation, Process Monitoring System, Applying Sensor Flows in Decision Making: Automated Monitoring,

Case Study.

Concluding Remarks and Observations about the Future

Introduction, Evolution of Manufacturing, Leveraging Manufacturing, Energy of Labor.

COURSE OUTCOMES

1. Understand the basic design concepts, methods, tools, the key technologies and the operation of sustainable green manufacturing.

2. Apply the principles, techniques and methods to customize the learned generic concepts to meet the

needs of a particular industry/enterprise.

3. Identify the strategies for the purpose of satisfying a set of given sustainable green manufacturing requirements.

4. Design the rules and processes to meet the market need and the green manufacturing requirements by

selecting and evaluating suitable technical, managerial / project management and supply chain management scheme.

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS)				
DENEWARI	SEMESTER - V	DCFS(Onon Floative)		
NEINE WADL	15EE563	IA Marks 20		
Number of Lecture Hours/Week	03	IA Marks20Exam Hours03		
Total Number of Lecture Hours	40	Exam Marks 80		
	Credits - 03			
Total Number of Lecture Hours 40 Exam Marks 80 Credits - 03 Course objectives: • To discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. • To explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships • To discuss about solar energy reaching the Earth's surface and solar thermal energy applications. • To discuss types of solar collectors, their configurations and their applications • To explain the components of a solar cell system, equivalent circuit of a solar cell, its characteristics and applications. • To discus benefits of hydrogen energy, production of hydrogen energy, storage its advantages and disadvantages. • To discuss wind turbines, wind resources, site selection for wind turbine • To discuss waste recovery management systems, advantages and disadvantages • To discuss biomass production, types of biomass gasifiers, properties of producer gas. • To discuss tidal energy resources, energy availability, power generation. • To discuss tidal energy resources, energy availability, power and energy availability and the devices for harnessing wave energy.				
Module-1 Tea			Teaching	
 Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications. ■ Revised Bloom's L₁ – Remembering, L₂ – Understanding, L₃ – Applying. 			08	
Taxonomy Level				
Module-2 Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond. Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems. Revised Bloom's Taxonomy Level L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.			08	
Module-3				
 Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection. Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects. 				

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER - V			
15EE563 RENEWABLE ENERGY RESOURCES(Open Elective) (contin	nued)		
Module-3 (continued)	Teaching Hours		
Solid waste and Agricultural Refuse: Waste is Wealth, Key Issues, Waste Recovery Manag Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling of Plastics. ■	gement		
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			
Module-4			
 Biomass Energy:Biomass Production, Energy Plantation,Biomass Gasification, The Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasi Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Clear Gasifiers. Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Problems Feeds and their Characteristics. Tidal Energy:Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability i Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy. Revised Bloom's L₁ – Remembering, L₂ – Understanding, L₃ – Applying, L₄ – Analysing. 	eory of 08 fication, Gasifier, aning of oduction, by Biogas l Power in Tides,		
Taxonomy Level Module-5			
Sea Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Power.Ocean Thermal Energy: Introduction, Principles of Ocean Thermal Energy Conversion (Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC.Revised Bloom's Taxonomy LevelL1 – Remembering, L2 – Understanding, L3 – Applying.	es, Wave of Wave (OTEC), d Cycle,		
 Course outcomes: At the end of the course the student will be able to: Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. Discuss energy from sun, energy reaching the Earth's surface and solar thermal energy applications. Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications. Discus generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse. Discuss production of energy from biomass, biogas. Discuss tidal energy resources, energy availability and power generation. Discuss power generation sea wave energy and ocean thermal energy. ■ 			
Graduate Attributes (As per NBA)			
Engineering Knowledge, Problem Analysis, Modern tool usage, Ethics.			
Question paper pattern:			
 The question paper will have ten questions. Each full question is for 16 marks. There will be 2full questions (with a maximum of four sub questions in one full question module. Each full question with sub questions will cover the contents under a module. 	on) from each		
L			

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER - V						
	15EE563 RENEWABLE ENERGY RESOURCES(Open Elective) (continued)					
Text	tbook					
1	Nonconventional Energy Resources	ShobhNath Singh	Pearson	1 st Edition, 2015		
Refe	Reference Books					
1	Nonconventional Energy Resources	B.H. Khan	McGraw Hill	3 rd Edition,		
2	Renewable Energy; Power for a sustainable Future	Godfrey Boyle	Oxford	3 rd Edition, 2012		
3	Renewable Energy Sources: Their Impact on global Warming and Pollution	TasneemAbbasi S.A. Abbasi	PHI	1 st Edition, 2011		

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS)				
	SEMESTER –V			
SUbject Code	WIND ENERGY (P	Tofessional Elective)	20	
Number of Lecture Hours/Week		Exam Hours	03	
Total Number of Lecture Hours	40	Exam Marks	80	
	Credits – 03	Entitle Marks	00	
Course objectives:				
 Course objectives: To discuss the importance of energy with energy use. To discuss the increasing role of ren efficiency, energy intensity. To discuss energy consumption stat efforts in India. To explain the concept of energy stot To discuss the characteristics and diaradiation and analysis of collected soc To explain availability of solar radiat collector with respect to horizontal state of discuss the operations of solar energies of the process of harnessin To discuss the operation of solar cell solar cell To discuss forces on the Blades, Win estimation and site selection. To discuss classification of WEC Sy Types of Wind Machines (Wind Energy Types of Wind Wind States Types of Wind Machines (Wind Energy Types of Wind Machines (Wind Energy Types of Wind Wind States Types of Wind Wind States Types of Wind Machines (Wind Energy Types of Wind Wind States Types of Wind Wind States Types of Wind Wind States Types of Wind Machines (Wind Energy Types of Wind Machines (Wind E	in human life, relation ewable energy, energy us in India, energy sa orage and the princip stribution of solar rad- lar radiation data. ion at a location and the orface. g solar energy in the rgy including heating and the environment cal solar PV systems Energy Conversion and the Energy Conversion and the Energy Conversion stems, its advantages ergy Collectors).	enship among economy a sy management, energy a aving potential and energ les of energy storage de iation, measurement of c the effect of tilting the su form of heat and workin and cooling. tal effects on electrical ch and their applications. and to compute the powe h, collection of Wind Dav s and disadvantages of v	and environment audit, energy and environment audit, energy conservation vices. components of arface of g of solar colle naracteristics of er available in ta, energy WECS, and	nt solar ectors. f the
• To discuss energy storage, application	s of Wind Energy and	Environmental Aspects.	•	
Module-1				Teaching Hours
Fundamentals of Energy Science and Tech Development, Classification of Energy Source features of Non-conventional Energy Source Conservation and Efficiency: Introduction Energy Conservation, Global Efforts, Achiev Scenario in India, Energy Audit, Energy Con Energy Storage: Introduction, Necessity of I Solar Energy-Basic Concepts: Introduction, Radiation Spectrum, Extraterrestrial and Terr Radiation, Depletion of Solar Radiation.■	nology: Introduction, J res, Importance of Non res, World Energy St n, Important Terms a ements and Future Pla servation Opportunities Energy Storage, Specif The Sun as Source of estrial Radiations, Spec	Energy, Economy and Soc -conventional Energy Sou atus, Energy Status in In nd Definitions, Important nning, Energy Conservations. ications of Energy Storage Energy, The Earth, Sun, E ctral Power Distribution of	ial urces, Salient dia. Energy t Aspects of on/Efficiency Devices. Earth f Solar	08
Revised Bloom's L ₁ - Remembering, L ₂ - Understanding, L ₃ - Applying. Taxonomy Level Modulo 2				
Solar Energy-Basic Concepts (continued Data, Solar Time, Solar Radiation Geon Horizontal Surface, Empirical Equations for Surface, Solar Radiation on Inclined Plane S Solar Thermal Systems: Introduction, Solar and Cooling Systems, Solar Industrial Heatin Conditioning Systems, Solar Cookers.■ Revised Bloom's L ₁ – Remembering, L ₂ –): Measurement of S netry, Solar Day Le For Estimating Terrest Surface. Collectors, Solar Wate g Systems, Solar Refri - Understanding, L ₃ –	Solar Radiation, Solar ngth, Extraterrestrial Ra trial Solar Radiation on er Heater, Solar Passive Sp geration and Air Applying, L ₄ – Analysing	Radiation diation on Horizontal pace Heating g.	08

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE)				
	SEMESTER – VI			
15E	E654 SOLAR AND WIND ENERGY (Professional Elective) (continued)			
Module-3		Teaching Hours		
Solar Photovoltai	c Systems: Introduction, Solar Cell Fundamentals, Solar Cell Characteristics,	08		
Solar Cell Classifi	cation, Solar Cell Technologies, Solar Cell, Module, and Array Construction,			
Maximizing the Sol	ar PV Output and Load Matching. Maximum Power Point Tracker. Balance			
of System Compon	ents, Solar PV Systems, Solar PV Applications.■			
Revised Bloom's	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.			
Taxonomy Level				
Module-4				
Wind Energy: Intr Wind Energy Scen- on the Blades, W Considerations Wind energy syst of wind energy, E- machine parameter	oduction, Basic Principles of Wind Energy Conversion, History of Wind Energy, ario – World and India. The Nature of the Wind, The Power in the Wind, Forces 7 ind Energy Conversion, Wind Data and Energy Estimation, Site Selection ems: Environment and Economics Environmental benefits and problems conomics of wind energy, Factors influence the cost of energy generation,	08		
Revised Bloom's	Life cycle cost analysis \blacksquare L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.			
Module-5				
Rasic Components	of a Wind Energy Conversion (WEC) System: Classification of WEC systems	08		
Advantages and D Analysis of Aerody Systems, Energy St Aspects.■ Revised Bloom's	isadvantages of WECS, Types of Wind Machines (Wind Energy Collectors), mamic Forces Acting on the Blade, Performance of Wind- machines, Generating orage, Applications of Wind Energy, Environmental L_1 – Remembering, L_2 – Understanding, L_3 – Applying.			
Taxonomy Level				
Course outcomes: At the end of the co • Discuss th energy use	burse the student will be able to: e importance of energy in human life, relationship among economy and environmen e and the increasing role of renewable energy.	t with		
• Explain th	e concept of energy storage and the principles of energy storage devices.			
To discuss of rediction	solar radiation on horizontal and tilted surface, its characteristics, measurement and	analysis		
 Describe the process of harnessing solar energy and its applications in heating and cooling. Discuss fabrication, operation of solar cell, electrical characteristics, sizing and design of solar PV systems and their applications. Explain basic Principles of Wind Energy Conversion, collection of wind data, energy estimation and site selection. Discuss the performance of Wind-machines, energy storage, applications of Wind Energy and environmental expected energy energy storage. 				
Cuadrasta Attain	utog (Ag non NDA)			
Engineering Knowledge, Design/ Development of Solutions, The Engineer and Society, Environment and Sustainability, Ethics, Project Management and Finance.				
Question paper	pattern:			
• The question paper will have ten questions.				
 Each full question is for 16 marks. There will be 2full questions (with a maximum of four subquestions in one full question) from each 				
module.				
 Each full question with sub questions will cover the contents under a module. Students will have to answer 5 full questions, selecting one full question from each module.■ 				

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER – VI						
	15EE654 SOLAR AND WINI	D ENERGY (Profess	sional Elective) (contin	ued)		
Text	Textbook					
1	Non-Conventional Energy Resources	B. H. Khan	McGraw Hill	2 nd Edition 2017		
2	2 Non-Conventional Sources of Energy Rai, G. D Khanna Publishers 4 th Edition, 2009					
Refe	rence Books					
1	Non-Conventional Energy Resources	ShobhNath Singh	Pearson	1 st Edition, 2015		
2Solar Energy – Principles of Thermal Collections and StorageS.P. Sukhatme J.K.NayakMcGraw Hill3rd Edition, 2008						
3	3Wind Turbine TechnologyAhmad HemamiCengage1st Edition, 2012					