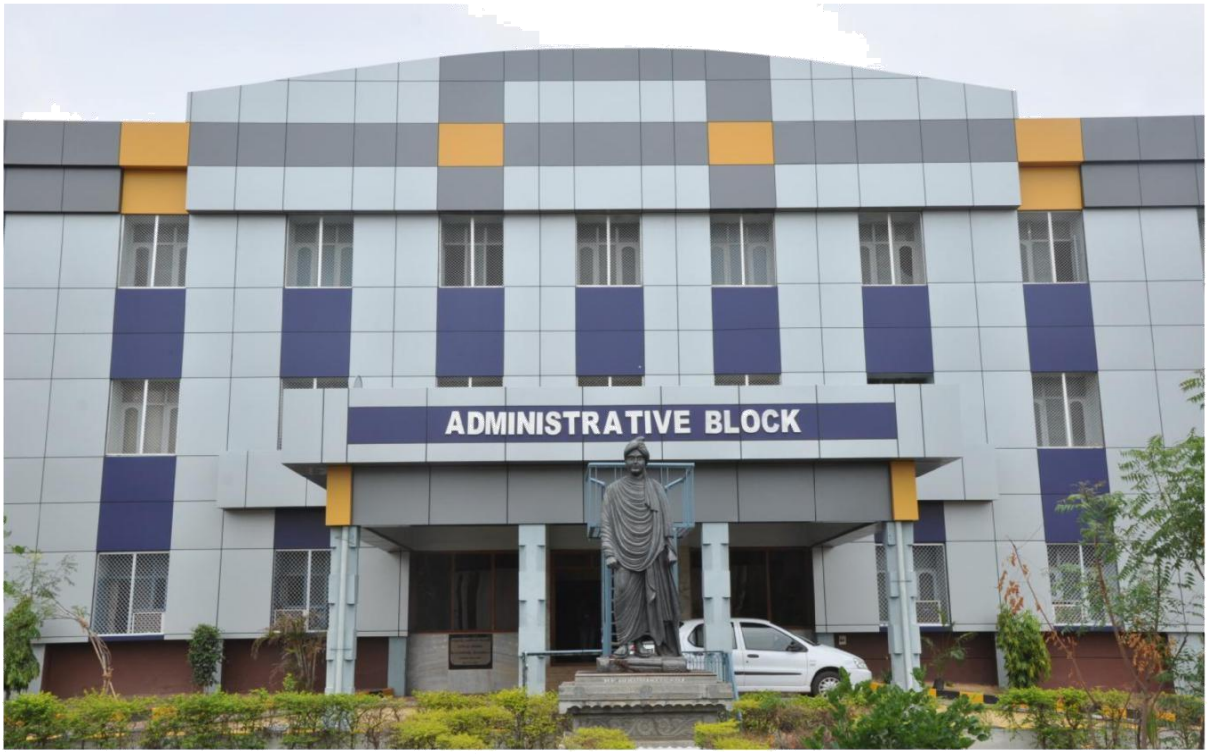

Scheme – 2023

Electrical & Electronics Engineering Department

G. Pulla Reddy Engineering College (Autonomous): Kurnool

Accredited by NBA of AICTE and NAAC of UGC

Affiliated to JNTUA, Anantapuramu

Scheme and Syllabus for

MINOR in ENERGY SYSTEMS

(With Effect from the Batch Admitted from 2023-24)

G. PULLA REDDY ENGINEERING COLLEGE (Autonomous): KURNOOL
Accredited by NBA of AICTE & NAAC of UGC
Affiliated to Jawaharlal Nehru Technological University Anantapur, Ananthapuramu
Department of Electrical & Electronics Engineering
MINOR in ENERGY SYSTEMS
Scheme of Instruction and Examination
Scheme -2023

MINOR in ENERGY SYSTEMS

S.No.	Course Code	Course Name	Contact Hours per week			Credits
			L	T	P	
1	MEE01	Energy Audit and Management	3	-	0	3
2	MEE02	Energy Management in Building	3	-	0	3
3	MEE03	Energy Storage Technologies	3	-	0	3
4	MEE04	Energy Scenario and Energy Policy	3	-	0	3
5	MEE05	Waste Energy Management	3	-	0	3
6	MEE06	Project in Energy Systems	-	-	6	3
Total						**18**

ENERGY AUDIT AND MANAGEMENT (EAM)								
EEE						**Scheme: 2023**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MEE01	**Minor**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2 Hrs						**End Exam Duration: 3 Hrs**		

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

CO1: Understanding the Fundamentals of Energy Auditing and Conservation

CO2: Analyzing Energy Audit Concepts and Techniques.

CO3: Designing and Implementing Energy Management Programs

CO4: Managing Thermal Energy and Implementing Energy Conservation Technique

CO5: Implementing Electrical Energy Management and Conservation

UNIT – I

Introduction

Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportunities.

UNIT – 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.

UNIT – III

Principles and Objectives of Energy Management

Design of Energy Management Programs - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Some case study and potential energy savings.

UNIT – 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 - Building Energy Management.

UNIT – V

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. Demand side management.

Text Books:

1. Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980
2. Energy Management: W.R.Murphy, G.Mckay

Reference Books:

1. Energy Management Principles: C.B.Smith
2. Efficient Use of Energy : I.G.C.Dryden
3. Energy Economics A.V.Desai
4. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com).

Web References:

1. https://nptel.ac.in/courses/108106022
2. https://beeindia.gov.in/sites/default/files/1Ch3.pdf
3. https://www.jcboseust.ac.in/assets/electrical/images/notes/unit3_eeca.pdf

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall answer any one of them. Each of these questions may contain sub-questions.

ENERGY MANAGEMENT IN BUILDING (EMB)								
EEE						**Scheme: 2023**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MEE02	**Minor**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2 Hrs						**End Exam Duration: 3 Hrs**		

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

CO1: Understanding the Fundamentals of Energy Use in Buildings Apply the Energy management concepts for building designs

CO2: Analyzing Indoor Environmental Requirements and Their Impact on Energy Use

CO3: Examining the Role of Climate and Environmental Factors in Building Energy Use

CO4: Evaluating Energy Utilization and Heat Transfer in Building Envelopes

CO5: Implementing Energy Management Strategies for Buildings

UNIT – I

Overview of the Significance of Energy use and Energy Processes in Building

Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications – Concepts of energy efficient building.

UNIT – II

Indoor Environmental Requirement and Management

Thermal comfort – Ventilation and air quality - Air-conditioning requirement - Visual perception – Illumination requirement - Auditory requirement – Concept of sick building syndrome – Significance in energy management in buildings.

UNIT – III

Climate

Solar radiation and their influences - The sun-earth relationship and the energy balance on the earth‘s surface – Climate – Wind - Solar radiation - Temperature – Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

UNIT – IV

END-USE

Energy utilization and requirements – Lighting and day lighting – End-use energy requirements – Status of energy use in buildings – Estimation of energy use in a building - Heat gain and thermal performance of building envelope – Steady and non steady heat transfer through the glazed window and the wall – Standards for thermal performance of building envelope – Evaluation of the overall thermal transfer – Concepts of window management.

UNIT – V

Energy Management Options

Energy audit and energy targeting – Technological options for energy management – Modifications for energy efficient buildings for Indian conditions. Energy Management for large tower buildings.

Text Books:

1. Heating and Cooling of Buildings – Design for Efficiency, J. Krieder and A. rabl, McGraw Hill, 1994.
2. Mechanical and Electrical Equipment for Buildings, S. M. Guinnes and Reynolds, Wiley, 1989.

Reference Books:

1. Energy Design for Architects, Shaw, Aee Energy Books, 1991.
2. Energy Conservation in Buildings – Royal Institute of Architecture, Canada.
3. Publication of CBRI, Roorkee – Energy Management in Buildings.

Web References:

1. https://www.diva-portal.org/smash/get/diva2:952035/FULLTEXT01.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAR1609.pdf
3. https://www.unido.org/sites/default/files/2009-02/Module18_0.pdf

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall answer any one of them. Each of these questions may contain sub-questions.

ENERGY STORAGE TECHNOLOGIES(EST)								
EEE						**Scheme: 2023**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MEE03	**Minor**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2 Hrs						**End Exam Duration: 3 Hrs**		

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

CO1: Understanding the Basics of Batteries and Their Performance Characteristics

CO2: Analyzing Primary Battery Types and Their Applications

CO3: Exploring Advanced Battery Technologies and Their Applications

CO4: Assessing Energy Storage for Renewable Energy Systems

CO5: Understanding and Applying Super capacitors in Energy Storage

UNIT – I

Batteries

Types-battery characteristics - voltage, current, capacity, volumetric energy density, specific energy density, charge rate, cycle life, internal resistance, energy efficiency, shelf life, battery management system, SoC, SoH estimation techniques. Testing of batteries, battery charging method, Factors affecting the battery performance.

UNIT – II

Primary Batteries

Fabrication, performance aspects, packing and rating of alkaline manganese, silver oxide cells. Lithium primary batteries-Lithium/Manganese Dioxide, Lithium/Carbon Monofluoride, Lithium/Thionyl chloride, Lithium/Sulfur Dioxide, Lithium/Iodine, Lithium-Aluminum/Iron Disulfide

UNIT – III

Advanced Batteries

Advanced Lead Acid Battery -design, performance aspects, Pb-Acid batteries for transportation, nickel-metal hydride batteries, zinc- alkaline batteries, ZEBRA Battery (Na/NiCl2) -NaS Battery-Lithium-Ion Battery-Lithium- Polymer Battery, Li-air batteries, Li-S batteries, Sodium -ion batteries

UNIT – IV

Storage for Renewable Energy Systems

Solar energy, Wind energy, pumped hydro energy, Energy storage in Micro-grid and Smart grid, Energy Management with storage systems, Battery SCADA, Increase of energy conversion efficiencies by introducing energy storage. Superconducting Magnetic Energy Storage (SMES),

charging methodologies, Photo galvanic cells, semiconductor solar batteries (SC-SB), thermo-ionic converter s, dye-sensitized solar cells (DSSC).

UNIT – V

Super capacitors and Fuel Cells

Fundamentals of electrochemical Super capacitors, electrode and electrolyte interfaces and their capacitances, charge-discharge characteristics, energy/power density, design, fabrication, operation and evaluation, thermal management. Super capacitors for transportation applications - aqueous and organic based super capacitors, Pseudo and asymmetric super capacitors. Advance battery-super capacitors hybrids for auto, space and marine applications. Fuel Cells working Principle and Construction.

Text Books:

1. Dell, Ronald M. Rand and David A. J., ―Understanding Batteries‖, Royal Society of Chemistry, 2001.
2. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij VM. Volfkovich., ―Electrochemical power sources : Batteries, fuel cells, and supercapacitors‖, John Wiley & Sons, Inc.,2015.

Reference Books:

1. Lindon David, ―Handbook of Batteries‖, McGraw Hill, 2002.
2. Kiehne H. A., ―Battery Technology Handbook‖, Expert Verlag, RenningenMalsheim, 2003.
3. AuliceScibioh M. and Viswanathan B., ―Fuel Cells – Principles and Applications‖, University Press, 2006.
4. A.G.Ter-Gazarian, ―Energy Storage for Power Systems‖, The Institution of Engineering and Technology (IET) Publication, UK, 2011.

Web References:

1. http://older.erckerala.org/docs/Energy%20storage%20systems%20digital%20%20flyer.pdf
2. https://mrce.in/ebooks/Engineering%20Energy%20Storage.pdf

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall answer any one of them. Each of these questions may contain sub-questions.

ENERGY SCENARIO AND ENERGY POLICY (ESEP)								
EEE						**Scheme: 2023**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MEE04	**Minor**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs						**End Exam Duration: 3 Hrs**		

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

CO1: Understanding the Global Energy Scenario and Its Impact on Economic Development.

CO2: Analyzing International Energy Policies and Treaties.

CO3: Understanding the Indian Energy Scenario and Policy Framework.

CO4: Evaluating Global Energy Issues and Energy Security.

CO5: Exploring Energy Conservation and Sustainable Development.

UNIT – I

Global Energy Scenario

Role of energy in economic development and social transformation - Energy and GDP - GNP and its dynamics - Energy sources and overall Energy demand and availability - Energy consumption in various sectors and its changing pattern - Depletion of energy sources and impact exponential rise in energy consumption on economies of countries.

UNIT – II

Energy Polices

International Energy Polices of G-8 Countries - G-20 Countries - OPEC Countries - EU Countries - International Energy Treaties (Rio, Montreal, Kyoto) - INDO-US Nuclear Deal.

UNIT – III

Indian Energy Scenario

Energy resources and Sector wise energy Consumption pattern Impact of energy on economy and development - National and State Level Energy polices and Issues - Status of Nuclear and Renewable Energy and Power Sector reforms. Energy policy 2030.

UNIT – IV

Energy Policy

Global Energy Issues - Energy Security - Energy Vision Energy Pricing and Impact of Global Variations Energy Productivity (National and Sector wise productivity).

UNIT – V

Energy Conservation

Act – 2001 and its features - Electricity Act – 2003 and its features - Energy Crisis - Future energy options - Need for use of new and renewable energy sources - Energy for Sustainable development.

Text Books:

1. Energy for a sustainable World: Jose Golden berg, Thomas Johan son, AKN. Reddy, Robert Williams (Wiley Eastern).
2. Energy Policy, B.V. Desai (Wiley Eastern)

Reference Books:

1. Modeling approach to long term demand and energy implication, J.K.Parikh
2. Energy Policy and Planning, B.Bukhootsow
3. TEDDY Year Book Published by Tata Energy Research Institute(TERI) World Energy Resources, Charles E. Brown, _International Energy Outlook' - EIA annual Publication.
4. BEE Reference book: no. 1/2/3/4

Web References:

1. https://nptel.ac.in/courses/109106161
2. https://www.teachmint.com/tfile/studymaterial/eee/energyconservationandaudit/energy conservation audit unit 1to5pdf /90d95659- f785-4665-834f- 28edae4477d5

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall answer any one of them. Each of these questions may contain sub-questions.

WASTE ENERGY MANAGEMENT(WEM)								
EEE						**Scheme: 2023**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MEE05	**Minor**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2 Hrs						**End Exam Duration: 3 Hrs**		

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

CO1: Understanding and Characterizing Different Types of Waste

CO2: Analyzing Thermo-Chemical Waste Conversion Methods and Their Environmental Impacts

CO3: Exploring Bio-Chemical Conversion Technologies for Waste to Energy

CO4: Evaluating Energy Production from Waste Plastics and Waste Heat Recovery

CO5: Analyzing Environmental and Health Impacts of Waste-to-Energy Conversion and Case Studies

UNIT – I

Characterization Of Wastes

Agricultural residues and wastes including animal wastes; industrial wastes; municipal solid wastes. Waste processing types and composition of various types of wastes; Characterization of Municipal Solid Waste, Industrial waste and Biomedical Waste, waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of Municipal solid waste.

UNIT – II

Thermo Chemical Conversion

Incineration, pyrolysis, gasification of waste using gasifiers, environmental and health impacts of incineration; strategies for reducing environmental impacts. Energy production from wastes through incineration, energy production through gasification of wastes, Energy production through pyrolysis and gasification of wastes, syngas utilization.

UNIT – III

Bio-Chemical Conversion

Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion biogas production, and present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages. Energy production from wastes through fermentation and trans esterification. Cultivation of algal biomass from waste water and energy production from algae, Energy production from organic wastes through anaerobic digestion and fermentation.

UNIT – IV

Energy Production From Waste Plastics, Gas Cleanup Waste, Heat Recovery

Concept of conversion efficiency, energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices.

UNIT – V

Environmental and Health Impacts-Case Studies

Environmental and health impacts of waste to energy conversion, Industrial waste management – Hazardous waste management – E-waste management -EV Batteries – Mobile Chargers - case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco- technological alternatives for waste to energy conversions.

Text Books:

1. Parker, Colin and Roberts, ―Energy from Waste – An Evaluation of Conversion Technologies‖, Elsevier Applied Science, 1985.
2. Khandelwal, K. C. and Mahdi, S. S., ―Biogas Technology - A Practical Hand Book‖, Vol. I & amp; II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books:

1. Robert C. Brown, ―Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power‖, John Wiley and Sons, USA, 2019
2. Sergio Capareda, ―Introduction to Biomass Energy Conversions‖, CRC Press, USA, 2013.
3. Krzysztof J Ptasinski, ―Efficiency of Biomass Energy: An Exergy Approach to Biofuels, Power, and Biorefineries, John Wiley & Sons, USA, 2013.
4. Vesilind, P.A., and Worrell W. A, ―Solid Waste Engineering, 2nd Ed‖, Cengage India, 2016.

Web References:

1. https://vtu.ac.in/pdf/2022syll/handbookBETCK105F.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCIA4002.pdf
3. https://stannescet.ac.in/cms/staff/qbank/EEE/Notes/EE8703-RENEWABLE%20ENERGY%20SYSTEMS-139177568-RES%20UNIT%204.pdf

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall answer any one of them. Each of these questions may contain sub-questions.

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