**ELECTRICAL ENGINEERING DEPARTMENT**

**MULTIDISCIPLINARY MINORS**

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| **Semester** | **Course Code** | **Course Title** | **L** | **T** | **P** | **S** | **Cr** |
| IV | MD M-01 | **Clean and Green Energy** | 3 | 0 | 0 | 1 | 3 |
| V | MD M-02 | **Energy Resources, Economics and Environment** | 4 | 0 | 0 | 1 | 4 |
| VI | MD M-03 | **Energy Audit and Management** | 4 | 0 | 0 | 1 | 4 |
| VII | MD M-04 | **Multidisciplinary Project** | 0 | 0 | 4 | 1 | 3 |
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| **SEMESTER IV**  **[MDM- 01] Clean And Green Energy** | |
| **Teaching Scheme** Lectures:3 hrs./week  Self-study:1 hr/week | **Examination Scheme**  Mid Semester Evaluation- 30 Marks  TA – 10 Marks  End Semester Evaluation - 60 Marks |
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| **Unit 1 (4 hrs)**  **Introduction:**  Energy as an indicator of development, World energy scenario, Energy consumption, Type of energy, Future perspective, Indian energy scenario, Energy consumption, Type of energy, Future perspective, Need of clean and renewable energy, Routes for clean energy from fossil fuels, Routes for renewable energy production, Energy conservation | |
| **Unit 2 (5 hrs)**  **Solar Energy**  Techniques for solar energy conversion to useable form, Solar thermal, Solar photo voltaic, Sun as a source of energy, Solar radiation and spectrum, Solar insulation: Some facts | |
| **Unit 3 (5 hrs)**  **Solar Energy Applications**  Applications of solar energy, Advantage and disadvantage of solar energy, Techniques for solar energy conversion to useable form: Solar thermal, Solar photo voltaic | |
| **Unit 4 (5 hrs)**  **Wind Energy**  Wind as a source of energy, Wind energy system, Types of wind machines, Energy production from wind, Wind energy computation, Nature of wind and selection of site | |
| **Unit 5 (6 hrs)**  **Wind Mills**  Parts of wind mills, Horizontal axis wind mill, Vertical axis wind mill. Rotors of wind mills, Advantage and disadvantage of wind mill, Wind energy in India, Future of wind energy | |
| **Unit 6 (6 hrs)**  **Other Renewable Energy Sources**  Physical conversion of biomass and wastes for energy use, Densification of biomass and wastes, Tidal Energy, Geothermal Energy. | |
| **Text Books:**   * Chetan Singh Solanki, “Solar Photovoltaics: Fundamentals, Technologies and Applications”, PHI Learning Private Limited, 2012. * P. Mondal, Technologies for clean and renewable energy production. Available at-https://drive.google.com/file/d/17vQiXJkTt9PqV8emokFJuCgiptyhonxr/view * S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009 * Rai. G.D, “Non conventional Energy Sources”, Khanna publishes, 1993. | |
| **Reference Books:**   * John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006. * Gray, L. Johnson, “Wind Energy System”, prentice hall of India, 1995 * B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009. * Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013 | |

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| **SEMESTER V**  **[MDM 02 ] Energy Resources, Economics and Environment** | |
| **Teaching Scheme**  Lectures:4 hrs./week  Self-study:1 hr/week | **Examination Scheme**  Mid Semester Evaluation- 30 Marks  TA – 10 Marks  End Semester Evaluation - 60 Marks |
| **Course Outcomes:**  At the end of the course, students will demonstrate the ability to   1. analyze the availability of energy resources and assess methods for quantifying resource depletion and scarcity. 2. apply basic concepts in economics to energy systems and their impacts. 3. utilize tools and techniques for project economics from both individual/company and macro-decision-making perspectives. 4. understand fundamental concepts of welfare economics and environmental economics relevant to energy systems analysis. 5. evaluate the environmental impacts of energy systems and their associated economic implications.   **Unit 1 (4 hrs)**  Energy Flow Diagram ,Global Trends in Energy Use, India and World- Disaggregation by supply, end use, Energy and Environment, The Kaya Identity, Emission Factor  **Unit 2 (4 hrs)**  Energy and Quality of Life, Energy Inequality, Energy Security, Introduction to Country Energy Balance assignment  **Unit 3 (5 hrs)**  Energy Economics - Simple Payback Period, Time Value of Money- discount rate, Criteria for Assessing Energy Projects –(Net Present Value (NPV), Benefit/Cost Ratio (B/C), Inflation, Internal Rate of Return (IRR)  **Unit 4 (5 hrs)**  Resources & Reserves Growth Rates in Consumption, Estimates of Duration of Fossil Fuels, McKelvey Diagram, Peak oil, Hubbert’s model  **Unit 5 (6 hrs)**  Materials used in renewable energy (Kuznet’s Curve, Betting on the planet, Simon’s Change), Non Renewable Energy Economics (Hotelling’s Rule)  **Unit 6 (6 hrs)**  Preferences and Utility, Utility and Social Choice Public and private goods / bads, Demand curves , Externalities Financing Energy – Debt/ Equity- Sources of funds, innovative financing models Input Output Analysis Primary Energy Analysis, Net Energy Analysis, Examples, Energy Cost of Energy, Life Cycle Analysis of Bioenergy, Net Energy Examples, Energy Policy, Energy Policy Examples, Practice problems solution. | |
| **This course is based on Swayam Portal Course by Dr. Rangan Banergy**  [**https://archive.nptel.ac.in/courses/109/101/109101171/**](https://archive.nptel.ac.in/courses/109/101/109101171/)  **Text Books:**    Dr. Rangan Banergee, “Energy Resources, Economics and Environment”  https://drive.google.com/file/d/1Ndn32ykytW2JV2eLHtR1KrqpHzGwTqBM/view | |

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| **Semester VI**  **[MDM-03] Energy Audit and Management** | |
| **Teaching Scheme**  Lectures:4 hrs./week  Self-study:1 hr/week | **Examination Scheme**  Mid Semester Evaluation- 30 Marks  TA – 10 Marks  End Semester Evaluation - 60 Marks |
| **Course Outcomes:**  At the end of this course students will demonstrate the ability to:  1. identify, formulate and solve energy related problems in the broad areas like electrical and  mechanical installations, electrical machines, power systems.  2. plan and execute energy management strategies.  3. perform energy audit and put forward practical solutions for energy conservation.  4. understand the energy billing and financial aspect in energy audit. Unit 1 [06 Hrs] **Energy Scenario**  Energy sources-Primary and Secondary, Commercial and Non-commercial, Renewable and Non-Renewable; Energy scenario in India (sector wise consumption, energy needs and integrated energy policy) and Global scenario, Energy Security, Energy and GDP, Energy Intensity on purchasing power parity, Electricity pricing in India, Energy conservation and its importance Unit 2 [06 Hrs]Energy Conservation PoliciesSalient Features of the Energy Conservation Act, 2001 &, The Energy Conservation (Amendment) Act, 2022, Schemes of BEE under the Energy Conservation Act-2001, Electricity Act, 2003, Integrated Energy Policy, National Action Plan on Climate Change (NPACC)Unit 3 [08 Hrs]Energy Audit and ManagementEnergy Audit Definition, Need for Energy Audit, Types of Energy Audit and Approach, Understanding Energy Costs, Benchmarking, Energy Performance, Matching Energy Usage to Requirement, Maximizing System Efficiencies, Optimizing Input Energy Requirements, Fuel and Energy Substitution, Instruments and Metering For Energy Audit, Bureau of Energy Efficiency (the manner and intervals of time for conduct of energy audit) Regulations, 2008; Components of Materials and Energy Balance, Basic Principles of Material and Energy Balance, Classification of Processes.Unit 4 [06 Hrs] **Energy Monitoring**  Assessing Energy Profile and Establishing Baseline, Energy Policy and Planning Implementation, Evaluating Energy Performance, Recognize Achievements; What is Monitoring & Targeting? Key Elements of Monitoring & Targeting, Data and Information Sources, Data and Information Analysis, Energy Management Information System (EMIS); Project Development Cycle (PDC), Project Planning Techniques,  Implementation Plan for Top Management, Planning Budget Unit 5 [06 Hrs]Financial and Project ManagementInvestment Need, Appraisal and Criteria, Financial Analysis Techniques; Simple payback period,ROI, Cash Flow, Sensitivity and Risk Analysis, Time value of money ,Net present value,IRR,Breakeven analysis, Energy Performance Contracting and Role of ESCOs, Developing a Typical ESCO Contract, Municipal Energy Efficiency Project through Performance Contracting **Unit 6 [06 Hrs]**  **Global Environmental Issues**  Acid Rain ,Ozone Layer Depletion, Global Warming and Climatic Change ,International Agreements: United Nations Framework Convention on Climate Change (UNFCCC),The Intergovernmental Panel on Climate Change (IPCC) ,Conference of Parties (COP) ,The Kyoto Protocol, Sustainable Development  **Text Books**:  1. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book General Aspects (available online)  2. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book2, Thermal Utilities (available online)  3. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)  4. Guide books for National Certification Examination for Energy Manager Energy Auditors Book-4  (Available online)  **Reference Books**:  1. S.C. Tripathy, “Utilization of Electrical Energy”, Tata McGraw Hill  2. Success stories of Energy Conservation by BEE, New Delhi ([www.bee-india.org](http://www.bee-india.org)). | |
| **Semester VII**  **[MDM-04] Multidisciplinary Project** | |
| **Teaching Scheme**  Practicals:4 hrs./week  Self-study:4 hr/week | **Examination Scheme**  100 Marks: Continuous Evaluation |
| **Course Outcomes:**  Students will be able to:   1. formulate problem statement 2. design a system based on earlier multidisciplinary minors 3. simulate, fabricate and test the system. 4. work in team and to communicate effectively 5. realize impact on environment.   Students will work on the problem statement offered by faculty and students. The student and faculty may collaborate with industry to make it industry relevant. | |

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