CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)
M. Tech. in Energy and Environmental Engineering

SECOND SEMESTER

S. No.	Board of Study	Subject code	Subject	Periods per week			Scheme of exam			Total	Credit L+(T+P)/2
				L	T	P	Theory/Practical			Marks	
							ESE	CT	TA		
1.			Geo environment, Effluent Treatment & Waste Utilization	3	1	-	100	20	20	140	4
2.			Biomass Conversion Technologies	3	1	-	100	20	20	140	4
3.			Energy Efficiency In Electrical & Thermal Utilities	3	1	-	100	20	20	140	4
4.			Solar Thermal And Solar Photovoltaic system	3	1	-	100	20	20	140	4
5.	**Refer Table-II**		**Elective-II**	3	1	-	100	20	20	140	4
6.			Solar Thermal & Photovoltaic Lab	-	-	3	75	-	75	150	2
7.			Energy Efficiency Lab	-	-	3	75	-	75	150	2
TOTAL				**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

Table -II

Elective- II			
S. No.	**Board of Study**	**Subject code**	**Subject**
1			Waste disposal & management
2			Mini & Micro Hydel Systems
3			Air & Noise Pollution Control
4			Remote Sensing & GIS Applications
5			Renewable Energy & Sustainable Development

L- Lecture T - Tutorial P - Practical ESE - End Semester Exam
CT - Class Test TA - Teachers Assessment

Note (1) 1/4th of total strength of students subject to minimum of twenty students is required To offer an elective in the college in a Particular academic session .

Note (2) Choice of elective course once made for an examination can be changed in future examinations.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Geo Environment, Effluent Treatment & Waste Utilization**
Code:
Total Theory Periods: **30** Total Tutorial Periods: **10**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

Unit – I
Introduction to Environmental Geotechniques-Environmental cycles and their Interaction-Soil water environment interaction relating to geotechnical problems-effect of pollution on soil water behavior ,Sources, production and classification of wastes, chemical reactions in subsurface.

Unit – II
Fly ash characterization process and utilization, Landfill engineering- Criteria for selection of sites for waste disposal facilities-parameters controlling the selection of wastes disposal sites-current practices for waste disposal, Liners-types and design-Passive containment systems-Leachate contamination, applications of geo-membrane, land fill gases and their properities, Landfill Gas monitoring systems.

Unit – III
Contaminant Transport phenomena in saturated and partially saturated porous media, contaminant migration and contaminant hydrology, Contaminant site remediation Bearing capacity of compacted fills- foundation for waste fill ground, Case studies of foundation failures by ground contamination.

Unit – IV
Characterization, Stabilization and Disposal Safe disposal of waste, site selection for landfills, characterization of land fill sites – waste characterization –stability of landfills, current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system– mechanism of stabilization, solidification of wastes, micro and macro encapsulation, absorption, adsorption, precipitation- detoxification , organic and inorganic stabilization. Long-term behavior of landfills-Landfill closure, Recultivation and aftercare of landfill, Ground modification techniques in waste fill, Remedial measures for contaminated grounds-Remediation technology-Bio-remediation.

Unit-V

Energy Generation from Waste Types: Biochemical Conversion: Sources of energy generation, Industrial waste, agro residues; Anaerobic Digestion: Biogas production; Determination of BOD, DO, COD, TOC & Organic loading, Aerobic & Anaerobic treatments – types of digester – factors affecting bio-digestion - Activated sludge process. Methods of treatment and recovery from the industrial waste water – Case Studies in sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.

Text Books:

1. Edward A., McBean, Frank A. Rovers “Solid Waste Landfill Engineering and Design”, Prentice Hall PTR.
2. Daniel D.E., “Geotechnical Practice for Waste Disposal”, Chapman & Hall, First edition.
3. Zheng C., “Applied Contaminant Modeling”, John Wiley & sons, First edition.

References:

1. Parker, Colin, & Roberts, *Energy from Waste - An Evaluation of Conversion Technologies*, Elsevier Applied Science, London, 1985
2. Shah, Kanti L., *Basics of Solid & Hazardous Waste Management Technology*, Prentice Hall, 2000
3. Manoj Datta, *Waste Disposal in Engineered Landfills*, Narosa Publishing House, 1997
4. Rich, Gerald et.al., *Hazardous Waste Management Technology*, Podvan Publishers, 1987
5. Bhide AD., Sundaresan BB, Solid *Waste Management in Developing Countries*, INSDOC, New Delhi,1983.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Biomass Conversion Technologies**
Code:
Total Theory Periods: **30** Total Tutorial Periods: **10**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

Unit I
Biomass: Biomass resources, Generation and utilization; classification and characteristics, Properties of biomass, Agriculture Crop & Forestry residues used as fuels; Techniques for biomass assessment; Application of remote sensing in forest assessment; Biomass estimation.

Unit II
Biochemical and Thermo-chemical Conversion: Combustion, Gasification, Biomass gasifiers and types etc. Applications of Gasifiers to thermal power plants and Engines. Concept of Bio-energy: Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials. Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification.

Unit III
Biomethanation: Importance of biogas technology, Different Types of Biogas Plants. Bio-Chemical Conversion: Aerobic and Anaerobic conversion. Bio-fuels: Types of Bio-fuels, Production processes and technologies, Bio fuel applications, Ethanol as a fuel for I.C. engines, Relevance with Indian Economy. Biomass, Feed stocks, Chemicals, Plastics, Fibres etc. Government Policy and Status of Bio fuel technologies in India.

Unit IV
Biomass combustion reactions: Combustion systems – Wood stoves and industrial combustion systems – Fluidized bed combustion systems – Phase theory - Densification – Types of devices – Performance parameters Feed preparation – Properties of densified fuels – Applications - Charcoal production – Dendrothermal power generation.

Unit V
Power generation: Utilization of gasifier for electricity generation; operation of spark ignition and compression ignition engine with wood gas, methanol, ethanol & biogas; biomass integrated gasification/combined cycles systems. Sustainable co-firing of biomass with coal.

Text Books:
1. Biomass Regenerable Energy – D.O.hall and R.P. Overeed John Wiley and Sons, New york,
2. Biomass for energy in the developing countries – D.O.Hall, G.W.barnard and P.A.Moss (Pergamon Press Ltd. 1982)
3. Thermo chemical processing of Biomass, Bridgurater A V.
4. Biomass as Fuel – L.P.White (Academic press1981)
5. Biomass Gasification Principles and Technology, Energy technology review No. 67, - T.B. Read (Noyes Data Corp., 1981)

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. – II (Energy and Environmental Engineering)
Subject: **Energy Efficiency in Electrical and Thermal Utilities**
Code:
Total Theory Periods: **30** Total Tutorial Periods: **10**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

Unit 1

Electrical Systems:
Introduction of Electrical Systems, Tariff And Economic Considerations; T & D Losses.
Electrical Load Management; Maximum Demand Management,
Role of Power Factor And Its Improvement, Energy Efficient Technologies In Electrical Systems,
Electric Motors, Motor Types, Characteristics, Efficiency Energy Efficient Motors
Factors Affecting Energy Efficiency of a Motor, Soft Starters, Variable Speed Drives.

Unit 2

Compressed Air Systems:
Compressor Types and Performance; Compressed Air Systems Components,
Efficient Operation of Compressed Air Systems, Systems Capacity Assessment,
Energy Conservation Opportunities
HVAC and Refrigeration Systems:
Introduction: Types of Refrigeration Systems; Common Refrigerant And Properties,
Compressor Types And Applications, Performance Assessment of Refrigeration Plants,
Energy Conservation Opportunities.
Pumping Systems And Cooling Towers:
Types, Performance Evaluation, Efficient System Operation,
Energy Conservation Opportunities In Pumping Systems,
Introduction To Cooling Towers; Cooling Tower Performance, Efficient System Operation.

Unit 3

Lighting Systems
Basic Terms of Lighting Systems; Lamp and Luminaries Types, Recommended Illumination Level,
Methodology of Lighting Systems Energy Efficiency Study,
DG Set Systems
Introduction, Selection and Capacity Factor, Operational Parameters,
Performance Assessment of DG Systems.
Fans and Blowers
Types of Fans and Blowers, Performance Evaluation, Efficient System Operation,
Capacity Selections; Performance Assessment of Fans and Blowers.

Unit 4

Fuels and Combustion

Introduction To Fuels,Properties of Fuel Oil, Coal and Gas, Storage,
Handling and Preparation of Fuels Principles of Combustion, Combustion of Oil, Coal, and Gas,
Stoichiometric Air Fuel Ratio, Theoretical and Excess Air,
Energy Conservation In Boilers, Boiler Systems, Types of Boilers, Combustion in Boilers,
Performances Evaluation; Analysis of Losses,
Feed Water Treatment, Blow Down, Energy Conservation Opportunities.

Steam Systems

Steam Properties, Steam Distribution,
Steam Pipe Sizing and Designing,Steam Traps: Operation And Maintenance.

Unit 5

Furnaces

Types and Classifications of Different Furnaces,
Performance Analysis of Furnaces; Analysis of Losses,
General Fuel Economy Measures in Furnaces.

Waste Heat Recovery

Classifications and Applications, Benefits of Waste Heat Recovery, Commercial Waste Recovery

Insulators And Refractories

Purpose Of Insulations, Types And Applications,Calculation of Insulation Thickness;
Economic Thickness of Insulation,
Types and Properties of Refractories; Industrial Use of Refractories ,
Heat Losses From Furnace Walls, Energy Performance Assessment of Heat Exchangers.

Books

[1] General Aspect Of Energy Management And Energy Audit, 2010, Bee Guide Book
[2]. Energy Efficiency In Thermal Utilities, 2010, Bee Guide Book
[3]. Energy Efficiency In Electrical Utilities, 2010, Bee Guide Book
[4]. Turner Wc. Energy Management Handbook, 5th Edition, The Fairmont Press, 2005
[5]. Capehart, Turner, Kennedy. Guide To Energy
Management. Fifth Ed. The Fairmount Press, 2006.
[6]. Thumann, Younger. Handbook Of Energy Audit. Sixth Ed. The Fairmount Press, 2003.
[7]. Thumann, Mehta. Handbook Of Energy Engineering. Fifth Ed. The Fairmount Press, 2001

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Solar Thermal and Solar Photovoltaic System**
Code:
Total Theory Periods: **30** Total Tutorial Periods: **10**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

Unit: 1 Solar Thermal Systems

Review of Solar Thermal Systems, Solar Thermal Application: Water Heating for-Domestic Use-Solar Thermal Application: Water Heating for Industrial Use, Case of Active Solar Drying: Sludge Drying, Solar Thermal Application: Solar Distillation, Case of Passive Direct and Indirect Solar Distillation: Water Desalination, Case of Passive Solar Indirect Drying: Food Drying Case of an Active Solar Chemical Process: Water Detoxification, Solar cooling, Combined solar heating and cooling.

Unit: 2 Solar Thermal Power Plants

Solar Thermal Power Plants - Principles, Solar tower power stations, Parabolic trough power plants, Dish/Stirling systems, Solar updraft tower power plant, Solar pond power plants, Solar Chimney Power plant, Some Case Studies. Costs of Solar Process Systems-Investment-Operating Costs-Solar savings, Design Variables, Economic Figures of Merit-LC solar energy-LCC-LCS-ALCC-Payback time-ROI, Discounting inflation, Present-Worth factor, Life cycle Saving Method, Evaluation of other Economic Indicators, The P1, P2 Method, Uncertainties in Economic Analyses

Unit: 3 Solar Photovoltaic Cell

Introduction, what are solar cells, How solar cells work- introduction, Electronic structure of semiconductors-the solar cell-power losses solar Cells-Temperature and irradiation effects. From sand to pure silicon, Growth of silicon crystals, typical solar cell fabrication process, Module fabrication. Energy storage-introduction, Battery operation in PV systems, Lead-acid batteries. Introduction, Amorphous silicon cells, Thin polycrystalline silicon on low-cost substrates, Copper indium telluride's cells, cadmium telluride cells, integrally interconnected Modules.

Unit: 4 Photovoltaic Technology

Introduction, Crystal Structure, Cell Physics, Energy Bands, More about Electrons and Their Energy, Electrons and Holes, Direct and Indirect Band-Gap Materials, Doping, Transport, Generation and Recombination, The p–n Junction, Solar Cell Equations, Characterization, Efficiency- Temperature-Light, Type and Purity of Material, Parasitic Resistances, Current Research, Concentrating Solar Cells, Tandem Cells, Thin Film Technologies, Quantum Dots, Cell Applications, Utility Power Generation, Space Systems, Solar-Powered Products. Photovoltaic Power Generation: Principles, Technical description, Economic and environmental analysis, Some Case Studies.

Unit: 5 Photovoltaic Systems

Introduction to Photovoltaic Systems, System Design for off-grid & on-grid systems, Photovoltaic systems – Installation, Commissioning, Operations & Maintenance. Economics of Solar Photovoltaic Systems. Application of solar PV system -Introduction, Rural electrification-domestic supply, Health care system, Lighting, Battery charging. Water pumping- water pumping technology – sizing and cost, Professional applications- telecommunications and remote monitoring. Electric power generation in SPACE- Satellite PV system- PV generator. Grid connected system- PV power station- PV in buildings.

Text Books:

1. Duffie and Beckman. (2013). Solar Engineering of Thermal Process, Fourth edition, Wiley Publications.
2. G.N. Tiwari. (2013) Solar Energy- Fundamentals, Design, Modelling and Applications, Revised edition 2013, Narosa Publishing House Pvt. Ltd,
3. Solar Electricity, Second edition, John Wiley & Sons Ltd, Tomas Markvart (2009)

Reference Books:

1. Non-conventional Energy Resources, S.K. Kataria & Sons, S.Hasan Saeed and D.K.Sharma. (2013)
2. Solar Energy Utilization, Fifth Edition, Khanna Publishers, G.D. Rai. (2011)
3. D.Y. Goswami, F.Kreith and J.F. Kreider. (2003) Principles of Solar Engineering, 2nd Edition, Taylor
   & Francis.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Waste Disposal & Management**
Code:
Total Theory Periods: **30** Total Tutorial Periods: **10**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

Unit-I
Sources and Composition of Municipal Solid Waste: State Municipal solid waste, sources, advantages of determining the composition of Municipal solid waste, types of solid waste, types of materials recovered from MSW.

Unit-II
Properties of Municipal Solid Waste: Physical, Chemical and Biological properties.

Unit-III
Solid Waste Generation and Collection: Functional Elements of solid waste management program, methods of MSW collection and its generation, quantities of solid Waste generated and factors affecting solid waste generation rate, Quantities of materials recovered from MSW.

Unit-IV
Handling, Separation and Storage of Solid Waste: Importance of onsite handling of solid waste, onsite solid waste handling and separation at commercial and industrial facilities, storage of solid waste at the sources.

Unit-V
Processing of Solid Waste: Solid waste processing methods, processing steps of residential, commercial and industrial site MSW from various sources with clean flow Chart.

Text Book:

1. Hazardous Waste Management, 2nd Edition, MD LaGrega, PL Buckingham and JC Evans, McGraw-Hill, 2001.
2. Ramachandra T.V., 2006. Management of Municipal Solid Waste, Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Mini and Micro Hydel Systems**
Code
Total Theory Periods: 30 Total Tutorial Periods: 10
Total Marks in End Semester Exam: 100
Minimum number of class tests to be conducted: 02

Unit-I: Introduction to micro-hydropower technology
Energy scenario in India, Environmental aspects of Electrical Energy Generation , Energy for sustainable development, Renewable Energy sources-Advantages and limitations , Power from water ,Classification of hydropower and end uses, System components of Mini and Micro Hydropower, Introduction of Hydropower plant in India , Micro Hydropower plant in India Policy of India Government and concerned authorities Potential Hydropower plant projects identified in India Water management, Comparison of Hydro electric power plant and steam power plant.

Unit-II: Technical aspects of MHP plant
Main component of MHP plant ,Intake ,Canal, De-sanding basin, Spillway, Fore-bay, Penstock, Powerhouse, Tailrace, Suitable condition for MHP, Potential power from MHP, Turbine, Introduction, Types of turbine, Uses of turbine, Types of generator, Synchronous generator, Induction generator, Controllers for MHP generator, Control panel, Load control governor, Plant efficiency, Load factor, Operation and maintenance of MHP plant, Structured system for operation and maintenance, Maintenance of different parts of MHP Operation of different parts of MHP plant.

Unit-III : Application and Sustainability of MHP plant
Application of MHP , Agro processing , Battery charging, Small scale industries Overview of sustainability of MHP plant, Technically feasible, Social acceptance Community management, Financially viable.

Unit-IV : Failure of MHP plant
Overview of failure of MHP plant, Insufficient site studies Effects of floods and land slides, Uneconomical canal length, Insufficient structures for service and repair ,Inability to pay tariffs by targeted population.

Unit-V : Project evaluation and report preparation
Overview of project evaluation and report preparation, Plant factors, Unit energy cost, Cost benefit decisions, Financial analysis, Pre-feasibility and feasibility study, Pre-feasibility, Feasibility study, Problems, recommendations and areas of future prospective of MHP plant in India.

References:

1. Adam Harvey, “Micro Hydro design Manual”, Intermediate Technology Publication.
2. Win Hulsher and Peter Frankel, “The Power Guide, Intermediate Technology Publication.
3. “Manuals on MHP for Installation and Commissioning, Maintenance and Repair, Operation and Management”, ICIMOD.

4. Dr. Rajendra Shrestha, “Basics of micro hydropower (AE 123)”, Course Manual for Department of Alternative Energy Tumba College of Technology Rwanda, 2009
5. Rai G.D, “Introduction to Power Plant Technology”, Khanna Publishers, 1995
6. Ministry of New and Renewable Energy reference manual available at http://mnre.gov.in/schemes/grid-connected/small-hydro

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Air and Noise Pollution Control**
Code
Total Theory Periods: 30 Total Tutorial Periods: 10
Total Marks in End Semester Exam: 100
Minimum number of class tests to be conducted: 02

Unit 1
Introduction of Air pollutants: History of Air pollutants - Sources and classification of pollutants and their effect on human health vegetation and property. Reactions of pollutants and their effects- Smoke, smog , Fog and mist. : Meteorological parameters and their effects on urban air pollution,

Unit 2
Monitoring techniques: Sampling methods and measurements of air pollutants and meteorological parameters, Analyses of air pollutants, i.e. analytical techniques; Control: Methods of air pollution control for defined sources; Meteorology Inversions; Wind rose; Atmospheric stability; Plume behavior; Mixing heights; Fick's law of diffusion;

Unit 3
Global Issues of Air Pollution: Global air pollution: Acid rain, Ozone layer depletion, Green house effect and Trans-boundary pollution, Kyoto protocol, Carbon credit and carbon trading; Legislations and regulations: Ambient air quality standards, Emission standards, emission inventory, and Acts;

Unit 4
Introduction of Noise as pollutants: Noise: Definition of noise, Sources of noise, Effects of noise on, Noise on human health, scales of noise, Decibels and levels.

Unit 5
Monitoring techniques of noise level: Noise level monitoring techniques, International standards and Indian standards for measuring environmental noise. Determination of acoustic power under diffuse field conditions.

Text books:
1. Rao, M. N. and Rao, H. V. N., Air pollution, Tata McGraw-Hill Publishing Co; Ltd, New Delhi, 1993.
2. Nevers, N. D., Air Pollution Control Engineering, McGraw-Hill International Ed., 1993.
3. Pandey V., Noise Pollution, Meerut Publishers, 1995.
4. Zannetti, P., Air Pollution Modeling, Computational Mechanics Publications, Southampton, Boston, 1990.
***Reference books**:*
1. Wark, K. and Warner, C.F., Air Pollution, Its Origin and Control, Harper and Row, New York,1981.
2. Wayne T. D., Air Pollution Engineering Manual, John Wiley & Sons, 2000.
3. Rao, C. S., Environmental Pollution Control Engineering, New Age Int. Pubs, 2005.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Remote Sensing & GIS Application**
Code:
Total Theory Periods: 30 Total Tutorial Periods: 10
Total Marks in End Semester Exam: 100
Minimum number of class tests to be conducted: 02

UNIT I : LITHOLOGY AND STRUCTURE

Introduction- Rocks and Minerals Image characters of igneous, sedimentary and metamorphic rocks. Lithological mapping using aerial and satellite data - Structural Geology-Introduction- Mapping structural features such as folds lineaments / faults fractures Image characters of folds faults lineaments etc. - Digital techniques for lithological and structural analysis - case studies.

UNIT II : SPECTRA OF ROCKS AND MINERALS

Spectral properties of geologic features in different regions of Electromagnetic Spectrum Elemental composition and nature of the spectra of rocks and minerals-Optimal spectral windows - Geologic Remote Sensing and its significance in Geologic mapping - case studies.

UNIT III : GEOMORPHOLOGICAL APPLICATIONS

Introduction - Geomorphic processes and Geomorphic Landforms-Geomorphic mapping using aerial photographs and satellite data - Landform analysis in Ground water studies, coastal zone management and Civil Engineering projects - case studies.

UNIT IV REMOTE SENSING AND GIS APPLICATIONS

Thematic presentation of Lithologic structural and Geomorphic details ground truth data. Integration of all relevant data using Remote Sensing and GIS in ground water studies.

UNIT V CASE STUDIES ON RS & GIS APPLICATIONS

Coastal zone management-Disaster Management Studies like Landslides, Droughts and Floods, Engineering Geology -Mineral exploration and Petroleum exploration.

Text Books:-

1.Sabins, F.Remote Sensing principles and interpretation‟ W.H. Freeman and Company, 1987.
2.Parbin Singh, „Engineering and General Geology‟, Ketson Publication House, 1987.

Reference Book:-

1.Drury, S.A., Image interpretation in Geology , Chapman and Hall, 1993.
2..Michael N. Demers, “Fundamentals of GIS”, John Wiley and Sons, 1999
3..Laura Lang, “Managing Natural Resources with GIS”, ESRI Press, 1998.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester- M.Tech. - II (Energy and Environmental Engineering)
Subject: **Renewable Energy & Sustainable Development**
Code:
Total Theory Periods: 30 Total Tutorial Periods: 10
Total Marks in End Semester Exam: 100
Minimum number of class tests to be conducted: 02

Unit I

Traditional and modern energy use; Methods of accounting the role of traditional energy in the overall energy system. Energy consumption patterns in rural areas . Trends of rural energy consumption.Need and development of rural energy data bases (REDB); methodologies for building REDB. Case studies of REDB

Unit II

Integrated Rural Energy Planning (IREP): Origin, implementation, case studies, critique. Socio-economic and environmental issues of traditional energy use. Health impacts of biomass burning in cookstoves. The debate of black carbon from biomass burning. The energy ladder for cooking. Gender issues in biomass collection and processing.

Unit III

Rural electrification: Overview, current status and future perspectives. Linkages with rural livelihoods, rural industries and social development. Issues of subsidization, last mile access and paying capacity.

Unit IV

Review and critique of various programs of government: National Program for Biogas Development (NPBD), National Program for Improved Cookstoves (NPIC), Village Energy Security Plan (VESP), Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) etc.

Unit V

Use of efficient/appropriate/renewable energy technologies for rural areas. Technologies/products for cooking, water heating, drying, irrigation pumping, small/micro enterprises, lighting, motive power etc.

References:

1) Report by a Panel of Experts, *Rural electrification in Asia and the Far East New York* United Nations, 1963.
2) B. Kaye and William S: Pintz, *Rural electrification issue papers* Honolulu: Pacific Islands Development. 2004
3) Chambers, Ann, *Distributed Generation: A Non-technical guide*, 4th Ed., Penn well, Oklahoma, 2001
4) Devadas, *Planning for Rural Energy System: Part I & II, V* Renewable and Sustainable Energy Reviews, 5 (2001), 203-226, 227-270.
5) T.C. Kandpal, H. P. Garg, *Financial Evaluation of Renewable Energy Technology,* Macmilan, New Delhi, 2003.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Name of program: M. Tech. - II (Energy and Environmental Engineering)
Subject: **Solar Thermal & Photovoltaic Lab**
Code:
Total Lab Periods: Batch Size:
Maximum Marks: Minimum Marks:

List of Experiments: (At least Ten experiments are to be performed by each student)

Practicals for Solar Thermal

1. Determination of Thermal Efficiency of Flat Plate Collector.
2. To Determine the Heat Loon Factor and Heat Removal Factor of a Flat Plate Solar Collector.
3. Study of Thermal Performance of a Built In Storage Solar Water Collector.
4. Determination of Tim Constant of a Flat Plate Solar Collector.
5. Thermal Testing of a Box Type Solar Cooker Determination of First and Second Figure of Merit.
6. Performance Evaluation of a Single Basin Solar Still.
7. Performance evaluation of concentrating solar collector.
8. Study of Thermal Performance of an Air Heater.
9. Drying Performance of a Solar Dryer.
10. Performance evaluation of wind generators.

Practicals for Solar PV

1. Power Load Characteristic of a Photovoltaic Cell.
2. To measure the voltage and current of the solar cell in series and parallel combination.
3. To calculate the efficiency of the solar cell.
4. Solar PV Cell Power Output Vs Exposed Area, Azimuthal and Tilt Angle.
5. Performance study of a solar cell with different irradiation.
6. To study the I-V Characteristics of a Si solar cell with varying temperature at constant irradiation.
7. Study on charging characteristics of a lead acid battery using solar photo voltaic panel.
8. To study the Pmax characterization of solar cell with different insolation.
9. To study of the application of solar cell of providing electrical energy to the domestic appliance such as light, fan, water purifier, power bank, solar cooker.
10. To measure the impact of shadow on a solar module.
11. Performance evaluation of PV powered solar water pump.

Equipment List:

1. Photovoltaic Modules
2. Multi-meter
3. Photoluminescence set-up or sun simulator
4. I-V curve tracer
5. Photovoltaic setup with modules, structure, inverter, battery, DC & AC protection, meter, loads.
6. Irradiation sensor

7. Temperature sensor
8. Photovoltaic thermal tile.
9. Solar lanterns, LEDs, fans, water distiller, power banks, solar cooker, solar dryer
10. Colored transparency films
11. Solar water heater experimental set up with rotating solar collector, control box, inlet / outlet piping, storage tank with thermocouple.
12. Experimental setup with Solar water heater – flat plate type
13. Solar concentrator training system
14. Thermal energy Solar training system

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Name of program: M.Tech. - II (Energy and Environmental Engineering)
Subject: **Energy Efficiency Lab**
Code:
Total Lab Periods: Batch Size:
Maximum Marks: Minimum Marks:

List of Experiments: (At least Ten experiments are to be performed by each student)

1. Heat transfer by radiation and natural convection, drying of material by hot air
2. Shell and tube heat exchangers – LMTD, pressure drop, heat transfer coefficient
3. Plate heat exchangers – LMTD, pressure drop, heat transfer coefficient
4. Pump and turbine efficiencies
5. CoP of refrigeration cycles – VCR and VAR
6. Efficiency and BHP of SI and CI engines
7. Efficiency of Rankine cycle and Stirling cycle
8. Energy consumption measurements & lumen measurement of lights and ballasts, light efficacy
9. Fuel cell and its performance
10. Perform an experiment for efficiency testing of 3-phase squirrel cage induction motor and study the characteristics,
11. Study of various speed control methods and calculating their efficiencies
12. Testing of Propeller type of wind turbine
13. Testing of gasifier
14. Boiler efficiency testing
15. Measurement of the calorific value of different Bio-mass fuels