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

M.Tech. in Energy and Environmental Engineering

FIRST SEMESTER

S. No.	Board of Study	Subject code	Subject	Periods per week			Scheme of exam			Total Marks	Credit L+(T+P)/ 2
				L	T	P	Theory/Practical				
							ESE	CT	TA		
1.	Chemical Engg.	**589111(19)**	New and Renewable Energy Sources	3	1	-	100	20	20	140	4
2.	Chemical Engg.	**589112(19)**	Environmental Pollution & Management	3	1	-	100	20	20	140	4
3.	Chemical Engg.	**589113(19)**	Energy system modeling & Energy audit	3	1	-	100	20	20	140	4
4.	Chemical Engg.	**589114(19)**	Applied Instrumentation for Energy & Environmental monitoring	3	1	-	100	20	20	140	4
5.	**Refer Table-I**		**Elective-I**	3	1	-	100	20	20	140	4
6.	Chemical Engg.	**589121(19)**	Environmental Quality Monitoring Lab	-	-	3	75	-	75	150	2
7.	Chemical Engg.	**589122(19)**	Applied Instrumentation Lab	-	-	3	75	-	75	150	2
TOTAL				**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

Table -I

Elective- I			
Sr. No.	**Board of Study**	**Subject code**	**Subject**
1	Chemical Engg.	589131(19)	Energy Conversion
2	Chemical Engg.	589132(19)	Energy conservation & efficiency
3	Chemical Engg.	589133(19)	Environmental hydrology
4	Chemical Engg.	589134(19)	Energy economics & project management
5	Chemical Engg.	589135(19)	Bio- Energy technologies

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 .

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI C.G.

Semester- **M.Tech. - I** (Energy and Environmental Engineering)
Subject: **New and Renewable energy Sources**
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: Fundamentals of Energy Science & Energy Technology

Introduction to Energy Science, Review of various forms of Energy, Introduction to Energy Technology. Trends in Energy Consumption of primary Energy sources. World future energy demand, Alternate Energy Resources-Non Commercial Energy Resources-Solar Energy, Wind Energy, biomass and biogas, Tidal, Geothermal Energy, Hydrogen Energy, Fuel cell, Thermoelectric Power, Prospects of Renewable Energy sources & Advantages.

Unit 2: Wind Energy and Geothermal Energy

Introduction to Wind Energy, Application and Historical background, Merits and Limitations, Nature and Origin of Wind, Wind Power Density, Power in a Wind Stream, Wind Turbine Efficiency, Power of a Wind Turbine, Forces on the Blade of a Propeller, Wind Velocities and Height from Ground, Mean Wind Velocity, Wind Velocity duration curve, Energy Pattern Factor, Wind Power Duration Characteristics. Introduction and Important aspects of Geothermal Energy (GTE), Applications, Geothermal Energy Resources, Origin of Geothermal Thermal Resources, Geothermal Thermal Gradients, Non-uniform Geothermal Thermal Gradients, Hydro-Geothermal Resources, Geo-Pressure, Geothermal Resources, Petro-Geothermal Resources, Geothermal Electrical Power Plants and its Fluids.

Unit 3: Biomass and Biogas

Introduction to Biomass, Origin of Biomass, Biomass Energy Resources, Biomass Conversion Process, Applications of Biomass Energy Conversion Process, Direct Combustion of Biomass (Incineration), Thermo-chemical Conversion of Biomass, Biochemical Conversion, Fermentation, Gaseous Fuels from Biomass,

Introduction to Biogas, Raw Biomass materials for Conversion to Biogas, Agriculture waste and Agriculture Crops, Fruit Farms, Aquatic Biomass, Raw materials for Biogas Production, Significance of Biogas Plants, Average Composition of Biogas, Anaerobic Fermentation and Digestion Process used in Biogas Plants, Biogas Plants and its Types.

Unit 4: Solar Photovoltaics and Solar Thermal

Introduction to Solar Photovoltaics, Basics principles, operating principles, Types of solar cells, Features and Limitations of Solar Photovoltaic system, how solar cells work- introduction, Electronic structure of semiconductors-the solar cell-power losses, solar Cells-Temperature and irradiation effects, Application of solar PV system.

Introduction to Solar Thermal, Solar Collectors-Flat-Plate Collectors, Flat-Plate Collector -Thermal Testing, Collector - Efficiency Curve, Evacuated-Tube Solar Collectors, Solar Concentrating Collectors Fundamentals, Parabolic Concentrators, Compound Parabolic Concentrators (CPCs), Fresnel Lens Concentrators, Heliostats, Tracking Systems, Solar Thermal Systems-Passive and Active Solar Thermal Systems.

Unit 5: Hybrid Energy Systems

Introduction, Need for hybrid systems, Types of hybrid systems, PV hybrid with diesel generator, Wind-diesel hybrid systems, Biomass- diesel hybrid systems, Wind-PV hybrid systems, Micro hybrid systems, Biogas-solar thermal hybrid systems, Solar-cum-biomass dryer hybrid systems, Electric and hybrid electric vehicles, E-vehicle, Hydrogen-powered electric vehicle.

Text Book:

1. Non-Conventional Energy Sources, Fourth Edition, Khanna Publishers, G.D. Rai. (2011).
2. Energy Technology-Nonconventional, Renewable & Conventional, S. Rao and Dr. B. B. Parulekar, Khanna Publishers.

Reference Book:

1. Renewable Energy: Power for a Sustainable Future, Sept 2012, Oxford Press, Godfrey Boyle
2. Solar Energy- Fundamentals, Design, Modelling and Applications, Revised edition 2013, Narosa Publishing house Pvt.Ltd, G.N. Tiwari. (2013)
3. Biomass- Application, technology & production, N.C. Cheremenisoff, P.N. Cheremenisoff & F. Ellurbrush, Marcel Dekker, New York, 1980.
4. Geothermal Energy: An Alternative Resource for the 21st Century, K. Gupta and Roy Sukanta.
5. Geothermal Energy: Renewable Energy and the Environment, William E. Glassley.
6. Wind Energy Systems and Applications, Narosa publishing house, 2013, D. P. Kothari.

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

Semester- **M.Tech. - I** (Energy and Environmental Engineering)
Subject: **Environmental Pollution and 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-1

Primary wastewater Treatment : Introduction to wastewater treatment, Volume and strength reduction of wastewater, Flow diagram of wastewater treatment, Preliminary treatments, flow measurement, screen and shredder, grit chamber, skimming tank, Primary treatments sedimentation, primary clarifier, final clarifier.

Unit-2

Secondary wastewater Treatment: Trickling filter, activated sludge process, biological tower, combined filtration and aeration process, tapered, step and extended aerations. Low cost treatments sand filter, contact bed, rotating biological contactor, septic tank, stabilization pond and lagoons.

Unit-3

Tertiary wastewater Treatment: Chemical precipitation, Membrane filtration, Reverse osmosis, Ion exchange, Electrodialysis and Effluent disinfections, Design aspects of effluent treatment plant (ETP), Concept, operation and maintenance of common effluent treatment plant (CETP), Wastewater treatment for major industries such as
Fertilizer, sugar, petroleum refining, pesticides, pulp and paper, textile and power generation.

Unit-4

Sludge Treatment: Organic and inorganic sludges, Primary and secondary sludges, Compressible and noncompressible sludges, Thickening, Conditioning, Dewatering, Filtration, Digestion and Drying of sludges, Sludge disposal strategies.

Solid waste management: Land filling, Incineration, Pyrolysis, Composting, Biogas generation and recycling; Hazardous waste management; generation, classification, collection, storage, transportation and disposal.

Unit-5

Air and noise pollution control: Control of particulate matters; Gravity settling chamber, Cyclone separator, Bag filter and Electrostatic precipitator; Control of gaseous pollutants, scrubbing, adsorption, combustion and dispersal. Noise pollution control; at source, during transmission and at receptor.

Recommended Books:

1.Waste Water Engineering: Metcalf & Eddy, Tata Mc-Graw Hill Publishers, III Edition (1995)
2. Water Supply and Sanitary Engineering: S. C. Rangwala, Charotar publishing house, Anand (1992)
3. Water and Wastewater Technology: Mark J Hammer & Mark J Hammer Jr., Prentice Hall of India, IV Edition (2002)
4. Environmental Pollution Control Engineering: C.S.Rao,New Age International (P) Ltd. (1991)
5. Sewage Disposal and Air pollution engineering: S. K. Garg, Khanna publishers, New Delhi (1998)

6. Air Pollution and Control: Mowli and Subbayya, Divyajyoti Prakashan, Jodhpur (1989)
7. Air Pollution: V.P. Kudesia, Pragati Prakashan, New Delhi (1997)
8. Noise Pollution and Management: G. Gaur, Sarup and Sons, New Delhi (1997)

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

Semester- M.Tech. - I (Energy and Environmental Engineering)
Subject: **Energy System Modeling and Energy Audit** Subject Code:
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 Models and modeling approaches
Energy demand analysis and forecasting, economics of stand-alone power supply systems, project management. Macroeconomic Concepts-Measurement of National Output-Investment Planning and Pricing, Economics of Energy Sources, Reserves and Cost Estimation. Multiplier Analysis – Energy and Environmental Input / Output Analysis, Energy Aggregation, Econometric Energy Demand Modeling, Overview of Econometric Methods. The 2-variable regression model; The multiple regression model; Tests of regression coefficients and regression equation; Econometric techniques used for energy analysis and forecasting with case studies from India; Operation of computer package Input – Output Analysis.

Unit-II Energy Modeling
Interdependence of energy-economy-environent; Modeling concept, and application, Methodology of energy demand analysis; Methodology for Energy Forecasting-Sectoral Energy Demand Forecasting. Inter-fuel substitution models; SIMA model, and I-O model for energy policy analysis; Simulation and forecasting of future energy demand consistent with macroeconomic parameters in India; Energy Economics and Policies: National and Sectoral energy planning; Integrated resources planning; Energy pricing.

UNIT III Energy Audit Fundamentals

Energy Audit Definition, Need and Objectives.
Types of Energy Audit
Internal Audit, External Audit, Walk through Energy Audit, Preliminary Energy Audit, Detailed Energy Audit, Investment Grade Energy Audit, Industrial Energy Audit, Utility (Services) Energy Audit, Commercial Energy Audit, Residential Energy Audit.
Energy Audit Strategies
Monitoring and Control, Questioning the Need, Minimizing the Need of End Use, Minimizing the Losses, Operating the Equipment at Optimum Efficiency, Operating the Most Efficient Equipments from Set of Equipments, Minimizing the Idle Redundant Running, Proper Maintenance of the Equipment, Substitution with Efficient Equipment, Substitution with more Efficient Equipment, Substitution with more Efficient Process, Energy Storage, Fuel Substitutions, Quality Control and Recycling.

UNIT IV Important Survey Items
Buildings, Lightings, HVAC, Furnaces & Ovens, Boilers and Steam Lines, Air Compressor and Compressed Air Distribution Lines, Chillers and Chilled Water Distribution Lines, Process Water Generation and Distribution Lines, Electrical Distributions Transformers and Lines, Pumps, Fans and Blowers, Cooling Towers, Electrical Motors, Waste Heat Sources, Material Transport, Peak Load Equipments.
Basic Components of Energy Audit
Preparing for Audit Visit, Instrumentation, Data Collection Techno-economic Analysis, Safety Considerations.

UNIT V Methodologies of Conducting Energy Audit

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

Post Audit Analysis

Process Flow Diagram, Material and Energy Balance, Energy Use and Cost Profile of each Fuel Used, Energy Balance Diagram for each Energy Type Used, Identification and Techno-economic Analysis of Energy Conservation Measures, Classification of Energy Conservation Measures, Outlines of Energy Audit Report Format.

Energy Audit Subsidy Scheme of PCRA, IDBI and IREDA.

Useful Forms for Data Collections; Useful Charts for Quick Estimations; Checklists for each Devices and Distribution Lines; Thumb Rules and Specific Energy Indices for Devices and Processes.

Text Books:-

1. Energy Policy Analysis and Modeling, M. Munasinghe and P. Meier Cambridge University Press, 1993.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998.
3. Instructions to Energy Auditors, Vol. - I & Vol. - II – National Technical Information Services U. S. Deptt. of Commerce Springfield, VA 22161.
4. G.G. Ranjan: Optimizing Energy Efficiencies in Industry, Edition-2003, McGraw Hill.

Reference books:-

1. The Economics of Energy Demand: A Survey of Applications, W.A Donnelly New York, 1987.
2. Econometrics Models and Economic Forecasts, S. Pindyck and Daniel L Rubinfeld, 3rdedition McGraw Hill, New York 1991
3. J.A. Clarke, Energy Simulation in Building Design (2e) Butterworth 2001.
4. J.K. Nayak and J.A. Prajapati Hadbook on Energy Consious Buildings, Solar Energy Control MNES, 2006.
5. Energy Conservation Building Codes 2006; Bereau of Energy Efficiency.
6. Albert Thumann, P.E., C.E.M. , Plant engineers & Managers Guide To Energy Conservation 8th edition-2002, Published by The Fairmont Press, Inc 700 Indian Trail Liburn, GA30047.
7. BEE Volume I –Second Edition 2005.

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

Semester- M.Tech. - I (Energy and Environmental Engineering)
Subject: **Applied Instrumentation for Energy & Environmental Monitoring**
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 Measurements
Measurements of thermal and physical properties , Viscosity, Use of poiseuille flow, Falling, Rotating and Oscillating bodies, Thermal conductivity of solids and liquids, Low conductivity and metallic, Steady and unsteady sates. Measurement of specific heat of gases, data acquisition, Analog and digital conversion, Post processing of data, Statistical analysis, Goodness of data, Correlating data, Linear and non-linear regression.

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

Unit – III Error estimates
Error estimates in Temperature measurements, Solids and fluids, Steady sate and unsteady measurements, Radiation effects, Platinum resistance thermometers, Construction and usage, Calibration, Bridges, Fluid pressure measurement, Capacitive probes , Piezoelectric pressure sensors, Anemometry.

Unit - IV Thermal radiation measurements
Thermal radiation measurements, Radiometry, Surface radiation measurements, Gas radiation instruments, Errors in radiation measurements, Transient experimental techniques for surface heat flux rates, Negligible internal resistance , Negligible surface resistance, Rapid response measurements, Thick film and thin film gauges, Non uniform surface temperatures , Quasi steady measurements.

Unit – V Temperature Measurements
Temperature Measurements in high temperature gases, Calorimetric electrostatic, radiation, cyclic, transient pressure and heat flux probes, Spectroscopic methods, Cooled film sensors ,Temperature measurement in cryogenics, Scales of measurement of temperature, Schlieren shadow-graph and interferometer, Errors in optical measurements.

Text book:
1. E.R.G. Eckert and R.J. Goldstein; Measurement in Heat Transfer, McGraw Hill, 1976.
2. J.P. Holman: Experimental Methods for engineers, McGraw Hill, 1971.
3. E.O. Doebelin: Measurements Systems: Application and Design.
4. T.G. Beekwith and L.M. Buck: Mechanical measurements, Adison-Wesley, 1965.
5. Barney: Intelligent Instrumentation, Printice Hall, 1988.

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

Semester- **M.Tech. - I** (Energy and Environmental Engineering)
Subject: **Energy Conversion**
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: Basics of Energy Conversion
Importance of Electrical energy in modern industrial society. Energy conversion process, indirect and direct energy conversion. Production of electricity using coal, oil, natural gas, nuclear fuels and hydel ,-its relative advantages and disadvantages (i.e. conversion of Thermal, Nuclear, hydel energy into electric energy).

Unit-2: Energy Conversion Techniques
Electricity generation using Renewable Energy Sources: Basic Principles and Applications. (Conversion of Electromagnetic energy and natural energy sources like solar radiation, Wind, Ocean waves, Solid waste etc. to electricity. Thermal power plant, nuclear power plants and hydroelectric power plant.

Unit-3: Conversion of Electrical Energy to Mechanical Energy
Electric Motors: Types, Losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, Energy efficient motors. Pumps and Pumping Systems: Types, performance evaluation, efficient system operation, flow control strategies, variable speed drives.
Diesel generating systems: Factors affecting selection, energy performance assessment of diesel conservation avenues.

Unit -4: Direct Energy conversion - I
Preview of semiconductor physics: Basic ideas of quantum physics, Fermi Energy, band diagram, Intrinsic and extrinsic semiconductors, p-n junction.
Thermoelectric conversion: thermoelectric effects, analysis of thermoelectric generators and coolers, figure of merit, device configuration.

Unit -5: Direct Energy conversion - II
Photovoltaic conversion: Optical effects of p-n junction, design and analysis of PV cells. PV cell fabrication, System design.
Magnetohydrodynamic conversion: gaseous conductors, analysis of MHD generators.
Batteries and fuel cell: Thermodynamic analysis, design and analysis of batteries and fuel cells. Other modes of direct energy conversion.

Text Books:

1. Begamudre, Rakoshdas, Energy Conversion systems , New Age International 2007
2. Kettani, M.A., Direct energy conversion, Addison-Wesley,Reading, Mass, 1970.
3. Angrist S.W. ,Direct Energy Conversion. 4th Ed. Allyn And Bacon, Boston, 1982
4. Green M.A. ,Solar Cells, Prentice-Hall, Englewood Cliffs, 1982

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

Semester- **M.Tech. - I** (Energy and Environmental Engineering)
Subject: **Energy Conservation and Efficiency**
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 Introduction
Basic Areas for Energy Efficiency and Conservation Measures, Low Cost/ No Cost Energy Conservation Measures (ECMs), Weatherization ECMs Replacement vs. Retrofits of Equipment. Energy bill analysis, including power factor correction, peak demand limiting, rate structure and comparison to alternative rate opportunities, including green power.

Unit 2 Data Acquisition And Monotiring Instruments
Brief introduction to data Acquisition, Monitoring, Auditing, and System Balancing Equipment for Energy Analysis, including: data loggers, universal data recorder, flue gas analyzer, thermometer, utility meters, combustion analyzers, infrared thermography, airflow velocity meters, relative humidity measures, electrical meters, refrigeration measures, light meter, and sling psychrometer.

Unit 3 Energy Systems
HVAC Energy Conservation Measures (ECMs) HVAC tuning and operation ECMs, including equipment sizing, selection and maintenance, heating combustion efficiency, system efficiency, steam traps, chiller optimization, Coefficient of Performance and Energy Efficient Rating, stratified air consideration, psychrometric charts, economizer cycles, waste heat recovery, operating and maintenance considerations, cogeneration and micro-turbines, and thermal storage.

Unit 4 Building Equipments
Other Building Equipment ECMs (kitchen, laundry, office equipment) Energy Star and other Energy Efficiency Ratings Domestic Water Heating ECMs Compressed Air ECMs. Building Envelope ECMs Conduction and infiltration heat loss/gain, including vapor barriers, insulation levels, radiant heat gain/loss, solar shading, infiltration, building ventilation, and thermal mass of building.

Unit 5 Efficiency in Motors and Lighting System
Electrical ECMs – Lighting Systems Review, Pumps, fans, motors review, including efficiencies, belt drives, variable speed/frequency drives, load factors, fan laws, pump curves. Prioritization of ECMs based on Cost Effectiveness and Environmental Impacts.

Text Book:

1. Management of Energy Environment Systems -W.K.Foell (John Wiley and Sons).
2. Energy Management and Control Systems -M.C.Macedo Jr. (John Wiley and Sons).
3. Environmental Impact Analysis Handbook -J.G.Rau, D.C.Wood (McGraw Hill).
4. Energy & Environment – J.M. Fowler, (McGrawHill)

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

Semester- M.Tech. - I Energy and Environmental Engineering)
Subject: **Environmental Hydrology**
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 - Hydrologic cycle

The hydrologic cycle; Watersheds, drainage basins, and catchments; Quantitative calculations involving water: units, dimensions, rates; Designing a rain garden; Dew point, humidity, and saturation; Causes of precipitation; Measuring dew point. Measuring precipitation; Design storms and time trends.

UNIT II - Precipitation

Precipitation intensity, duration, and frequency; Frequency distributions; Accessing and working with online precipitation data; Design storms and IDF curves; Infiltration and soil water.

UNIT III- Measurement

Measuring snow fall equivalent depths; Field capacity and capillary action; Wilting point; PAW; Factors determining infiltration rates; Measuring infiltration rates; Evapotranspiration; Runoff and overland flow; Storm hydrographs; Watershed factors affecting hydrograph shape; Predicting peak runoff volume from a storm; The NRCS Curve Number procedure.

UNIT IV – Designing of water bodies

Well Design; Determining drawdown from estimated aquifer characteristics; Pump tests; Groundwater velocity and practice problems; Water Constituents & Contaminants; Groundwater Modeling.

UNIT V - Groundwater

Darcy's law (of groundwater flow) and Soil sieve tests; Groundwater basics; Water table Contour Maps; The Steady-state Groundwater Flow Equation; Streamlines and Flow Nets; Regional Flow and Geologic Controls on Flow; Transient Flow, Aquifer Storage and Compressibility; Unconfined Flow; Groundwater Interaction with Streams and Lakes; Numerical Methods; Flow in Fractured Rock.

TEXTBOOKS

1. Andy D. Ward and Stanley W. Trimble (2004), "Environmental Hydrology, Second edition", CRC Press.
2. Manning, J. C. (1997) Applied Principles of Hydrology, 3rd edition; Upper Saddle River, NJ: Prentice Hall.
3. Andrew David Ward, William J. Elliot; CRC/Lewis Publishers, 1995

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

Semester- **M.Tech. - I** (Energy and Environmental Engineering)
Subject: **Energy economics and Project 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 1: Economics & Planning of Energy Systems

Relevance of financial and economic feasibility evaluation of energy technologies and systems, Basics of engineering economics, Financial evaluation of energy technologies, Social cost benefit analysis, Case studies on techno-economics of energy conservation and renewable energy technologies. Energy demand analysis and forecasting, Energy supply assessment and evaluation, Energy demand – supply balancing, Energy models. Energy – economy interaction, Energy investment planning and project formulation.

UNIT 2: Energy Policies

Energy pricing, Policy and planning implications of energy – environment interaction, clean development mechanism, technology transfer and its financing, carbon credits and trading opportunities, Financing of energy systems, Energy policy related acts and regulations.

UNIT 3: Economic Analysis:

Objectives, Investment needs, appraisal and criteria, sources of funds. Anatomy of investment – Initial investment, Return on Investment, Economic life, Basic income equations. Tax considerations: Depreciation, types and methods of depreciation, Income tax Considerations. Financial analysis: Simple pay back period, Return on investment (ROI), Net Present value (NPV), Internal Rate of Return (IRR), and Annualized cost, Time value of money, Cash flows, Discounting, Inflation Risk and sensitivity analysis, financing options.

UNIT 4: Financial Management:

Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs, and Case Studies.
Concept and purpose of projects management, functions of project manager, project feasibility analysis, project appraisal criteria, monitoring and control of a project.

UNIT 5 :-Project Evaluation & Management Financial analysis:

Project cash flows, time value of money, life cycle approach & analysis, conception, definition, planning, feasibility and analysis; Project appraisal criteria; Risk analysis; Project planning matrix; Aims oriented project planning; Social cost benefit analysis. Network analysis for project management; Time estimation; Critical path determination; PERT, CPM and CERT; Fuzzy logic analysis; Stochastic based formulations; Project evaluation techniques; Funds planning; Project material management, evaluation & analysis; Implementation and monitoring; Performance indices; Case studies.

Text Books:

1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
2. Energy Management Principles: C.B.Smith (Pergamon Press).
3. Energy Economics A.V.Desai (Wieley Eastern)
4. Financial Management, Prasanna Chandra, Tata Mc-Graw Hill
5. Project Management, S.Choudhury, Tata McGraw Hill

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

Semester- M.Tech. - I (Energy and Environmental Engineering)
Subject: **Bio Energy 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 1 Bio Energy Status
Bio Energy Resources, World Bio Energy Potential, India's Bio Energy Potential, Current Technology and Research Status

Unit 2 .Thermo-chemical conversions:
Direct Combustion, Technology of Biomass gasification, Pyrolysis and Liquefaction, Bio-Chemical Conversion: anaerobic digestion, alcohol production from biomass, Chemical conversion process: hydrolysis and hydrogenation,

Unit 3. Bio- Energy Systems
Energy Efficient Wood Stoves : Traditional Stoves , Energy Efficient Cooking and Space heating Stoves, Metal Stoves Improved Gasifier Stoves , Current Research Status, Pollution due to smoke emissions.

Unit 4 Bio- gas Systems :
Technology of Bio-gas production, Biogas Plants , Digester types, Digester design, Chemical kinetics and mathematical modeling of bio- methanation process, Dung, Vegetable Waste and Night Soil and Municipal Waste based Bio -gas plants, Bio gas as fuel for transportation ,Lighting , Running Dual Fuel Engines, Electricity generation, Bio gas Bottling Plant Technology, Application of Bio gas slurry in agriculture , Design of Biogas for cold climates

Unit 5 Biomass Gasifiers :
History , Principle , Design of Bio mass Gasifiers , updraft gasifier, down draft gasifier, zero carbon biomass gasification plants, Gasification of plastic-rich waste, applications for cooking, electricity generation, Gasifier Engines, Operation of spark ignition and compression ignition engine with wood gas, methanol, ethanol and biogas, Biomass integrated gasification/combined cycles system. Environmental Policy Issues of Bio- Energy systems.

Text Books

1. KC Khandelwal, SS Mahdi, Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986
2. RC Maheswari, Bio Energy for Rural Energisation , Concepts Publication, 1997
3. J Twidell and T Weir, Renewable Energy Resources, Taylor and Francis (Ed), New York, USA, 2006
4. B Sorensen, Renewable Energy,2nd Ed, Academic press, New York, 2000
5. G Boyle (Ed), Renewable energy: Power for a sustainable future, Oxford, OUP, 1996
6. Thomas B Johansson et.al, (Ed), Renewable energy: Sources for Fuels and electricity, Earthscan Publishers, London, 1993

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

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

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

1. Determination of Langelier Index Microscopic sludge analysis

2. Determination of dissolve oxygen and carbon dioxide in waste water sample.

3. Determination of Optimum coagulant dose in potable water treatment & waste water treatment.

4. Collect data on levels of particulate air pollution, and to analyze them by distance from various traffic and industrial sources in order to draw conclusions about their causes.

5. Determination of nutrients present in soil sample.

6. Determination of iron, lead, and phosphate in solution by spectrophotometer.

7. Estimation of Total Dissolved Solids in water.

8. Determination of pH of water of at least three water samples.

9. Determination of available chlorine / free chlorine / chloride in given water samples.

10. Determination of Biological and Chemical Oxygen Demand (BOD & COD) in water.

Reference Books:

1. H.H. Ramp and H. Krist, Laboratory manual for the Examination of water, waster water and soil, VCH Publishers, 1988.
2. APHA (1980) Standard Methods for the Examination of Water and Wastewater Published by American Public Health Association, 15th ed.
3. S.S. Dara, Experiments and Calculations in Environmental Chemistry, S. Chand, 2000.
4. G.M. Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997.

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

Name of program: M.Tech. - I (Energy and Environmental Engineering)
Subject: **Applied Instrumentation 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. Manipulation of environmental data files on a personal computer.

2. Graphical representation of environmental data and to draw inferences from them.

3. To study the differences between analytical and numerical solutions to environmental models.

Minimum 05 experiments to be performed by taking any environmental samples using Instruments listed below:

1. UV Spectrophotometer
2. High performance liquid Chromatography
3. Atomic Adsorption spectrophotometer
4. Water & Soil Testing Kit
5. Flame photometer
6. Turbidity meter
7. Thermostat
8. Microwave
9. Tentiometer

Reference Books:

1. APHA (1980) Standard Methods for the Examination of Water and Wastewater Published by American Public Health Association, 15th ed.

2. J.L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.

3. Deaton and Wine Brake, Dynamic Modeling of Environmental Systems, Wiley & Sons, 2002.

4. H.H. Ramp and H. Krist, Laboratory manual for the Examination of water, waster water and soil, VCH Publishers, 1988.

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.	Chemical Engg.	589211(19)	Geo environment, Effluent Treatment & Waste Utilization	3	1	-	100	20	20	140	4
2.	Chemical Engg.	589212(19)	Biomass Conversion Technologies	3	1	-	100	20	20	140	4
3.	Chemical Engg.	589213(19)	Energy Efficiency In Electrical & Thermal Utilities	3	1	-	100	20	20	140	4
4.	Chemical Engg.	589214(19)	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.	Chemical Engg.	589221(19)	Solar Thermal & Photovoltaic Lab	-	-	3	75	-	75	150	2
7.	Chemical Engg.	589222(19)	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	Chemical Engg.	589231(19)	Waste disposal & management
2	Chemical Engg.	589232(19)	Mini & Micro Hydel Systems
3	Chemical Engg.	589233(19)	Air & Noise Pollution Control
4	Chemical Engg.	589234(19)	Remote Sensing & GIS Applications
5	Chemical Engg.	589235(19)	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

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

M.Tech. in Energy and Environmental Engineering

THIRD 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.	Chemical Engg.	**589311(19)**	Energy efficient Buildings	3	1	-	100	20	20	140	4
2.	**Refer Table- III**		**Elective-III**	3	1	-	100	100	20	20	4
3.	Chemical Engg.	**589321(19)**	Field Visit and Case Study	-	-	28	100	-	100	200	14
4.	Chemical Engg.	**589322(19)**	Minor Project	-	-	3			20	20	2
TOTAL				**6**	**2**	**31**	**300**	**40**	**160**	**500**	**24**

Table -III

Elective- III			
Sr. No.	**Board of Study**	**Subject code**	**Subject**
1	Chemical Engg.	589331(19)	Wind Energy Technology
2	Chemical Engg.	589332(19)	Grid Integration of Distributed Energy Sources
3	Chemical Engg.	589333(19)	Smart Grid & mini grid
4	Chemical Engg.	589334(19)	Energy policies & planning
5	Chemical Engg.	589335(19)	Risk assessment and disaster management

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. – III (Energy and Environmental Engineering)
Subject: **Energy Efficient Buildings**
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

Energy required for building construction , Heat Transfer, Measuring Conduction Thermal Storage, Measurement of aeration, The Green house Effect, Psychometric Chart, Measuring latent and sensible heat. Thermal Comfort, Site Planning and Development, Temperature, Humidity, Wind, Optimum Site Locations, Sun Protection, Types of Shading Devices Conservation, Heating and Cooling loads.

UNIT II: Passive Solar Heating and Cooling

General Principles of passive Solar Heating , Key Design Elements , Direct gain Trombe Walls, Water Walls, Convective Air oops, Concepts, Case Studies, General Principles of Passive Cooling, Ventilation, Predicting ventilation in buildings, window ventilation calculations, Radiation, Evaporation and dehumidification, Mass Effect, Load Control, Air Filtration and odor removal, Heat Recovery in large buildings.

UNIT III: Day-lighting and Electrical Lighting

Materials, components and details, Insulation, Optical materials, Radiant Barriers Glazing materials, Day lighting, Sources and concepts Building Design Strategies Case Studies, Electric Lighting, Light Distribution, Electric Lighting control for day lighted buildings, Illumination requirement Components of Daylight factor, Recommended Daylight factors, Day lighting analysis Supplementary Artificial Lighting Design.

UNIT IV: Heat Control and Ventilation

Requirements, Heat transmission through building sections, Thermal performance of Building sections , Orientation of buildings, Building characteristics for various climates Thermal Design of buildings Influence of Design Parameters, Mechanical controls Examples. Ventilation Requirements Minimum standards for ventilation, Ventilation Design Energy Conservation in Ventilating systems, Design for Natural Ventilation.

UNIT V: Design for Climatic Zones

Energy efficiency, an overview of design concepts and architectural interventions, Energy efficient buildings for various zones - cold and cloudy, cold and sunny, composite, hot and dry, moderate, warm and humid, case studies of residences, office buildings and other buildings in each zones; Energy Audit, Certification,

Learning Outcomes: On successful completion of this course, it is expected that students should be able to, Design energy efficient buildings which balance all aspects of energy, lighting, space conditioning and ventilation, Design energy efficient buildings with passive solar design strategies materials with low embodied energy.

Text Books:

1. Majumdar, M. (Ed), Energy efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
2. Tyagi, A. K.(Ed), Handbook on energy audits and management, Tata Energy Research.
3. M.S. Sodha, N.K. Bansal et al., Solar Passive: Building Science and Design, Pergamon Press (1986).
4. Moore, F., Environmental Control System, McGraw Hill Inc. 2002

References

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light Architectural Design Strategies,John Wiley andSons Inc, 2001.
2. Chilogioji, M.H., and Oura, E.N., Energy Conservation in Commercial and Residential Buildings, MarcelDekker Inc., New York and Basel, 1995.
3. Cook, J., Award-winning Passive Solar Designs McGraw Hill Book Company, 1984.
4. Dubin, F.S. and Long, C.G., Energy Conservation Standards For Building Design, Construction and Operation McGraw Hill Book Company 1990.Institute, 2000.
5. Handbook on Functional Requirements of Buildings Part1 to 4 SP: 41 (S and T) 1995.
6. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.

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

Semester- M.Tech. – III (Energy and Environmental Engineering)
Subject: **Field Visit and Case Study**

The Industrial Training should be carried out in a Industry or Research Laboratory engaged in the R & D activities in Energy Field. The NGO's undertaking pilot projects in the Field of Energy can also impart training to the M. Tech. students. The training shall be for a period of six weeks and student should spend approximately 100 hours on training. A brief report of training activities certified by authorities imparting training shall be submitted at least one month before the end of semester.

The Assessment of training shall be done as follows:

1. Evaluation by Training Institute of Student- 50 Marks
2. Mid-Term Evaluation of Training (including Energy Awareness programme) – 50 Marks
3. Final Viva Voce Examination – 100 Marks

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

Semester- M.Tech. – III (Energy and Environmental Engineering)
Subject: **Minor Project**

A group of 2 or 3 Students should develop a cost effective renewable energy gadget / Biomass Assessment Study / Village Level Energy Planning / Evaluation of Renewable Energy Plants etc.

Evaluation is based on the product, report and *viva voce*.

Product / Report - 20 marks
Seminar/ Viva-Voce - 20 marks

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

Semester- M.Tech. - III (Energy and Environmental Engineering)
Subject: **Wind Energy Technology**
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
Wind Energy: Introduction to wind energy, Applications of wind energy and historical background, merits and limitation of wind energy conversion, nature of wind and origin of wind, wind power density, power of wind turbine for given incoming wind velocity V1,forces on blades of propeller, wind power duration characteristics.

UNIT 2
Wind Turbines: Introduction, terms and definition, types of wind turbines-generator units, planning of wind farm, Horizontal axis propeller type wind turbine, vertical axis wind turbines, wind turbine rotor speed, practical P.V characteristics, power coefficient versus tip speed ratio for various types of wind turbine, operation and control of horizontal axis wind turbine, power versus velocity characteristics, power duration curves.

UNIT 3
Wind energy farms and energy conversion system: introduction, types of wind energy system, wind to electrical energy conversion alternatives, grid connection, energy storage requirement with wind energy system, wind turbine generator unit with battery storage facility, solar wind hybrid, wind farm siting, indigenously developed wind turbine generators by BHEL, India.

UNIT 4
Wind Turbine Performance: The performance curves, constant rotational speed performance, variable speed operation, estimation of energy capture, wind turbine field testing, wind turbine performance measurement, field testing methodology.

UNIT 5
Design loads for horizontal axis wind turbines: Basics for design load, turbulence and wakes, extreme loads, fatigue loads, stationary baldes loading, blade load during operation, blade dynamic response, hub and low speed shaft loading, tower loading.

Text Books:
1. Energy Technology (non conventional renewable and conventional) By S.Rao.
2. Wind Energy by Tony burton, David Sharpe.

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

Semester- M.Tech. - III (Energy and Environmental Engineering)
Subject: **Grid Integration of Distributed Energy Sources**
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 - Dynamics of distributed generation power systems
Introduction: Operation of the classic electric system, Historical development of the electrical system, Control System, Dynamic response of the electrical system.
Distributed generation:- Wind generation, Photovoltaic generation, Other technologies, Effect on the grid Interconnection generation-grid: Connection with synchronous generator, Connection with asynchronous generator, Electronic connection VSC, Inverter Control, Synchronization, Grid supporting from inverters.

Unit 2 - Energy Storage
Mechanical Systems, Electrochemical Systems, Electrical Systems, Thermal Systems
Energy storage for power system applications:- Grid Side, Renewables, Demand Side, Other factors

Unit3. - Grid integration of photovoltaic systems
Requirements for photovoltaic systems: Interconnection requirements, Power Quality, Structure of PV inverters, Detection of island.
Structure of PV inverters:- Structure, Investors and modulation, Control
Island detection and MPPT: Introduction, Passive Methods, Active methods, MPPT

Unit4. - Grid integration of wind systems
Requirements for wind systems: Grid Codes for wind turbines, Control of active power- Control of the reactive power, Frequency Control, Operating Range, LVRT, Future trends
Wind Turbines structures:- Configuration turbine, Topology converters. Turbine Control

Unit 5. - Advanced topics in grid integration
The electric vehicle in the grid: Load management, HVDC interconnection, STATCOM and filters Assets, FACTS and UPFC.

References:

1. Ali K., M.N. Marwali, Min Dai, "*Integration of Green and Renewable Energy in Electric Power Systems*", Wiley.
2. Peter S. Fox-Penner, "*Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*", Island Press.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "*Smart Grid: Technology and Applications*", Wiley India.
4. Technology enabling the transformation of India's power distribution http://www.infosys.com/newsroom/features/power-sector-report.pdf
5. Gridwise Alliance website http://www.gridwise.org/
6. European Union Smart Grids Technology Platform http://www.smartgrids.eu/

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

Semester- M.Tech. - I (Energy and Environmental Engineering)
Subject: **Smart Grid & mini grid**
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**

Unit1. Introduction to Smart Grid:

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid, CDM opportunities in Smart Grid, What is a Smart Grid?, The Smart Grid Enables the ElectriNet M, Local Energy Networks, Electric Transportation, Low-Carbon Central Generation, What Should Be the Attributes of the Smart Grid?, Why Do We Need a Smart Grid?, Is the Smart Grid a "Green Grid"?, Smart Grid Initiative for Power Distribution Utility in India.

Unit2. Grid Sensing, Measurement, Control and Automation Technologies:
Smart metering and demand-side integration, Introduction, Smart metering, Evolution of electricity metering, Key components of smart metering, Smart meters: An overview of the hardware used Signal acquisition, Signal conditioning, Analogue to digital conversion, Computation, Input/output, Communication, Communications infrastructure and protocols for smart metering, Home-area network, Neighbourhood area network, Data concentrator, Meter data management system, Protocols for communications, Demand-side integration, Services provided by DSI, Implementations of DSI, Hardware support to DSI implementations, Flexibility delivered by consumers from the demand side, System support from DSI.

Unit3. Micro Grids And Distributed Energy Resources:
Concept of micro grid, need & applications of micro grid, formation of micro grid, issues of interconnection, protection & control of micro grid. Islanding, need and benefits, different methods of islanding detection.
Distributed Energy Resources: Small scale distributed generation, Distributed Generation Technology, Internal Combustion Engines, Gas Turbines, Combined Cycle Gas Turbines, Micro turbines, Fuel Cells, Solar Photovoltaic, Solar thermal, Wind power, Geothermal - all sources as a DG. Advantages and disadvantages of DG.

Unit4. Power Quality Management in Smart Grid:
Power Quality Management In Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit5. Information and Communication Technology for Smart Grid:
Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Broadband over Power line (BPL).

Text Books:

4. Clark W. Gellings, "*The Smart Grid: Enabling Energy Efficiency and Demand Response*", CRC Press.
5. JanakaEkanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, "*Smart Grid: Technology and Applications*", Wiley.

6. Jean Claude Sabonnadiere, NouredineHadjsaid, "*Smart Grids*", Wiley Blackwell.
7. James Momoh "*SMART GRID Fundamentals of Design and Analysis*", IEEE press, A John Wiley & Sons, Inc., Publication.

References:

1) Tony Flick and Justin Morehouse, "*Securing the Smart Grid*", Elsevier Inc.
2) Peter S. Fox-Penner, "*Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*", Island Press.
3) Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "*Smart Grid: Technology and Applications*", Wiley India.
4) Bhavesh Bhalja, R. P. Maheshwari and N. G. Chothani, "*Protection and Switchgear*", Oxford University Press, New Delhi, India, 2nd Edition, 2015.
5) Join Gridwise & Smartgrids groups in LinkedIn http://www.linkedin.com/
6) Sign up to Smart Grid News www.smartgridnews.com
7) US DoE Smart Grid Book
http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf
8) Technology enabling the transformation of India's power distribution
http://www.infosys.com/newsroom/features/power-sector-report.pdf
9) Gridwise Alliance website http://www.gridwise.org/
10) European Union Smart Grids Technology Platform http://www.smartgrids.eu/

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

Semester- M.Tech. - III (Energy and Environmental Engineering)
Subject: **Energy Policies and Planning**
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
Energy policies of India – Supply focus approach and its limitations – Energy paradigms – DEFENDUS approach – End use orientation – Energy policies and development – Case studies on the effect of Central and State policies on the consumption and wastage of energy – Critical analysis – Need for renewable energy policies in India.

Unit II
Energy and environment – Green house effect – Global warming – Global scenario – Indian environmental degradation – environmental laws – Water (prevention & control of pollution) act 1974 – The environmental protection act 1986 – Effluent standards and ambient air quality standards – Latest development in climate change policies & CDM.

Unit III
Energy conservation schemes – Statutory requirements of energy audit – Economic aspects of energy audit – Capital investments in energy saving equipment – Tax rebates – Advantages of 100% depreciation – India's Plan for a domestic energy cap & trade scheme.

Unit IV
Social cost benefit analysis – Computation of IRR and ERR – Advance models in energy planning – Dynamic programming models in integrated energy planning – Energy planning case studies – Development of energy management systems – Decision support systems for energy planning and energy policy simulation.

References:
1. J. Goldemberg, T.B. Johansson, A.K.N. Reddy and R.H. Williams: Energy for a Sustainable World, Wiley Eastern, 1990.
2. IEEE Bronze Book: Energy Auditing, IEEE Publications, 1996.
3. P. Chandra: Financial Management Theory and Practice, Tata McGraw Hill, 1992.
4. Annual Energy Planning Reports of CMIE, Govt. of India.
5. Amlan Chakrabarti: Energy Engineering and Management, PHI, Eastern Economy Edition, 2012
6. A.K.N. Reddy and A.S. Bhalla: The Technological Transformation of Rural India, UN Publications, 1997.
7. A.K.N. Reddy, R.H. Williams and J.B. Johanson: Energy After Rio-Prospects and Challenges, UN publications, 1997.
8. P. Meier and M. Munasinghe: Energy Policy Analysis & Modeling, Cambridge University Press, 1993.
9. R.S. Pindyck and D. L. Rubinfeld: Economic Models and Energy Forecasts, 4e, McGraw Hill, 1998.

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

Semester- M.Tech. - III (Energy and Environmental Engineering)
Subject: **Risk Assessment & Disaster 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:
Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit- II:
Disaster Risk Assessments Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment; Strategies for Survival.

Unit -III:
Disaster Preparedness and Management; Preparedness: Monitoring of Phenomena, Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.
Unit -IV:

Response to Disasters, Rescue, Relief and Rehabilitation, Role of National and International Agencies in Disaster Management; National Disaster Policy of India (Salient Features).

Unit -V:

News Media In Disaster Management, Types of News Media, Structure and Trends, News Media During Crisis, Impact of Media On Policy.

Reference Books:

1. R. Nishith, Singh AK 2012 Disaster Management in India: Perspectives, issues and strategies New Royal book Company, Lucknow.
2. Sharma, Kadambari C, Avina 2010 Disaster Management in India Jnanada Prakashan [P&D], New Delhi
3. Mishra A 2012 New Dimensions of Disaster Management in India: Perspectives Approaches and Strategies (Set of 2 Vols) Serials publications, New Delhi
4. Dagur OS Disaster Mana gement: An Appraisal of Institutional Mechanisms in India Center for Land Welfare Studies
5. Sinha P. C. 2006 Disaster Mitigation: Preparedness, Recovery and Response . SBS Publication & Distributions Pvt. Ltd. New Delhi.
6. Goel S. L. 2007 Disaster Adminastration And Management Text And Case Studies Deep &Deep Publication Pvt. Ltd., New Delhi.
7. Dhunna M 2001 Disaster Management Vayu Education Of India, New Delhi.
8. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.

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

M.Tech. in Energy and Environmental Engineering

FOURTH 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.	Chemical Engg.	**589421(19)**	Project + Seminar	6	-	34	300		200	500	23
TOTAL				6	-	34	300		200	**500**	**23**

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

Industrial Project or Major Project equivalent to 23 Credits shall be completed by the student during fourth semester. A project report giving details of work done under the project should be submitted one month before the end of the semester. The project work shall be monitored by internal guide and / or a authorized / qualified person from the industry where student is doing the work.

The topic of the project and work-plan shall be approval by the internal committee of Experts. Mid- Term and pre-submission viva-voce examination shall be compulsory to every student.

Distribution of Credits for Project work shall be as follows.

1) Selection of Topic with Detailed Work Plan - 50 Marks
2) Mid-Semester presentation – 50 Marks
3) Pre- Submission Presentation - 100 Marks
4) Find Viva- Voce Examination- 300 Marks

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

M.Tech. in Energy and Environmental Engineering

FOURTH 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.			Project + Seminar	6	-	34	300		200	500	23
TOTAL				6	-	34	300		200	**500**	**23**

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

Industrial Project or Major Project equivalent to 23 Credits shall be completed by the student during fourth semester. A project report giving details of work done under the project should be submitted one month before the end of the semester. The project work shall be monitored by internal guide and / or a authorized / qualified person from the industry where student is doing the work.

The topic of the project and work-plan shall be approval by the internal committee of Experts. Mid- Term and pre-submission viva-voce examination shall be compulsory to every student.

Distribution of Credits for Project work shall be as follows.

1) Selection of Topic with Detailed Work Plan - 50 Marks
2) Mid-Semester presentation – 50 Marks
3) Pre- Submission Presentation - 100 Marks
4) Find Viva- Voce Examination- 300 Marks