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.			New and Renewable Energy Sources	3	1	-	100	20	20	140	4
2.			Environmental Pollution & Management	3	1	-	100	20	20	140	4
3.			Energy system modeling & Energy audit	3	1	-	100	20	20	140	4
4.			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.			Environmental Quality Monitoring Lab	-	-	3	75	-	75	150	2
7.			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			Energy Conversion
2			Energy conservation & efficiency
3			Environmental hydrology
4			Energy economics & project management
5			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.

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