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.			Energy efficient Buildings	3	1	-	100	20	20	140	4
2.	Refer Table- III		Elective-III	3	1	-	100	100	20	20	4
3.			Field Visit and Case Study	-	-	28	100	-	100	200	14
4.			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			Wind Energy Technology
2			Grid Integration of Distributed Energy Sources
3			Smart Grid & mini grid
4			Energy policies & planning
5			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.