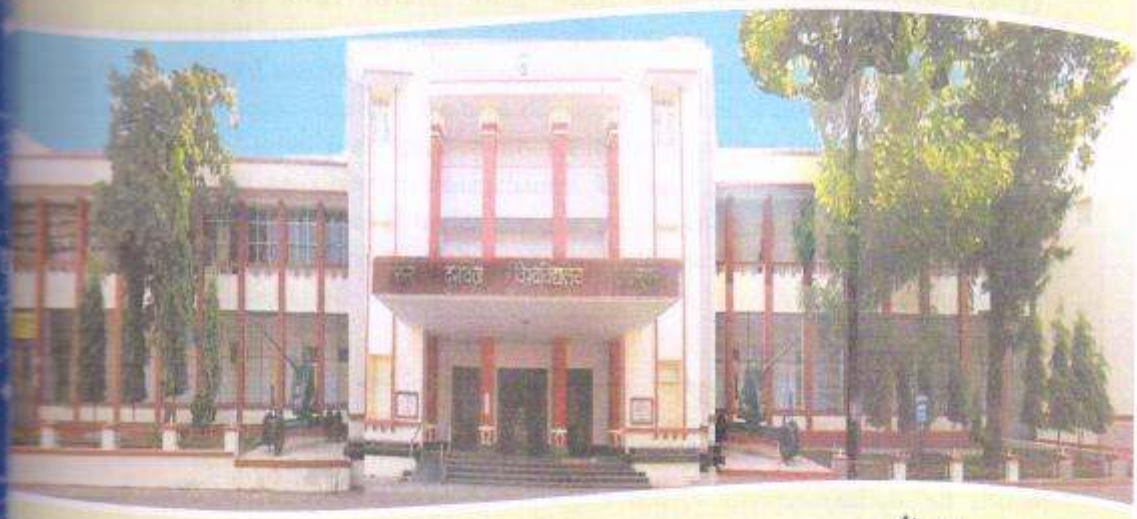
SYLLABUS

One Year Programme (Semester I and II)

Diploma in Renewable Energy

Under the Scheme of Community College

(Sponsored by U.G.C. New Delhi)



Women's Studies and Research Centre

Rani Durgavati Vishwavidayalaya, Jabalpur (M.P.)

Website: www.rdunijbpin.org

To be implemented from Academic Year 2016-2017 onwards

CURRICULUM STRUCTURE OF COMMUNITY COLLEGE DIPLOMA IN RENEWABLE ENERGY

Preamble of the course

Energy is a vital input for the development and economic growth of a country. The growth for energy sector is critical for socioeconomic development particularly for rural areas. In the Indian context, it is a great challenge to provide affordable energy services to the population. Renewable energy contributes to energy supply reserves and the environment. India is fortunate in having a lot of resources of solar, hydro, wind, wave, and tidal hydro-electric energy. Development must, however, occur with proper attention to the technical, economic and operational constraints associated with increase in penetration of such technology. The development of energy systems is also constrained by the depletion of fossil fuel, local environmental impacts and the problem of global warming and associated climate change. The energy sector is in transition and there is significant need to understand the various energy conversion and efficient utilization process. In view of the problem of climate change and scar city of fossil fuels, the field of energy engineering offers significant challenges and opportunities.

The Diploma in Renewable Energy prepare the students in theoretical as well as practical aspects of renewable energy technologies, energy conservation, and management. This multi-disciplinary integrated programme train the students not only in renewable energy technologies and its implementation but also in equally important areas of energy infrastructure, rational use of energy, energy policies and regulations, and energy-environment interface etc. The programme exhibits its uniqueness fostering the much sought-after leadership skills through the management energy courses. Thus, the programme enables the students to tackle practical problems of design, development, deployment in the industry, and to pursue academics as well as frontiers of research. The objective of the programme is to provide specialist manpower to meet the challenges of the energy sector.

DIPLOMA IN RENEWABLE ENERGYPROGRAMME STRUCTURE OF DIPLOMA IN RENEWABLE ENERGY

One Year Programme (Semester - I)

S. No.	Paper No.	Subject Name	Component	Credit			
				L	T	P	C
1	RE-101	Energy sources and Energy Scenario	Skills	3	2	0	5
2	RE-102	Renewable energy sources and technology	Skills	3	2	0	5
3	RE-103	Solar energy	Skills	3	2	0	5
4	RE-104	Functional English & Communication Skills	General Education	2	1	0	3
5	RE-105	Practical and Project work	Skills	0	0	12	12
Total Credit of Semester-I				30			

One Year Programme (Semester - II)

S. No.	Paper No.	Subject Name	Component	Credit			
				L	T	P	C
1	RE-106	New Energy Resources	Skills	3	2	0	5
2	RE-107	Solar photovoltaic technology	Skills	3	2	0	5
3	RE-108	Energy management and auditing	Skills	3	2	0	5
4	RE-109	Fundamental of Computer & Information Technology	General Education	2	1	0	3
5	RE-110	Practical and Project work	Skills			12	12
Total Credit of Semester-II				30			

- L – Lecture, T- Tutorial, P- Practical, C – Credit
- After successful completion of I st semester, student will be awarded **Certificate in Renewable Energy.**
- After successful completion of II nd semester, student will be awarded **Diploma in Renewable Energy.**

RE-101 Energy Sources and Energy Scenario

Unit I

Introduction to Energy

Definition and units of energy and power, Conversion, Energy terms, calorific value, Forms of energy, Classification of energy sources Quality and concentration of energy sources,Energy and Thermodynamics, Energy parameters, Conservation of energy, Energy flow diagram to the earth. Origin of fossil fuels, Time scale of fossil fuels, Role of energy in economic development and social transformation, Energy security.

Unit II

Energy and Growing Economy

Commercial energy production, Final energy consumption, Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy conservation and its importance, Energy strategy for the future, Energy Conservation Act-2001 and its features.

Unit III

Global Energy Scene

Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.

Unit IV

Indian Energy Scene

Commercial and non-commercial forms of energy, energy consumption pattern and its variation as a function of time, India's Power Scene, Gas-Based Generating Plants, Nuclear Power Programme, urban and rural energy consumption, energy as a factor limiting growth, need for use of new and renewable energy sources, Socio-economic impacts, Rural development, Poverty alleviation, Employment; Security of supply and use, Environmental and ethical concerns, Economical aspects of renewable energy systems vs large hydro and thermal power projects.

Suggested reading references

- Bani P. Banerjee, Energy and the Environment in India, Oxford Univesity Press, New Delhi.
- G. D. Rai, Non- conventional Sources of Energy, Khanna Publishers, Delhi.
- Gopal kumar, Energy Independence Vision of a Hybrid, Unbound Future, Deep and Deep Publications Pvt. Ltd., New Delhi.
- D. K. Asthana, Meera Asthana, Environment Problems and Solutions, S. Chand and Company Ltd., New Delhi.
- Abdul Mubeen, M. Emran Khan, M. Muzaffarul Hasan, Energy and Environment, Anamaya Publishers, New Delhi.
- Upender Pandel, M. P. Poonia, Energy Technologies for Sustainable Development, Prime Publishing, Ghaziabad (UP).
- Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Singal K. C, New Arrivals - PHI; 2 edition (2011)
- Other relevant books also be used.

RE-102 Renewable energy sources and technology

Unit I

Non-conventional energy sources:

Introduction to Non-conventional energy sources, Solar energy, Wind energy/power, Energy from biomass and biogas, Ocean energy ,Wave energy, Tidal energy/power, Geothermal energy, Hydrogen energy, Thermo-electric power, Fuel cell, Magneto-Hydro-dynamic (MHD) generator.

Unit II

Renewable and Non-renewable energy sources:

Renewable (Non-conventional) energy sources, Non-renewable energy sources, Alternative energy sources, Energy Scenario in India context, ElectricityGeneration from Non-conventional energy sources, Impact on environment, Fuels, Classification of fuels, Solid fuels ,Liquid fuels, Gaseous fuels.

Unit III

Solar Thermal Technologies:

Solar Thermal Energy Systems: Absorption and Radiation, Heat Gain and Loss, Solar Cooking Systems ,Principle of Cooking, Cooking by Boiling, Speed of Cooking, Energy Required for Cooking, Types of Solar Cooker, Solar Distillation System , Distillation: Natural Process for Purifying Water.

Unit IV

Wind Energy:

Wind Flow, Motion of Wind , Vertical Wind Speed Variation,Distribution of Wind Speeds, Power in the Wind, Conversion of Wind Power: Wind Turbine, Efficiency of Wind Power Conversion: Cp, Types of Wind Turbines, Components of a Wind Turbine, Worldwide Wind Installations Wind Turbine Sizing and systems Design , Energy Derived from a Wind Turbine.

Suggested reading references

- Renewable Energy Technologies: A Practical Guide for Beginners, Chetan Singh Solanki, PHI|School Books (2008)
- Fundamentals of Renewable Energy Systems Paperback – D. Mukherjee, New Age International Publisher; First edition (2011)
- Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Singal K. C, New Arrivals - PHI; 2 edition (2011)
- G. D. Rai, Non- conventional Sources of Energy, Khanna Publishers, Delhi.
- Other relevant books also be used.

RE-103 Solar energy

Unit I

Solar Radiation

Solar radiation: extra-terrestrial and terrestrial, Radiation measuring instruments, Radiation measurements and predictions

Unit II

Basics of Solar Thermal Conversion

Solar thermal conversion: basics, Flat plate collectors-liquid and air type, Theory of flat plate collectors, Selective coatings

Unit III

Solar thermal systems and applications

Advanced collectors: ETC, Solar Pond, Concentrators: optical design of concentrators, Solar water heaters, Solar dryers, Solar stills, Economics of solar thermal conversion systems

Unit IV

Solar thermal Energy conversion

Solar cooling and refrigeration, Thermal storage, Conversion of heat into mechanical energy, Active and passive heating of buildings, Solar thermal power generation

Suggested reading references

- Goswami DY. Kreith F. Kreider JF. Principles of Solar Engineering, Taylor & Francis, 1999
- Tiwari GN. Solar Energy, Fundamentals design, modeling and Applications. Narosa, 2002
- Duffie JA. Beckman WA. Solar Engineering of Thermal Processes, John Wiley, 2006
- Kishore VVN. Renewable Energy Engineering and Technologies, TERI, 2009
- Other relevant books also be used.

RE-104 Functional English & Communication Skills

UNIT-I

Grammar:- Determiners, Tenses, Defining a Verb, Chief forms of a Verb, Tense and Time, Further Division of Tenses, Active – Passive Voice, Introduction, Defining the Voice, Some General rules regarding the change of voice, Modals & Auxiliaries,

UNIT-II

Business Letters: Introduction, Functions of a Business Letter, Inward Structure / Layout of a Business Letter, Other Important Parts of Business Letter, Outward appearance of a business letter, Arrangement Styles, Salient Features of a Business Letter, Legal Aspects of a business Letters, Kinds of Business Letter, Inquiry and Reply Order and Reply Cancellation of order Complaint /Adjustment Sales Letter.

UNIT-III

Report Writing: Introduction, The Nature of a Report, Functions of a Report, Preparing a Report, Types of Reports, Business report, Press report.Job Application / Resume Writing

UNIT-IV

Conversation Skills: Conversations based on everyday situation / Dialogue Writing. Introduction, Nature of Conversations, Purpose of conversation, Guidelines for Effective Conversation Skills,

UNIT-V

Communication Skills: Communication – Meaning, Features & Process, Verbal & Non – Verbal comm. Verbal, Oral Communication, Written Communication, Non – Verbal, Body language, Space, Para language Others, Group discussion skills, Meaning, Characteristic, Do's & Don'ts, Relevance, Moderating a group discussion, Presentation skills meaning, Planning a presentation skills, Preparing a presentation skills, Delivering a presentation skills, Presentation skills, Public Speaking, Meaning, Essential of effective public speaking, Facing Interviews, Importance, Do's & Don'ts

Suggested reading references

- Recommended Reading: Alexander, Michael. A History of English Literature, Basingstoke Hampshire: Palgrave Macmillan, 2000
- Birch, Dinah ed. The Oxford Companion to English Literature, Oxford: OUP, 2009
- Sanders, Andrew. The Short Oxford History of English Literature, Oxford: OUP, 2004
- Widdowson, Peter . The Palgrave Guide to English Literature and its Contexts 1500-2000,
- Basingstoke Hampshire:Palgrave Macmillan, 2004
- Rain and Martin English grammar book.
- Other relevant books also be used.

RE-106 New Energy Resources

Unit I

Energy Resources

Need of energy systems and materials, Application to supplement and expedite energy conservation efforts, Addressing environmental concern, Suitability as CDM., Hydrogen Energy- Basics of Hydrogen Energy, Production methods, Storage and transportation, Applications. Fuel Cell working, Basic thermodynamic and electrochemical principles, Classifications, Applications for power generations.

Unit II

Ocean and Geothermal Energy

Ocean energy- Origin,Types of geothermal energy sites, Geothermal Power plants, Ocean energy resources, Ocean energy routes, Ocean thermal energy conversion, Wave energy conversion, Tidal energy conversion Geothermal Energy- Origin, Types of geothermal energy sites, Geothermal Power plants

Unit III

Magnetohydrodynamic (MHD) energy conversion

Principle of operation, Classifications, Features of MHD Systems, Magnetic and Electric Storage System-Super conducting magnetic energy storage (SMES) systems, Capacitor and super capacitor

Unit IV

Electrochemical Energy Storage System

Batteries, Types, Working principles, Role of carbon nanotubes in electrode

Suggested reading references

- Narayan R. Biswanathan B. *Chemical and Electrochemical Energy Systems*, University Press (India)Ltd. 1998.
- J W Twidell & A D Weir, *Renewable Energy Resources*, ELBS, 2006
- Tiwari GN. Ghoshal MK. *Fundamental of Renewable Energy Sources*, Narosa, 2007.
- Other relevant books also be used.

RE-107 Solar photovoltaic technology

Unit-I

Basics of Solar Photovoltaics

Principle of photovoltaic conversion, Technology for fabrication of photovoltaic devices

Unit-II

Solar Photovoltaic energy conversion and utilization

Photovoltaic power generation systems. Off-grid systems, Grid connected systems, Organic solar cells, Electrochemical energy storage: Batteries, Economics of solar photovoltaic systems.

Unit-III

Power electronics for Photovoltaic systems

Off-grid power control and management systems, Grid-connected power control and management systems

Unit-IV

Solar Photocatalysis

Solar photocatalysis: mechanism, Kinetics, Nano-catalysts: system design, Performance parameters, Applications of solar photo-catalysis

Suggested reading references

- Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki PHI; 3 edition 2015
- Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Chetan Singh Solanki PHI (1 January 2013)
- Science & Technology of Photovoltaics P Jayrama Reddy, BS Publications ,CRC Press 2010
- From Sunlight to Electricity: A Practical Handbook on Solar Photovoltaic Applications, Suneel Deambi, The Energy and Resources Institute, TERI (30 January 2009)
- Other relevant books also be used.

RE-108 Energy management and auditing

Unit 1

Energy and its various forms

Commercial and Non-commercial energy, primary energy resources, commercial energy production, Energy pricing, energy security, energy conservation and its importance, Electricity tariff, load management and maximum demand control, Thermal energy contents of fuel, heat capacity, sensible and latent heat, heat transfer, Stochiometric air-fuel ratio, Flue gas analysis

Unit 2

Energy management and auditing

Concept of energy management programme , Energy auditing services; basic components of an Energy audit, types of energy audit, Industrial, commercial and residential audit planning, Understanding energy costs, bench marking, energy performance index, Understanding energy used pattern, system efficiencies, input energy requirements optimization, Fuel & energy substitution, Energy conservation act and its features, Duties and responsibilities of energy managers and auditors, Energy audit instruments/ tools

Unit 3

Energy Action Planning

Energy management systems, Management commitment and energy conservation policy, Energy performance assessment: Data collection and management, analysis of data, baseline, and benchmarking, Estimation of energy savings potential, Action planning, training planning.

Unit 4

Financial and Project Management

Financial analysis techniques : simple payback period, return on investment, net present value, internal rate of return, cash flows and sensitivity analysis, Financing options, energy performance contracts and role of ESCOs., Project definition and scope, Technical design and Financing, Project planning techniques; CPM and PERT, case studies

Suggested reading references

- General Aspect of Energy Management and Energy Audit, 2010, BEE Guide book
- Energy Efficiency in Thermal Utilities, 2010, BEE guide book
- Energy Efficiency in Electrical Utilities, 2010, BEE guide book
- Turner WC. Energy Management Handbook, 5th Edition, The Fairmont Press, 2005
- Capehart, Turner, Kennedy. Guide to Energy Management. Fifth Ed. The Fairmount Press, 2006.
- Thumann, Younger. Handbook of Energy Audit. Sixth Ed. The Fairmount Press, 2003.
- Thumann, Mehta. Handbook of Energy Engineering. Fifth Ed. The Fairmount Press, 2001
- Other relevant books also be used.

RE-109 Fundamental of Computer & Information Technology

Unit-I

Basics & Booting Procedure:- Introduction to Computers, Characteristics, Data Processing Cycle, History and Generations of Computers, Classification of Computer by Processing, Capabilities, Micro, Mini, Mainframe and Super, Computers, Layered Approach of Operating System,, booting process, software and Types of Software. Hardware and Peripherals .

Unit-II

Word Processing Using Ms Word:- Introduction to Word, Font, Paragraph, Style, Editing, Pages, tables, Illustrations, bookmark, hyperlink, Header, Footer, Text, symbol, Page layout ribbon, Foot, Note End note, Caption, Mail merge,, Spell check, comments, Document View, Show Hide, Zoom, Window and Office, Button Options, Printing documents, Password Protection.

Unit-III

Spread Sheet Using Ms Excel:- Sheet Introduction, Selecting row, column, Cell, changing height, and Formula bar, Cell Referencing - Relative, Absolute, Mixed,, Calculative Examples like salary sheet, mark, sheet etc., Conditional formatting, inserting, deleting, Row or column, Cell, Changing height and width, Pivot table and, Pivot chart, types of different chart, editing, Charts, Print Preview and Page Layout, Useful, Functions from Function Library. Data sorting and subtotaling, filter, protecting sheet.

Unit-IV

Presentation Using Ms Power Point:- Inserting new slide, different layout of slide, Inserting date, slide number, movie, sound, object, header footer, Designing slide, theme and background, custom animation, slide transition Rehearse timings, slide show , Setup slide, show, hide slide, different views of slide, Use of slide master, Printing handout, slide etc.

Unit-V

Internet:- Introduction to Internet, Use of Internet, Applications of Internet, World wide web (web page, web site,, web client and web server), Web browsers, Search engines, Email, Blogs and forums, Social media and chatting, E-commerce, FTP, Bookmarks, Internet Search, Basic search, Tips and Tricks for search, IP addressing. HTML..

Suggested reading references

- Anurag Seetha, "Introduction to Computers and Information Technology", Ram Prasad & Sons, Bhopal.
- S.K.Basandra, "Computers Today ", Galgotia Publications. Alexis Leon & Mathews Leon, " Fundamentals of Information technology ", Vikas Publishing House, New Delhi.
- DOS Quick reference by Rajeev Mathur, Galgotia Publications
- Linux Complete by BPB Publications Peter Norton Complete Guide to Linux by Peter Norton, Techmedia Publications
- Level Module M 1.1 Information technology by Khanna Book Publications, NewDelhi • Windows XP Complete Reference. BPB Publications
- Windows XP Complete Reference. BPB Publications MS Office XP complete BPB publication
- MS Windows XP Home edition complete, BPB Publications I.T. Tools and Applications, A. Mansoor, Pragya Publications
- Ms Office XP complete BPB publication ISBN 81-7656-564-4 • Ms Access 2002 fast&easy by Faithe Wempen PHI .ISBN 81-203- 1893
- Vb.Net Programming Black Book By Steven Holzner –Dreamtech Publications
- Mastering Vb.Net By Evangelos Petroutsos- Bpb Publications
- Introduction To .Net Framework-Worx Publication
- Other relevant books also be used.