

**Syllabus for
Certificate course in Renewable Energy**

Department of Physics

S N College for Women

Kollam

PROGRAMME STRUCTURE

Sl No.	Paper code	Subject Name	Component	Credit			
				L	T	P	C
1	CRE1	Energy Sources and Energy Scenario	Skills	2	1	0	3
2	CRE2	Renewable energy sources and technology	Skills	2	1	0	3
3	CRE3	Solar energy	Skills	3	1	0	4
4	CRE4	New Energy Resources	Skills	2	1	0	3
5	CRE5	Energy management and auditing	Skills	3	1	0	4
6	CRE6	Fundamentals of Computer & Information Technology	General Education	2	1	0	3
7	CRE7	Practical and Project work	Skills	0	0	10	10
Total Credits of the programme				30			

- L Lecture, T- Tutorial, P- Practical, C - Credit
- After successful completion of six months, student will be awarded Certificate in Renewable Energy.

SYLLABUS

CRE1 :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 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 III 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.

References

1. Bani P. Barter*, Energy and the Environment in India. Oxford University Press, New Delhi.
2. G. D. Rai, Non- conventional Sources of Energy, Khanna Publishers, Delhi.

3. Gopal kumar, Energy Independence Vision of a Hybrid, Unbound Future, Deep and Deep Publications Pvt. Ltd., New Delhi.
4. D. K. Asthana, Meera Asthana, Environment Problems and Solutions, S. Chand and Company Ltd., New Delhi_
5. Abdul Mulreen, Eintan Khan.M. rvitrz.aNrul Hasan. Energy and Environment. Anamaya Publishers, New Delhi.
6. Renewable Energy Sources and Emerging Technologies, Kothari **D.P**, and Sineal K. C, New Arrivals - PHI; 2 edition (2011)

CRE2:Renewable energy sources and technology

Unit I Renewable and Non-renewable energy sources:

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

References

1. Renewable Energy Technologies: A Practical Guide for Beginners. Chetan Singh Solanki, PHINchool Books (2008)
2. Fundamentals of Renewable Energy Systems Paperback —11 Makherjee, New A5ze International Publisher; First edition (2.011)
3. Renewable Energy Sources and Emerging Technologies, Kothari D.P.and Singal K. C, New Arrivals - PHI: 2 edition (2011)
4. G. a Rai, Non- conventional Sources of Enerp, Khanna Publishers. Delhi.

CRE3: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

Unit V Solar photovoltaic technology

Principle of photovoltaic conversion, Technology for fabrication of photovoltaic devices, generation systems. Off-grid systems, Grid connected systems, Organic solar cells, electrochemical energy storage: Batteries. Economics of solar photovoltaic systems. Off-grid power control and management systems, Grid-connected power control and management systems, Solar photocatalysis: mechanism, Kinetics. Nano-catalysts: system design. Performance parameters, Applications of solar photo-catalysis

References

1. Goswarrii DY, Kreith F. Kreider JF_ Principles of Solar Engineering, Taylor & Frauds, 1999
2. Tiwari GN_ Solar Energy, Fundamentals design, modeling and Applications. Narosa, 2002
3. Duffie JA. Beckman WA. Solar Engineering of Thermal Processes, John Wiley, 2006
4. Kishore VVN. Renewable Energy Engineering and Technologies, TERI, 2009
5. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki, 3 edition 2015
6. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Chetan Singh Solanki PHI (1 January 2013)
7. Science & Technology of Photovoltaics P Jayranta Reddy, BS Publications , CRC Press 2010
8. From Sunlight to Electricity: A Practical Handbook on Solar Photovoltaic Applications, Sinned Deambi, The Energy and Resources Institute, TERI (30 January 24)09)

CRE4:New Energy Resources

Unit 1 Energy Resources

Need of energy systems and materials, Application to supplement and expedite energy conservation efforts, Addressing environmental concern, 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 Electrochemical Energy Storage System

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

References

1. Narayan R. Biswanathan B. Chemical and Electrochemical Energy Systems, University Press (India)Ltd. 1998.
2. J W Twidell & A D Weir, Renewable Energy Resources, ELBS, 2006
3. Tiwari ON Ghoshal MK. Fundamentals of Renewable Energy Sources, Narosa, 2007.

CRE5:Energy management and auditing

Unit I 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

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 ES.00s., Project definition and scope. Technical design and Financing, Project planning techniques; CPM and PERT, case studies

References

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. Capchart, Turner, Kennedy. Guide to Energy Management, Fifth Ed. The Fairmourn Press, 2006.
6. Thomann, Mehta. Handbook of Energy Engineering, Fifth Ed. The Fairmount Press. 2001

CRE6: Fundamental of Computer & Information Technology

Unit-I Introduction to Computers

History and Generations of Computers, Classification of Computer by Processing, Capabilities, Micro, Mini, Mainframe and Super Computers., 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, table & Illustrations, bookmark, hyperli nk, 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, Calculative Examples like salary sheet, mark.

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.

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, f-commerce, FTP, Bookmarks, Internet Search, Bask search. Tips and Tricks for search. IP addressing, HTML.

References

1. Anutag Seetha, "Introduction to Computers and Information Technology", Ram Prasad tik Sons, Bhopal.
2. S.K.Basandra, "Computers Today", Galgotia Publications; Alexis Leon & Mathews Leon, "Fundamentals of Information technology", Vikas Publishing House, New Delhi
3. DOS Quick reference by Rajen: Mathur, Galgotia Publications
4. Linux Complete by BPB Publications Peter Norton Complete Guide to Linux- by Peter Norton, Tech media Publications

Practical and Project work

1. Evaluation methods of solar power plants
2. study of V-I characteristics of solar PV system

3. Study of different batteries used in PV system
4. Study of different methods of solar power tracking

Minor Project

1. AIM:

To expose student to industry-standard project practices, through a real-life project work under time and deliverable constraints, applying the knowledge acquired through various courses.

2. OBJECTIVES:

To provide an opportunity to apply the knowledge gained through various courses in solving a real life problem

To provide an opportunity to practice different phases of software/system development life cycle

To introduce the student to a professional environment and/or style typical of a global industry

To provide an opportunity for structured team work and project management

To provide an opportunity for effective, real-life, technical documentation

To provide an opportunity to practice time, resource and person management.

3. PROJECT GUIDELINES

Group Size – Maximum 3

No. of records – No. of group members + 1 (Department copy) Certificate should include the names of all members

The minimal phases for the project are: Project search, finalization and allocation, Investigation of

system requirements, System Design, System implementation and acceptance testing.

3.1 Planning the Project: The Major Project is an involved Exercise which has to be planned well in advance. The topic should be chosen in Semester 4 itself and the case study of Course should as far as possible, be based on the project topic, though on Exceptional cases, for valid reasons, the project guide may waive this condition. Related reading, training and discussions should start from first semester itself.

4. Selection of project work:

- a) Developing solution for a real-life problem
- (b) Innovative Product development:

(c) Research level project

Teaching Methodology

- Familiarize some Technologies of Energy conversion
- Interact with some Industry people
- writing project proposals
- Writing assignments
- Quizzes, test papers
- Case studies and feasibility studies of various energy conversion systems
- Mock Energy auditing

Scheme of Evaluation

The course shall have six theory papers of 100 marks each, that is a total of 600 marks. Practical and project paper of 100 marks each. Total 800 marks for the entire course.

Each theory paper of 100 marks shall have two components of evaluation:

- a) Continuous evaluation of 20 marks, comprising of quizzes, assignments, test papers etc.
- b) Final Written Examination of 80 marks.

The practical paper shall be a practical examination of experiments and viva-voce of 100 marks.

Final Score for 800 Marks shall be calculated for the continuous evaluation and final examination; and grade shall be as per the grading system below.

Grading System

Based on the student's performance in all the five papers, a final letter grade will be awarded at the end of the PG Diploma course. The letter grades and the corresponding grade points are as given in Table

Table: Grades and Grade Points

S.No.	Grade	Grade Points	Absolute Marks
1	O (Outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (AboveAverage)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab (Absent)	0	

Grade

Point Average

A Grade Point Average (GPA) for the course will be calculated according to the formula:

$$\text{GPA} = \frac{\Sigma [C _ G]}{\Sigma C}$$

A student, who earns a minimum of 4 grade points (P grade) in the final exam and continuous evaluation put together in each of the eight papers, is declared to have successfully completed the course, subject to securing a GPA of 8 for a pass in the course.