

Vijayanagar Sri Krishnadevaraya University Ballari



SYLLABUS

U.G Diploma in Solar Renewable Energy

(I to II Semester)

With effect from 2019-20

'Preamble of the Course'

"GO SOLAR STAY SECURE"

Solar is the solution for many of the depleting resource saving energy in large chunks; solar power has the potential to turn the worlds into a greener and healthier place to live. Every hour the sun above beams onto Earth sufficient amount of energy that's capable of satisfying global energy needs for an entire year.

Harnessing sun's energy that's unending and making it useable, we are securing not just many other exhaustible energy sources but also switching to a solution that's smart, economical and environmental friendly,

Objectives:

1. To introduce new course for the students and to eradicate unemployment.
2. Develop Undergraduate and research level programs for creating professional manpower in Solar technology
3. For the present competitive world Establish linkages with educational institution and industries to share experience and knowledge.
4. To understand appliances available in the market that promote solar usage.
5. To join hands for a greener tomorrow.
6. Provide innovative, flexible and regular education by using the teaching methodology and by applying modern communication technologies to education
7. Ensure relevance of programmes by updating course regularly
8. Help participating students to become more effective decision makers in their knowledge and managerial skills.

U.G Diploma in Solar Renewable Energy

Eligibility:

PUC/10+2 Equivalent/ 10th + ITI/ Diploma Passed candidate are eligible.

Course Structure :

The Under Graduate Diploma in Solar Renewable Energy program is offered under semester pattern for two semesters with five papers per semester.

Duration and Medium :

The minimum duration of the Under Graduate Diploma program is one year. The Medium of instruction and examination is in English.

Evaluation Procedure:

Examination (Theory Paper)	70 Marks
Internal Assessment	30 Marks
Total Marks per Paper	100 Marks

VSK UNIVERSITY BALLARI
U.G Diploma in Solar Renewable Energy

Semester-I

S.N	Paper Code	Title	Credits	Marks		Total
				Exam	IA	
1	UGDRE101	Energy Sources	4	70	30	100
2	UGDRE102	Principles of Solar Photovoltaic Systems	4	70	30	100
3	UGDRE103	Design of Solar Cell	4	70	30	100
4	UGDRE104	Fundamentals of Safety & Protective Equipment	4	70	30	100
5	UGDRE105	Practicum- I (field work)	4	70	30	100
Total			20	350	150	500

Semester-II

S.N	Paper Code	Title	Credits	Marks		Total
				Exam	IA	
1	UGDRE201	Energy and Environment	4	70	30	100
2	UGDRE202	Solar Electric System Installation and Service	4	70	30	100
3	UGDRE203	Selection and Maintenance of Solar Plant	4	70	30	100
4	UGDRE204	Study of Solar Power Axillary Equipments	4	70	30	100
5	UGDRE205	Practicum- II (Field work)	4	70	30	100
Total			20	350	150	500

SEMESTER-I

U.G Diploma in Solar Renewable Energy

Subject: ENERGY SOURCES

(52 Hours)

Sub Code: UGDRE101	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module 1

14 Hours

Introduction, Definition of Power and energy, difference between power and energy, the role of energy in development, Limitation of renewable energy sources their usefulness seasonal nature, requirement, need for the use of new energy sources.

Module-2

14 Hours

Conventional energy sources Hydro Electric, Thermal, Nuclear, Non-Conventional Energy sources Bio-mass, geo-thermal, solar, wind energy, ocean energy, wave energy, advantages and disadvantages, challenges.

Module- 3

12 Hours

Commercial energy sources, fossil-fuels coal, oil, natural gas, hydro electric power, nuclear, Non-commercial energy sources, wood, animal wastes, agricultural waste, cost of raw materials, transport problems, issues

Module- 4

12 Hours

Solar system: Energy from the sun, solar window, atmospheric effects, diffused radiations, Air mass, effect of Air Mass, seasonal effects, environmental effects on standard test conditions.

Reference

- Renewable energy; power for a sustainable future; oxford; Stephen peake; oxford university press- 2017
- Renewable energy systems; Devid M, Buchla, Thomas E kissell, Thomas, L Floyd; Pearson India Education Services Pvt. Ltd. 2017
- Fundamentals of Renewable Energy Systems Paperback – D.Mukherjee, New Age International Publisher; First edition (2011)
- Solar Power Hand Book, Dr. H. Naganagouda(2014)

Subject: Principles of Solar Photovoltaic Systems

(52 Hours)

Sub Code: UGDRE102	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module 1:

14 Hours

Introduction, Sun movement over the day, shadowing effects, Photovoltaic Cell. Advantages & disadvantages of photo-voltaic conversion. Use of solar cell in various instruments. Photo-voltaic array & its connections, arrangements of array according to the voltage. Module & its connections. Faults & their effects in photo-voltaic cell, array & module (connection of cell, connection of array, connection of module)

Module 2:

14 Hours

Solar Photovoltaic energy conversion and utilization, solar power generation systems a) off-grid systems b) grid connected systems c) power control and management systems, economics of solar photovoltaic systems, World Energy Requirement, Energy and Role of Photovoltaic, Types of PV Installation, Common Systems type, GRID-TIED System, Hybrid Systems, Photovoltaic in Energy Supply,

Module 3:

12 Hours

Introduction, Why Solar Energy generation, solar radiation, radiation measuring instruments, radiation measurement and predictions, atmospheric effects, seasonal effects, environmental effects on standard test conditions, Solar PV production and cost.

Module 4:

12 Hours

Solar Photovoltaic system: Check the functions of different parts upto the performance level expected. Balance of Solar PV Systems: Electrical Storage: Battery technology, Batteries for Photovoltaic systems, DC – DC converters, Charge Controllers, DC – AC inverters; single phase, three phase, MPPT.

Reference:

- Solar Photovoltaic; Chetansingh solanki; PHI, Learning private ltd., New delhi- 2018
- Non-conventional Sources of Energy , G.D Rai, Khanna Publishers, Delhi, 2012
- Solar Power Hand Book, Dr. H. Naganagouda (2014)
- Renewable Energy Technologies; A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008)
- Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Signal K.C New Arrivals –PHI; 2 Edition (2011)

Subject: Design of Solar Cell

(52 Hours)

Sub Code: UGDRE103	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module 1: 14 Hours

Solar Cell technologies Crystalline Cells: Mono- crystalline and poly – crystalline cells, Metallurgical Grade Si, Electronic Grade Si, wafer production, Mono – crystalline Si Ingots, Poly – crystalline Si Ingots, Si – wafers, Si – sheets, Solar grade Silicon, Si usage in solar PV, Commercial Si solar cells, process flow of commercial Si cell technology, process in solar cell technologies, Sawing and surface texturing, diffusion process, thin film layers, Metal contact

Module 2: 12 Hours

Thin Film Cells: Advantage of thin film, thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition.

Module 3: 14 Hours

Semiconductors as basic solar cell material, materials and properties, P – N junction and solar cell. Sources of Losses and prevention, Common Features: Substrate and Super-state configuration, Thin film module manufacturing, Amorphous Si Solar cell technology, Cadmium Telluride Cell Technology, CIGS solar Cell.

Module 4: 12 Hours

Concentrators and PV Modules: Concentration: Advantages and disadvantages, Series Resistance optimization, Concentrating techniques; tracking / non-tracking systems, Cooling requirements, High concentration solar cells.

Reference:

- Solar Electricity Handbook; Michael Boxwell; Greenstream publishing ltd, UK-2011
- Solar Power Hand Book, Dr. H. Naganagouda (2014)
- Fundamentals of Renewable Energy Systems Paperback – D.Mukherjee, New Age International Publisher; First edition (2011)
- Renewable energy Technologies; A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008)

Subject: Fundamentals of Safety & Protective Equipments

(52 Hours)

Sub Code: UGDRE104	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module- I

14 Hours

National Policy on Safety, Health and Environment at Workplace (NPSHEW), Major OSH Laws & Regulations, Educational and awareness-raising arrangements to enhance preventive safety and health culture, including promotional initiatives, National Safety Day activities, National Safety Awards, OSH Education in Schools

Module- II

14 Hours

Electrical Safety Electrical safety Rules, Simple First Aid , General safety of tools and equipment PPEs , Fire extinguishers, Type of fire extinguishers b. Electricity Basics, Fundamental of Earthing system, PV module, Fundamental types of modules and its applications, PV components and configuration etc. c. System components & inspection d. Site layout & marking

Module- III

12 Hours

Types and Importance of Safety helmet, Safety souse, Safety belt, Nose mask, Safety goggles , Ear plug , PVC hand glove ,Cotton hand glove , Reflective jacket, First aid kit , Gum boots, Construction of cable trenches & conduits, Cable Tray support & Tray Erection, Requirements & uses of tools & tackles, General Safety Guidelines for O&M, Soft & Entrepreneurship skills

Module- IV

12 Hours

Study of work method & document for the followings: String Testing- Pre-checks, Short Circuit Test- Work Method, Inverter Testing- Work Method, Check list preparation, Pre -requirement of installation of sub-station equipment, Basics and erection of transformers, pole erection and stringing

REFERENCES

1. Solar Power Hand Book, Dr. H. naganagouda (2014)
2. Green Power: Eco-Friendly Energy Engineering”, Khartchenko . N.V, “Tech Books, and New Delhi, 2008.
3. Handbook of energy and environment in India; Banerjee BP , Oxford University press-2005 India

PRACTICUM -I (FIELD WORK)

Sub Code: UGDRE105	Internal Marks : 30
Total Credit: 04	Viva Marks : 70 Total = 100

RATIONALE FOR FIELD WORK:

Theory provides the perspective and information base to understand the solar power production, challenges and issue contexts, within which human societies, engage and strive to create better living conditions. The classroom provides this theoretical knowledge and understanding which forms the foundation and core areas of Solar Renewable Energy. Field Work offers an environment within which students are given an opportunity to develop a coherent framework for practice by integrating and reinforcing the knowledge acquired in the classroom with actual practice. It also enables students to acquire and test relevant practice skills. Ongoing learning of practice is an opportunity to develop intervention skills in reality situations. This entails learning practice for **25 days of the semester**.

SEMESTER-II

U.G Diploma in Solar Renewable Energy

Subject: Energy and Environment

(52 Hours)

Sub Code: UGDRE201	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module- I

14 Hours

Environment concerns of energy extractions:

Environment effects of energy extractions, conversion and use. Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, Methods of environmental impact assessment, Sustainability issues of energy use- Future energy system, Clean energy technologies.

Module- II

12 Hours

Waste management and pollution control

Waste as a source of energy - Industrial, domestic and solid waste as a source of energy. Pollution control - Causes process and exhaust gases and its control, mechanism and devices for pollution control.

Module- III

12 Hours

Pollution from power plants and its control

Pollution - Pollution due to thermal power station and its control and systems. Pollution due to nuclear power generation, radioactive waste and its disposal, effect of hydro electric power stations on ecology and environment.

Module- IV

Environmental protection and carbon credits

14 Hours

Global environmental concern - United Nations framework convention on climate change (UNFCCC), protocol, clean development mechanism (CDM), benefits to developing countries, building a CDM project, Environmental impacts -Environmental degradation due to energy production and utilization

REFERENCES

1. The Climate Solution; Mridula Ramesh; neelkamal publication - 2009
2. "Green Power: Eco-Friendly Energy Engineering", Khartchenko . N.V, Tech Books, and New Delhi, 2008.
3. Handbook of energy and environment in India; Banerjee BP , Oxford University press 2005 India
4. "Environmental Science", Cunningham .W.P,11th ed., McGraw-Hill, 2010.

Subject: Solar Electric System Installation and Service (52 hours)

Sub Code: UGDRE202	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module 1: 14 Hours

Solar water Heater: Principals of solar thermal systems, Technology's in solar water heating systems, salient features of solar water heating systems, Types of solar heating systems available, Application of solar water heating systems, installing of solar water heating systems, advantages and disadvantages solar water heating systems.

Module 2: 12 Hours

Solar lighting system: Description of main parts of solar lighting system: Solar Lantern, street light, home light, Charge controller, Storage battery, Inverter, Luminars, Maintenance of solar lighting system, types and advantages of solar outdoor lighting Comparative study of Conventional lighting system & solar lighting system

Module 3: 14 Hours

Solar cooking: benefits of solar cooking, advantages and disadvantages solar cooking, principals and application of solar cooking, solar wall applications, solar safe dinking water systems, solar air heating drying systems, solar powered water pumps and salient features, types of solar powered pumps, advantages, and limitations of solar powered pumps, maintenance and tracking systems.

Module 5: 12 Hours

Roof Top: Technical Standards and Specification, Types of Roof top, Capacity Limiting, Technical Considerations, Standards and Specifications, Grid Connected Rooftop Solar System, Benefits from the Grid Connected Rooftop Solar System, Types of metering arrangements, Rooftop Solar Programme by Government of India and Objectives of the Programme.

Reference:

- Non-conventional Sources of Energy , G.D Rai, Khanna Publishers, Delhi -2008
- Solar Power Hand Book, Dr. H. Naganagouda (2014)
- Renewable Energy Technologies; A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008)
- Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Signal K.C New Arrivals –PHI; 2 Edition (2011)

Subject: Selection and Maintenance of Solar Plant

(52 Hours)

Sub Code: UGDRE203	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module :1

14 Hours

Introduction, Solar energy system site considerations, components of typical SPV system, Types of Roof, overview of the planning stage, Selection of systems design and objective for grid connected system. check list preparation, soft and entrepreneurship skills on job training

Module :2

14 Hours

Fundamental of Earthing system, objectives of earthing, need for earthing, Design of earthing, types of Earthing, types of Earth Testers, Standards / regulations on Earthing, Need of Earthing, grounding equipments, Design of Earthing, types of earthing tester, the factors impact on grounding systems, earthing checking systems, regulation on earthing tools and their uses.

Module :3

12 Hours

Electrical safety, electrical safety rules, simple first aid, general safety of tools and equipment, fire extinguishers, types of fire extinguishers, Guideline of Safety measurement in solar plant, Performance and monitoring system, ways to maximize energy, solar cell utility – scale system performance.

Module :4

12 Hours

Basic knowledge about tools and tackles required for PV plant installation , requirement and uses of tools and tackles, basic knowledge of ammeter voltmeter, clamp on-meter, tong tester, irradiance sensor temperature sensors.

References.

- Solar Power Hand Book :- Dr. H. Naganagouda (2014)
- Solar Energy, Fundamentals Design, modeling and Application: Tiwari GN.-2015
- Solar Electricity Handbook; Michale Boxwell; 2017 edition
- Dawn of the Solar Age: An End to Global Warming and to Fear; Prem Shankar JHA; PHI publication - 2015

Subject: Study of Solar Power Axillary Equipment

(52 Hours)

Sub Code: UGDRE204	No. of Lecture Hours per week :04
Total Credit: 04	Internal Marks : 30 and Exam Marks : 70 = 100

Module- I

14 Hours

Use of Tools and tackles and safe application practices, a, voltmeter, amp meter, MultiMate, tong tester, AC/DC side testing, Temperature Sensors, monitoring of incoming and outgoing power at junction box & inverter level.

Module- II

12 Hours

Inverter: Introduction – evolution of the Inverter- inverter technical specifications and selection – types of Inverter – feature of Inverter, importance of Inverter, compression of inverters, solar inverters.

Module- III

12 Hours

Battery: Typical values of battery voltage, module current & voltage. Acid & their properties, current flow in batteries & impact of shorting of terminals. Charging process & precautions to be taken while charging a battery, Different types of tools & their use

Module- IV

14 Hours

Need for personal safety & safety of others. Dangers associated with working at heights. Methods of safety practices while using different hand tools. - Impact of incorrect lifting of objects, system components (especially battery) while installing at heights & while working. - Personal protective equipments & their usage. - Knowledge of the causes of accident & its remedial actions.

References :

- Solar Photovoltaic; Chetansingh solanki; PHI, Learning private ltd., New dehli-02-Oct. 2018.
- Solar Power Hand Book, Dr. H. Naganagouda (2014)
- Fundamentals of Renewable Energy Systems Paperback – D.Mukherjee, New Age International Publisher; First edition (2011)
- Renewable energy Technologies; A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008)

PRACTICUM - II

(Field Work)

Sub Code: UGDRE205	Internal Marks : 30
Total Credit: 04	Viva Marks : 70 = 100

RATIONALE FOR FIELD WORK:

Theory provides the perspective and information base to understand the solar power production, challenges and issue contexts, within which human societies, engage and strive to create better living conditions. The classroom provides this theoretical knowledge and understanding which forms the foundation and core areas of Solar Renewable Energy. Field Work offers an environment within which students are given an opportunity to develop a coherent framework for practice by integrating and reinforcing the knowledge acquired in the classroom with actual practice. It also enables students to acquire and test relevant practice skills. Ongoing learning of practice is an opportunity to develop intervention skills in reality situations. This entails learning practice for **25 days of the semester**.

Question Paper Pattern
for UG Diploma in Solar Renewable Energy Examination

Paper Code :

Paper Title:

Time : 3 Hours

Max Marks : 70

Section – A

Answer any **Five** questions

(5x2=10)

Q1.

Q2.

Q3.

Q4.

Q5.

Q6.

Section –B

Answer any **three** of the following questions

(3x10=30)

Q7.

Q8.

Q9.

Q10.

Q11.

Section –C

Answer any **Two** of the following questions

(2x15=30)

Q12.

Q13.

Q14.

Note for paper Setter: Question paper shall be set in English Version only