

Savitribai Phule Pune University



Skill Development Centre

**Bachelor of Vocation (B.Voc.)
in
Renewable Energy Skills (Second
Year)**

Revised Syllabus in Academic Year:-2025-2026

Savitribai Phule Pune University
Skill Development Centre
Bachelor of Vocation (B.Voc.) in Renewable Energy Skills
 Academic Year: -2025-26

Course Structure (Second Year)

Course Code	Course Title	Credit
SEMESTER – III		
RE 201 MJ	Introduction to Solar Photovoltaic Systems	2
RE 202 MJ	RE 202 MJ Solar PV System Life Cycle	2
RE 203 MJP	Practical Based on Theory-VII	2
RE 221 VSC	Solar PV System Design – Traditional & Digital Tools Approach	2
RE 231 OJT	On Job Training (Industrial Training- I)	2
RE 241 MN	Advanced Electronics for Renewable Energy	2
RE 242 MNP	Practical Based on Theory-VIII	2
OE-201-RE	Introduction to Indian Constitution	2
RE 201 IKS	Ancient Indian Trade & Commerce	2
AEC-201-MAR	Marathi	2
CC-201-PE	Physical Education	2
	Total Credits	22
SEMESTER – IV		
RE 251 MJ	Solar PV Pre-Installation & Mounting Skills	2
RE 252 MJ	Solar PV Wiring, Commissioning & Maintenance	2
RE 253 MJP	Practical Based on Theory-IX	2
RE 271 VSC	Basic Mechanical Engineering for Renewable Energy	2
RE 281 OJT	On Job Training (Industrial Training-II)	2
RE 291 MN	Solar Energy Applications in Agriculture	2
RE 292 MNP	Practical Based on Theory-X	2
OE-251-RE	Introduction to Human Rights & Duties	2
SEC-251-RE	Life Skills	2
AEC-251-MAR	Marathi	2
CC-251-PE	Physical Education	2
	Total Credits	22

SEMESTER III

1. RE 201 MJ Introduction to Solar PV Systems

Learning Outcomes:

1. Student states the types of Solar Photo Voltaic Systems.
2. Student explains the characteristics of each type of solar PV system.
3. Student identifies the components of Solar PVS.

Unit 1: Solar Energy Basics (7.5 Hours)

- 1.1 Basics of solar energy and solar radiation
- 1.2 Principle of photovoltaic effect

Unit 2: PV System Types and Applications (7.5 Hours)

- 2.1 Types of PV systems: Off-grid, on-grid, hybrid
- 2.2 Solar energy potential and applications in India

Unit 3: Key PV Components (7.5 Hours)

- 3.1 PV modules – types, ratings, and selection
- 3.2 Inverter types and functions

Unit 4: Energy Storage and Support Systems (7.5 Hours)

- 4.1 Batteries and charge controllers
- 4.2 Mounting structures and wiring basics

2. RE 202 MJ Solar PV System Life Cycle

Learning Outcomes:

1. Student states the stages in life cycle of Solar PV Plant.
2. Student describes the steps in establishment of Solar PV Plant.
3. Student identifies the causes of performance degradation of solar PV plant.

Unit 1: Life Cycle Overview of PV Systems (7.5 Hours)

- 1.1 Stages of a PV system's life cycle: design, production, use, disposal
- 1.2 Environmental and economic impacts across the life cycle
- 1.3 Life Cycle Assessment (LCA): definition, purpose, and methods

Unit 2: Manufacturing and Supply Chain Aspects (7.5 Hours)

- 2.1 Materials used in PV modules and components
- 2.2 Energy payback time (EPBT) and carbon footprint
- 2.3 Global vs. local supply chains: sourcing, logistics, and implications

Unit 3: Operational Longevity and System Degradation (7.5 Hours)

- 3.1 Performance degradation of modules and components over time
- 3.2 Reliability, durability, and expected lifespan
- 3.3 Warranty, insurance, and lifecycle costing

Unit 4: Decommissioning and Recycling (7.5 Hours)

- 4.1 End-of-life strategies: reuse, recycling, safe disposal
- 4.2 Recycling technologies and challenges in India
- 4.3 Circular economy in solar energy: opportunities and innovations

Reference Books

- 1 Green, M. A. (2009). *Third Generation Photovoltaics: Advanced Solar Energy Conversion* (2nd ed.). Springer.
- 2 Kalogirou, S. A. (2013). *Solar Energy Engineering: Processes and Systems* (2nd ed.). Academic Press.
- 3 Sampaio, P. G. V., & González, M. O. A. (2017). *Photovoltaic Solar Energy: From Fundamentals to Applications*. Springer.
- 4 Garg, H. P., & Prakash, J. (2000). *Solar Energy: Fundamentals and Applications*. Tata McGraw-Hill Education

3. Course Code: RE 203 MJP Practical Based on Theory - VII

List of Practical– Solar PV Systems (30 Hours)

Learning Outcomes:

1. Student measures the various parameters of functional Solar PV plant using appropriate devices.
2. Student estimates the battery load accurately.
3. Student fixes the electrical and mechanical faults in operational PV plant using appropriate troubleshooting mechanism.

1. Measurement of Solar Radiation

Using pyranometer or mobile apps to record solar intensity.

2. Identification of PV System Components

Hands-on with modules, inverters, batteries, charge controllers, etc.

3. Testing and Measuring PV Module Output

Use a multi meter to measure voltage and current of a solar panel.

4. Series and Parallel Connection of PV Modules

Learn effects on voltage and current with real modules.

5. Site Survey for PV Installation

Use compass/inclinometer or app to assess rooftop or ground site.

6. Wiring and Mounting of a Mini PV System

Connect modules, inverter, load, and battery (demo setup).

7. Installation of a Solar Charge Controller

Connect and test charging performance with battery and load.

8. Inverter Wiring and Load Testing

Connect inverter to system and test with AC/DC loads.

9. Routine Maintenance and Cleaning of PV Modules

Learn proper cleaning techniques and maintenance checklist.

10. Troubleshooting Common PV System Issues

Diagnose and fix issues like loose wires, no output, low voltage.

4. RE 221 VSC Solar PV System Design – Traditional & Digital Tools Approach

Learning Outcomes:

1. Student can determine the site feasibility using given parameters.
2. Student can estimate the cost and material requirement depending upon the proposed PV plant capacity.

Unit 1: Fundamentals of PV System Design (7.5 hrs)

- Quick recap: types of PV systems
- Components: panels, inverters, batteries

Unit 2: Load and Site Analysis (7.5 hrs)

- Load profiling: daily/seasonal, critical/non-critical loads
- Site feasibility: shading, tilt, solar potential using tools like Solcast

Unit 3: Manual Design and Costing (7.5 hrs)

- System sizing: panels, batteries, inverters, controllers
- PV sizing calculations (formulas and data sheets)
- Wiring design: series-parallel, schematic diagrams
- Costing and BOM preparation

Unit 4: Software-Based PV Design Tools (7.5 hrs)

- Hands-on tools: PVWatts, HelioScope, SAM, SolarDesignTool
- Simulating and analysing system performance
- Comparing manual vs software-based designs

Reference Books:

1. Masters, G. M. (2013). *Renewable and Efficient Electric Power Systems* (2nd ed.). Hoboken, NJ: Wiley.
2. Mukherjee, D., & Chauhan, S. (2011). *Fundamentals of Renewable Energy Systems*. New Delhi, India: New Age International Publishers.
3. Green, M. A. (2015). *Solar Cells: Operating Principles, Technology, and System Applications*. New York, NY: UNSW Press.

5. RE 231 OJT On Job Training

6. RE 241 MN Advanced Electronics for Renewable Energy Systems

Learning Outcomes:

1. Student identifies various components related to power electronics.
2. Student records readings of electrical parameters using appropriate measuring devices.
3. Student identifies the right type of inverter depending upon power generation and storage requirement.
4. Student employs appropriate mechanism for circuit protection.

Unit 1: Basics of Power Electronics (7.5 hrs)

- 1.1 Introduction to power electronics in energy systems
- 1.2 Semiconductor switching devices: SCR, MOSFET, IGBT

Unit 2: Conversion and Inversion Techniques (7.5 hrs)

- 1.3 Rectifiers and filters – AC to DC conversion
- 1.4 DC-DC converters (buck, boost, buck-boost)
- 1.5 Inverters – Types and working principle

Unit 3: Control and Protection Circuits (7.5 hrs)

- 2.1 Microcontroller basics and applications in solar/wind systems
- 2.2 PWM control for solar charge controllers and inverters
- 2.3 Overload, overvoltage, and short-circuit protection circuits
- 2.4 Relay control and timer circuits
- 2.5 Battery protection and monitoring circuits

Unit 4: Instrumentation and Troubleshooting (7.5 hrs)

- 3.1 Sensors: voltage, current, light, temperature
- 3.2 Analog and digital meters (multimeter, clamp meter, DSO)
- 3.3 Data logging and basic communication interfaces
- 3.4 Testing of PV-related electronic boards and circuits
- 3.5 Fault detection and basic troubleshooting techniques

Reference Books

- 1 Rashid, M. H. (2017). *Power Electronics: Circuits, Devices, and Applications* (4th ed.). Pearson.
- 2 Singh, B., & Dwivedi, S. (2015). *Power Electronics and Control: Concepts, Techniques, and Devices*. Wiley India.
- 3 Basso, C. (2012). *Switch-Mode Power Supplies: SPICE Simulations and Practical Designs*. McGraw-Hill Education.
- 4 Kanchan, R. S. (2014). *Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration*. Springer.

7. RE 242 MNP Practical Based on Theory-VIII (Advanced Electronics for Renewable Energy Systems)

List of Practical – (30 Hours)

1. **Identify and test power electronic components**
(SCR, MOSFET, IGBT) using multi meter.
 2. **Assemble and test a bridge rectifier with filter**
Convert AC to DC using diodes and capacitors.
 3. **Build and test a buck or boost converter circuit**
Observe voltage regulation using DC-DC converter setup.
 4. **Test operation of a basic inverter circuit**
Convert 12V DC to 230V AC (low wattage lab model).
 5. **Interface a sensor (e.g., light or temp) with microcontroller**
Simple input-output demo using Arduino or similar.
 6. **Generate PWM signal using microcontroller**
Control brightness of LED or speed of DC fan.
 7. **Test battery protection circuit**
Demonstrate overcharge/discharge cut-off using relays.
 8. **Connect and test relay control circuit**
Operate a load using a timer or switch.
 9. **Use a multimeter and clamp meter for circuit analysis**
Measure voltage, current, resistance in a live setup.
 10. **Troubleshoot a faulty solar charge controller or inverter board**
Identify common issues like blown fuse, loose wires, or faulty components.
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8. OE-201-RE Introduction to Indian Constitution

UNIT I: PHILOSOPHY OF THE INDIAN CONSTITUTION (5 Hours)

1. Constitutional History of India
2. Role of Dr. B.R. Ambedkar in Constituent Assembly
3. Preamble - Source and Objects
4. Sovereign and Republic
5. Socialist and Secular
6. Democratic - Social and Economic Democracy
7. Justice - Social, Economic and Political
8. Liberty - Thought, Expression, Belief, Faith and 'vVorship
9. Equality - Status and Opportunity
10. Fraternity, Human Dignity, Unity and Integrity of the Nation

UNIT 2: FUNDAMENTAL RIGHTS (10 Hours)

- a) Right to equality b) Right to freedoms c) Right against exploitation d) Right to freedom of religion e) Cultural and educational rights f) Right to property g) Right to constitutional remedies

UNIT 3: DIRECTIVE PRINCIPLES OF STATE POLICY (5 Hours):

a) Equal Justice and free legal aid b) Right to work and provisions for just and humane conditions of work c) Provision for early childhood, Right to education and SC, ST, weaker section d) Uniform Civil Code e) Standard of Living, nutrition and public health f) Protection and improvement of environment g) Separation of Judiciary from executive h) Promotion of International peace and security

UNIT 4: FUNDAMENTAL DUTIES (5 Hours) a) Duty to abide by the Constitution b) Duty to cherish and follow the noble ideals c) Duty to defend the country and render national service d) Duty to value and preserve the rich heritage of our composite culture e) Duty to develop scientific temper, humanism, the spirit of inquiry & reform f) Duty to safeguard public property and abjure violence g) Duty to strive towards excellence

Text/Reference Books:

- 1 D. D. Basu, Introduction to the Constitution of India, LexisNexis
 - 2 Granville Austin, The Constitution of India: Cornerstone of a Nation, Oxford University Press c) Subhash Kashyap, Our Constitution, National Book Trust
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9. RE 201 IKS Ancient Indian Trades and Commerce (2 Credits)

Learning Objectives:

- Student explains the key terms, concepts, and timelines of ancient Indian trade.
- Student explains the socio-cultural and geographical contexts influencing trade.
- **Student** identify traditional trade routes on map.

UNIT 1: Introduction to Ancient Indian Economy (7 hours)

- 1.1 Nature of the early Indian economy (Agrarian, pastoral, artisanal)
- 1.2 Role of barter and emergence of currency

UNIT 2: Local and Regional Trade Systems (8 hours)

- 2.1 Village markets and trade fairs
- 2.2 Guilds (Shrenis) and artisanal networks
- 2.3 Role of women in trade

UNIT 3: Trade Routes and Means of Transport (7 hours)

- 3.1 Ancient highways and trade centres
- 3.2 Riverine and coastal trade
- 3.3 Ports and maritime facilities

UNIT 4: Commodities and Trade Specializations (8 hours)

- 4.1 Agricultural produce, spices, textiles, metals
- 4.2 Trade in gems, ivory, perfumes
- 4.3 Craftsmanship and exports

Reference Books:

1. Sharma, R. S. (2005). *India's ancient past*. Oxford University Press.
2. Abraham, M. (1988). *Two medieval merchant guilds of South India*. Manohar Publishers.
3. Kosambi, D. D. (1956). *An introduction to the study of Indian history*. Popular Prakashan.
4. Majumdar, R. C. (1960). *Corporate life in ancient India* (3rd ed.). Mukhopadhyay.
5. Paranjape, M. (2022). *Indian culture and civilization: The IKS perspective*. Rupa Publications.
6. Pillay, K. K. (1975). *Indian history: Social and cultural*. University of Madras.

10. AEC-201-MAR व्यावहारिक व उपयोगित मराठी

अभ्यासक्रमाची उद्दिष्टे :

१. उपयोगित व सर्जनशील लेखनाची क्षमता विकसित करणे.
२. मराठी भाषेची कार्यालयीन, व्यावसायिक कामकाजातील गरज, स्वरूप व उपयोग यांची माहिती करून घेणे.
३. कार्यालयीन, व्यावसायिक भाषा व्यवहारासाठी आवश्यक लेखनकौशल्ये प्राप्त करणे.
४. नवसमाजमाध्यमांतील विविध भाषिक अभिव्यक्तींचे स्वरूप समजून घेणे.

घटक व तपशील

घटक क्रमांक	तपशील	तार
१	भाषा आणि जीवनव्यवहार — भाषा म्हणजे काय? परिभाषेची आवश्यकता, विविध शब्दकोशांची ओळख, शास्त्रीय, व्यवहार, साहित्य, कार्यालयीन भाषा.	१०
२	कार्यालयीन लेखन — औपचारिक : माहितीपत्रक, परिपत्रक, सूचना पत्रक इ. अनौपचारिक : ट्विटर, व्हॉट्सअॅप, चित्रवाणी इत्यादी	१०
३	स्वपरिचय, अर्ज लेखन, जाहिरात लेखन	१०

संदर्भ ग्रंथ :

१. सांगणक — अच्युत गोडबोले, मौज प्रकाशन, मुंबई.
२. इंटरनेट — डॉ. प्रबोध चोबे, मनोरमा प्रकाशन, मुंबई.
३. व्यावहारिक मराठी — डॉ. ल. रा. नवसराबादकर, फडके प्रकाशन, कोल्हापूर.

४. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात — दीपक भिशिक्रापुरे, उज्ज्वल मराठे, उत्कर्ष प्रकाशन, पुणे.
 ५. भाषांतरमीमांसा — कल्याण काळे, अंजली सोमन.
 ६. व्यावहारिक मराठी — पुणे विद्यापीठ प्रकाशन.
 ७. व्यावहारिक मराठी — डॉ. कल्याण काळे, डॉ. दत्तात्रेय पुंडे, वनराळी प्रकाशन, पुणे.
 ८. व्यावहारिक मराठी — डॉ. लीला गोविलकर, डॉ. जयश्री पाटणकर, स्नेहधन प्रकाशन, पुणे.
 ९. प्रसारमाध्यमांसाठी लेखन कौशल्य — यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक.
 १०. व्यावहारिक मराठी — डॉ. सयाजीराजे मोकाशी, डॉ. रांजना नेमाडे.
 ११. व्यावहारिक मराठी — डॉ. ल. रा. नवसराबादकर, फडके प्रकाशन, कोल्हापूर.
 १२. प्रसारमाध्यमे आणि मराठी भाषा — संपादक : डॉ. भास्कर शेळके.
 १३. व्यावहारिक व उपयोगित मराठी व प्रसारमाध्यमांची कार्यशैली — संपादक : डॉ. संदीप सांगळे.
 १४. व्यावहारिक व उपयोगित मराठी — डॉ. मनोहर रोकडे.
 १५. मराठी भाषा उपयोगन व सर्जन — प्रा. सुहासकुमार बोबडे.
 १६. व्यावहारिक मराठी — संपादक डॉ. स्नेहल तावरे, स्नेहधन प्रकाशन, पुणे.
 १७. भाषांतरमीमांसा — संपादक : डॉ. रमेश विरखेडे, यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक.
 १८. सायबर संस्कृती — डॉ. रमेश विरखेडे.
 १९. उपयोगित मराठी — संपादक : डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई.
 २०. [MKCL – Solar IT Marathi App](#)
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11. CC-201-PE Physical Education

SEMESTER IV

1. RE 251 MJ Solar PV Pre-Installation & Mounting Skills

Learning Outcomes

By the end of this course, the learner:

1. **Conducts** rooftop site assessments for PV system installation, considering tilt, orientation, and shading.
2. **Identifies** and properly uses safety gear and testing instruments required for rooftop solar installation.
3. **Interprets** technical drawings and prepares a detailed pre-installation checklist.
4. **Installs** mounting structures and places panels with alignment and safety considerations.

Unit 1: Rooftop Assessment and Site Layout (7.5 hrs)

1. Rooftop inspection: tilt, orientation, and shading analysis
2. Site layout and assessment checklist

Unit 2: Safety Gear and Electrical Testing Tools (7.5 hrs)

1. Identifying and using safety gear: PPE, harnesses, ladders
2. Introduction to insulation testers and multimeters

Unit 3: Installation Planning and Safety Protocols (7.5 hrs)

1. Understanding technical drawings and PV installation manuals
2. Creating a pre-installation checklist (mechanical and electrical)
3. Planning panel layout and cable routing
4. Safety protocols for rooftop work

Unit 4: Mounting and Panel Placement Practice (7.5 hrs)

1. Installation of mounting structures for different roof types
2. Anchoring and tilt adjustment techniques
3. Safe panel handling and alignment
4. Practice drill with dummy installations

2. RE 252 MJ Solar PV Wiring, Commissioning & Maintenance

By the end of the course:

1. **Student performs** safe and efficient series-parallel connections using appropriate cables and routing practices.
2. **Student connects** inverters and batteries correctly for both off-grid and grid-tied solar PV systems.
3. **Student applies** protection techniques such as earthing, surge protection, and performs system balancing.
4. **Student carries out** testing, commissioning, maintenance, and basic troubleshooting of PV systems.

Unit 1: Wiring and Connections (7.5 hrs)

1. Series and parallel connections
2. Cable types, sizing, and routing best practices

Unit 2: Connectors and System Integration (7.5 hrs)

1. Working with MC4 connectors
2. Inverter and battery connections (off-grid and grid-tied systems)

Unit 3: Protection, Metering, and Safety (7.5 hrs)

1. System earthing and surge protection
2. Basics of net metering for grid-connected systems
3. Load calculation and system balancing basics
4. Safety checks before commissioning

Unit 4: Testing, Commissioning, and Maintenance (7.5 hrs)

1. Performing continuity, insulation, and voltage tests
2. First-time system switch-on procedure
3. Creating and following a maintenance schedule
4. Troubleshooting common faults in PV systems

Reference Books :

1. Solanki, C. S. (2015). *Solar Photovoltaics: Fundamentals, Technologies and Applications* (3rd ed.). New Delhi, India: PHI Learning.
2. Rai, G. D. (2011). *Non-Conventional Energy Sources* (5th ed.). New Delhi, India: Khanna Publishers.
3. James, W., & Dunlop, J. P. (2012). *Photovoltaic Systems* (3rd ed.). Clifton Park, NY: Delmar Cengage Learning.

4. Kandpal, T. C., & Bhandari, R. (2021). *Renewable Energy Engineering: Solar, Wind, Biomass, Hydrogen and Geothermal Energy Systems*. Cham, Switzerland: Springer.
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3. RE 252 MJP Practical Based on Solar PV System Installation Skills - IX

Mode: Hands-on lab + demo + outdoor installation setup

1. Site Assessment Practice (4 hrs)

Procedure:

1. Measure roof area using tape
2. Check orientation and tilt with compass and inclinometer
3. Identify shade sources using sun path chart or app (e.g., Sun Surveyor)

2. Tool Identification & Safety Drill (4 hrs)

Procedure:

1. Identify and demonstrate use of tools: multi meter, MC4 crimper, wire stripper, torque wrench
2. Wear PPE (helmet, gloves, harness)
3. Practice ladder safety and electrical isolation steps

3. Mounting Structure Installation (4 hrs)

Procedure:

1. Mark panel layout on a demo roof
2. Fix mounting rails using clamps/anchors
3. Check alignment and tilt angle
4. Torque all fasteners to spec

4. Solar Panel Installation (5 hrs)

Procedure:

1. Lift panels safely and place on mounting structure
2. Connect panels in series and parallel
3. Use MC4 connectors and secure cables using ties and conduits

5. Inverter & Battery Setup (5 hrs)

Procedure:

1. Install inverter near power point
2. Connect panel strings to inverter (DC side)
3. Connect battery bank to charge controller
4. Connect AC output to simulated load board

6. Earthing & Surge Protection (3 hrs)

Procedure:

1. Drive earth rod into ground (demo setup)
2. Connect to inverter and panels using copper wire
3. Install SPD in combiner box (if available)

7. System Testing & Commissioning (5 hrs)

Procedure:

1. Measure open-circuit voltage (Voc) and short-circuit current (Isc)
2. Check continuity and insulation resistance
3. Power ON system and observe readings on inverter display
4. Verify AC output and battery charging status

4. RE 241 VSC Basic Mechanical Engineering for Renewable Energy

Learning Outcomes

By the end of the course:

1. **Student explains** the types of energy and basic mechanical principles relevant to renewable energy systems.
2. **Student applies** the concept of simple machines and mechanical advantage in energy applications.
3. **Student describes** fluid mechanics and heat transfer in the context of solar and wind energy systems.
4. **Student demonstrates** safe handling, basic fabrication, and maintenance of mechanical components used in renewable energy systems.

Unit 1: Energy Types and Mechanical Principles (7.5 hrs)

1. Types of energy: mechanical, thermal, electrical (overview)
2. Force, torque, work, power, and efficiency

Unit 2: Simple Machines and Mechanical Advantage (7.5 hrs)

1. Simple machines: gears, pulleys, levers (in context of windmills & trackers)
2. Basics of mechanical advantage in renewable systems

Unit 3: Heat and Fluid Mechanics (7.5 hrs)

1. Heat transfer: conduction, convection, radiation (in solar thermal systems)
2. Thermal expansion and insulation materials
3. Fluid properties: pressure, flow, viscosity
4. Basics of pumps, blowers, and fluid circulation in solar/wind systems

Unit 4: Mechanical Components and Maintenance Practices (7.5 hrs)

1. Bearings, shafts, fasteners, and supports (used in wind turbines & panels)
2. Intro to mechanical fabrication: cutting, drilling, joining
3. Maintenance tools and techniques: alignment, tightening, lubrication
4. Safety in handling mechanical components

References

1. Duffie, J. A., & Beckman, W. A. (2013). *Solar Engineering of Thermal Processes* (4th ed.). Wiley.
2. Bhadra, S. N., Kastha, D., & Banerjee, S. (2005). *Wind Electrical Systems*. Oxford University Press.
3. Boyle, G. (Ed.). (2012). *Renewable Energy: Power for a Sustainable Future* (3rd ed.). Oxford University Press.
4. Kreith, F., & Goswami, D. Y. (Eds.). (2007). *Handbook of Energy Efficiency and Renewable Energy*. CRC Press.

5. RE 281 OJT

6. RE 241 MN Solar Energy Applications in Agriculture

By the end of this course:

1. **Student explains** basic mechanical principles such as force, torque, and efficiency relevant to energy systems.
2. **Student demonstrates** the use of simple machines and calculates mechanical advantage in renewable applications.

3. **Student applies** concepts of heat transfer and fluid mechanics in the context of solar and wind systems.
4. **Student identifies** mechanical components and uses appropriate tools and techniques for maintenance and safety.

Unit 1: Fundamentals of Energy and Mechanics (7.5 hrs)

1. Types of energy: mechanical, thermal, electrical (overview)
2. Force, torque, work, power, and efficiency

Unit 2: Simple Machines and Mechanical Advantage (7.5 hrs)

1. Simple machines: gears, pulleys, levers (in context of windmills & trackers)
2. Basics of mechanical advantage in renewable systems

Unit 3: Heat Transfer and Fluid Mechanics (7.5 hrs)

1. Heat transfer: conduction, convection, radiation (in solar thermal systems)
2. Thermal expansion and insulation materials
3. Fluid properties: pressure, flow, viscosity
4. Basics of pumps, blowers, and fluid circulation in solar/wind systems

Unit 4: Mechanical Components and Maintenance (7.5 hrs)

1. Bearings, shafts, fasteners, and supports (used in wind turbines & panels)
2. Intro to mechanical fabrication: cutting, drilling, joining
3. Maintenance tools and techniques: alignment, tightening, lubrication
4. Safety in handling mechanical components

Reference Books

1. Solanki, C. S. (2015). *Solar Photovoltaics: Fundamentals, Technologies and Applications* (3rd ed.). PHI Learning.
2. Rathore, N. S., Panwar, N. L., & Kothari, S. (2007). *Renewable Energy Technologies for Agriculture and Rural Development*. Scientific Publishers.
3. Ministry of New and Renewable Energy. (2020). *Guidelines for Implementation of PM-KUSUM Scheme*. Government of India.
[Note: This can be used as an official document/manual in place of a traditional book]

7. RE 242 MNP Practical Based on Theory- X

Activity 1: Field Visit & Observation Report (10 hrs)

Procedure:

1. Visit 1–2 farms using solar irrigation pumps / dryers / cold storage
2. Interact with farmers and technicians (guided by instructor)
3. Observe and note:
4. System type and capacity
5. Daily usage and performance
6. Maintenance practices and challenges
7. Prepare a short report with photos, layout sketch, and findings

Activity 2: Hands-on Assembly & Testing (12 hrs)**Procedure:**

1. Assemble a demo solar irrigation setup (panel, controller, DC pump)
2. Fabricate or test a small solar dryer unit
3. Measure water flow rate vs sunlight
4. Temperature change in dryer chamber
5. Troubleshoot common issues: poor wiring, shadowing, misalignment
6. Record readings and observations in lab sheet

Activity 3: Scheme Simulation & Project Pitch (8 hrs)**Procedure:**

1. Study PM-KUSUM scheme and simulate a farmer application process
 2. Role-play: farmer, technician, bank officer (in small groups)
 3. Develop a mini project idea (e.g., solar-powered drip system)
 4. Create a poster or 2-slide pitch:
 5. Benefits, cost estimate, subsidy info
 6. Basic layout and implementation steps
 7. Present to class and get peer/instructor feedback
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8. OE-251-RE Introduction to Human Rights & Duties

1. Basic Concept a) Human Values- Dignity, Liberty, Equality, Justice, Unity in Diversity, Ethics and Morals
 - a. Meaning and significance of Human Rights Education
 - b. Perspectives of Rights and Duties a) Rights: Inherent-Inalienable-Universal- Individual and Groups b) Nature and concept of Duties
 - c. Interrelationship of Rights and Duties

2. Introduction to Terminology of Various Legal Instruments a) Meaning of Legal Instrument- Binding Nature b) Types of Instruments: Covenant-Charter-Declaration-Treaty-Convention-Protocol Executive Orders and Statutes
 3. United Nations and Human Rights a) Brief History of Human Rights- International and National Perspectives b) Provision of the charters of United Nations c) Universal Declaration of Human Rights- Significance- Preamble d) Civil and Political Rights-(Art. 1-21) e) Economic, Social and Cultural Rights-(Art.22-28) f) Duties and Limitations-(Art. 29) g) Final Provision (Art. 30)
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9. SEC-251-RE Life Skills

Learning Outcomes

By the end of this course:

1. **Student identifies** different types of cognitive skills and applies strategies to enhance them.
2. **Student demonstrates** the use of critical thinking and problem-solving in real-life scenarios.
3. **Student explains** the significance of non-cognitive skills and practices empathy and creativity.
4. **Student develops** teamwork, resilience, and interpersonal skills through collaboration and reflection.

Unit 1: Introduction to Cognitive Skills (7.5 hrs)

Cognitive Skills: Meaning and Types
Strategies to Develop Cognitive Skills

Unit 2: Higher-Order Thinking Skills (7.5 hrs)

Critical Thinking Skills
Problem-Solving Skills, Ability to Learn

Unit 3: Foundations of Non-Cognitive Skills (7.5 hrs)

Non-Cognitive Skills: Meaning and Types
Strategies to Develop Non-Cognitive Skills
Empathy and Creativity

Unit 4: Applied Non-Cognitive Competencies (7.5 hrs)

Teamwork and Collaboration
Resilience and Perseverance
Interpersonal Skills and Social Skills

Reference:

Chrome

extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ugc.gov.in/pdfnews/4874522_Draft-Curriculum-for-Life-Skill-Jeevan-Kaushal.pdf

10. AEC-251-MAR**व्यावहारिक व उपयोगित मराठी****अभ्यासक्रमाची उद्दिष्टे :**

१. उपयोगित व सर्जनशील लेखनाची क्षमता विकसित करणे.
२. संगणकाची भाषा व त्यातील विविध भाषिक अभिव्यक्तींचे स्वरूप समजून घेणे.
३. विविध कोशांसाठी नोंदलेखन क्षमता विकसित करणे.

घटक व तपशील

घटक क्रमांक	तपशील	श्रेयांक	तास
१	वृत्त व टिप्पण लेखन	१	१०
२	संगणक व मराठी : मुक्तस्रोत साधनांचा वापर, यूनिकोड टंक ओळख, विडर, एक्सेल, पॉवर पॉइंट	१	१०
३	विश्वकोश, ज्ञानकोश, विकिपीडिया लेखन : नोंद म्हणजे काय? नोंदीची उदाहरणे, नोंदीची भाषांतरं, प्रत्यक्ष नोंदलेखन	१	१०

संदर्भ ग्रंथ :

१. संगणक – अच्युत गोडबोले, मौज प्रकाशन, मुंबई.
२. इंटरनेट – डॉ. प्रबोध चोबे, मनोरमा प्रकाशन, मुंबई.
३. व्यावहारिक मराठी – डॉ. ल. रा. नवसराबादकर, फडके प्रकाशन, कोल्हापूर.
४. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात – दीपक भिशिक्रापुरे, उज्ज्वल मराठे, उत्कर्ष प्रकाशन, पुणे.
५. भाषांतरमीमांसा – कल्याण काळे, अंजली सोमन.
६. व्यावहारिक मराठी – पुणे विद्यापीठ प्रकाशन.
७. व्यावहारिक मराठी – डॉ. कल्याण काळे, डॉ. दत्तात्रेय पुंडे, वनराळी प्रकाशन, पुणे.
८. व्यावहारिक मराठी – डॉ. लीला गोविलकर, डॉ. जयश्री पाटणकर, स्नेहधन प्रकाशन, पुणे.
९. प्रसारमाध्यमांसाठी लेखन कौशल्य – यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक.
१०. व्यावहारिक मराठी – डॉ. सयाजीराजे मोकाशी, डॉ. राजना नेमाडे.
११. व्यावहारिक मराठी – डॉ. ल. रा. नवसराबादकर, फडके प्रकाशन, कोल्हापूर.
१२. प्रसारमाध्यमे आणि मराठी भाषा – संपादक : डॉ. भास्कर शेळके.
१३. व्यावहारिक व उपयोगित मराठी व प्रसारमाध्यमांची कार्यशैली – संपादक : डॉ. संदीप सांगळे.
१४. व्यावहारिक व उपयोगित मराठी – डॉ. मनोहर रोकडे.
१५. मराठी भाषा उपयोग व सर्जन – प्रा. सुहासकुमार बोबडे.
१६. व्यावहारिक मराठी – संपादक डॉ. स्नेहल तावरे, स्नेहधन प्रकाशन, पुणे.
१७. भाषांतरमीमांसा – संपादक : डॉ. रमेश विरखेडे, यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक.

१८. सायबर संस्कृती – डॉ. रमेश विरखेडे.
१९. उपयोगित मराठी – संपादक : डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई.
२०. ओळख माहिती तंत्रज्ञानाची – व्ही. जे. ओलवरी.
२१. MKCL – Solar IT Marathi App
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11. 10. CC-251-PE Physical Education
