# OBE REPORT OF B. Voc. DEGREE PROGRAMME IN RENEWABLE ENERGY MANAGEMENT

## SEMESTER 1

### BOCG101 LISTENING AND SPEAKING SKILLS IN ENGLISH

| Sl. No | **Modules** | **Outcome** |
|---|---|---|
| 1 | Module 1 | Speech Sounds |
| 2 | Module 2 | Basic Grammar |
| 3 | Module 3 | Listening |
| 4 | Module 4 | Reading |

### REMTG102 MATHEMATICS

| Sl. No | **Modules** | **Outcome** |
|---|---|---|
| 1 | Module 1 | Fundamental knowledge on Sets and Functions and their operations and applications |
| 2 | Module 2 | Fundamental knowledge on Matrix and their operations and applications |
| 3 | Module 3 | Fundamental knowledge on Limit, Continuity and Differentiability<br>Their operations and applications<br>Applications of Derivatives |
| 4 | Module 4 | Numerical Analysis and their applications<br>Statistical Methods of Analysis and their applications |

## REMTS103 BASIC ELECTRICAL AND ELECTRONICS

| Sl.no. | Modules | Outcome |
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| **1** | Module-1 | ● Learning about the necessity of measurement, concept of unit, various system of units<br>● Understanding the basics of various time measuring devices, Understanding the basics of various length measuring devices, Understanding the basics of various electrical measuring devices<br>● Importance of measurements, working principle of various measuring devices are the outcome students get from the first module of Basic Electrical and Electronics paper. |
| **2** | Module-2 | ● Fundamentals of electric circuits, Definition of electric current, electric potential, electric resistance, electric conductance<br>● Electrical work, power and energy<br>● Electrical law - Kirchoff's current and voltage laws<br>● Fundamentals of AC, power factor, measurement of AC power, Distribution of three phase current<br>● OUTCOME: Basic idea about electricity |
| **3** | Module-3 | ● Basic idea about semiconductors, types of diodes, Rectifiers, Filters, Regulators, LED, Photodiode, LDR, clipping and clamping circuits |
| **4** | Module-4 | ● Understanding the basics of Resistors and their types, capacitors and their types, colour coding, Cables and Wires, Switches, Relays |

## REMTS104 FUNDAMENTALS OF SUSTAINABLE ENERGY AND DEVELOPMENT

| Sl.no. | Modules | Outcome |
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| **1** | module-1 | ● The outcome of students learning about the energy sources and their availability.<br>● understand the difference between renewable and non renewable energies.<br>● Students should be able to be aware about the needs of renewable energy sources. |
| **2** | module-2 | ● Awareness about the potential of solar energy.<br>● To understand the types of solar energy collectors, solar water heating systems. |

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| | | ● Students should be able to understand the difference between solar air heating and solar cooling systems.<br>● The outcome of students learning about the different applications of solar energy. |
| **3** | module -3 | ● To understand the usable forms of biomass and their composition and fuel properties.<br>● Awareness about the different biomass conversion technologies.<br>● To understand the types of biogas pants.<br>● Awareness about the methods of maintaining biogas production. |
| **4** | module -4 | ● The outcome of students learning about the scope of wind energy in india.<br>● To understand the basic components of a wind energy conversion system.<br>● The outcome of students learning about the different applications of wind energy. |

## REMPS105 PRACTICAL- GENERAL PHYSICS LAB

| SL.No | | Outcome |
|---|---|---|
| 1 | Verification of basic electrical laws | ● Verification of Ohm's law<br>● Verification of Kirchoff's law |
| **2** | Measuring of basic electrical parameters | ● Potentiometer-Measurement of e.m.f. of a cell<br>● Measurement of average resistance per unit length of a wire using Carey Foster's bridge<br>● Conversion of Galvanometer into voltmeter<br>● Potentiometer-Calibration of a low range voltmeter<br>● Determination of the specific resistance of the material of a wire using meter bridge |
| **3** | Basics of electronic circuits | ● colour coding of resistors and capacitors, basics of breadboard connections, LED, Zener diode |

## REMPG106 PRACTICAL- INTRODUCTION TO COMPUTERS

| SL.No | Software | Outcome |
|---|---|---|
| 1 | Excel | ● The outcome of students learning basic Excel usually involves acquiring fundamental skills in spreadsheet usage. |

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| | | ● This includes understanding Excel's interface, creating and formatting worksheets, using basic formulas and functions, and managing data effectively.<br>● Students should be able to perform tasks such as data entry, sorting, filtering, and creating simple charts.<br>● The goal is for students to feel confident in using Excel for basic data manipulation and analysis, setting a foundation for more advanced skills in the future. |
| **2** | MS Word | ● The outcome of students learning Microsoft Word typically involves gaining proficiency in creating, formatting, and editing documents.<br>● Students should be able to use various text formatting options, insert images and other multimedia elements, create tables, and utilize features like headers and footers.<br>● Understanding document organization, styles, and collaboration tools are also essential outcomes. Overall, the goal is for students to develop practical skills in using Microsoft Word for a variety of document creation and editing tasks. |
| **3** | PowerPoint | ● The outcome of students learning Microsoft PowerPoint generally includes the ability to create effective and engaging presentations.<br>● Students should be adept at designing slides with appropriate layouts, using visual elements like images and charts, and incorporating transitions and animations.<br>● They are expected to understand how to deliver a clear and compelling message through their presentations, utilizing features such as speaker notes and rehearsing timings. Ultimately, the goal is for students to feel confident in using PowerPoint as a tool for effective communication in various settings. |

# SEMESTER – 2

## BOCG201 WRITING AND PRESENTATION SKILLS IN ENGLISH

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Module 1 | Letter Writing |
| 2 | Module 2 | Types of Academic and business Communication(written) |
| 3 | Module 3 | Presentation Skills |
| 4 | Module 4 | Non-verbal communication |

## REMTG202 FUNDAMENTALS OF ELECTROCHEMISTRY

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Module - 1 | ● The outcome of students learning electrochemistry typically involves understanding the principles and applications of electrochemical processes.<br>● Students should be able to comprehend concepts such as redox reactions, electrode potentials, and electrolysis.<br>● Proficiency in using the Nernst equation and understanding electrochemical cells, batteries, and corrosion is essential. Additionally, students are expected to apply electrochemical principles to real-world scenarios, demonstrating problem-solving skills in this field.<br>● The ultimate goal is for students to have a solid foundation in electrochemistry that can be applied in further studies or practical applications. |
| **2** | Module 2 | ● The outcome of students learning about electromotive force (EMF) typically involves a comprehensive understanding of the concept and its applications.<br>● Students should be able to define EMF, differentiate it from potential difference, and grasp the factors influencing EMF in different contexts, such as in electrical circuits or electrochemical cells.<br>● Proficiency in solving problems related to EMF, calculating voltage, and understanding the connection between EMF and internal resistance in batteries is also expected. |

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| | | ● Overall, the goal is for students to apply their knowledge of electromotive force in various scenarios within the field of physics and electrical engineering. |
| **3** | Module 3 | ● The outcome of students learning electroanalytical methods involves gaining a deep understanding of techniques used for chemical analysis based on electrochemical principles.<br>● Students should be proficient in employing methods such as voltammetry, potentiometry, and amperometry for quantitative and qualitative analysis.<br>● Mastery of instrumentation, data interpretation, and troubleshooting in electroanalytical experiments are key outcomes. Additionally, students are expected to apply these techniques to solve real-world problems, demonstrating their ability to design experiments and analyze results.<br>● Ultimately, the goal is for students to be well-equipped with the skills and knowledge necessary for conducting advanced electroanalytical studies in various scientific and industrial settings. |
| **4** | Module 4 | ● The outcome of students learning photochemistry involves acquiring a comprehensive understanding of the principles and applications of chemical reactions initiated by light.<br>● Students should be able to explain the key concepts such as absorption of light, excited states, and photophysical processes.<br>● Proficiency in analyzing and predicting photochemical reactions, understanding the role of sensitizers and catalysts, and applying photochemistry in various contexts is expected.<br>● Additionally, students should be capable of critically evaluating experimental data related to photochemical processes. The ultimate goal is for students to have a solid foundation in photochemistry, enabling them to contribute to research or applications in fields such as chemistry, materials science, or biology. |

# REMTS203 PHOTOVOLTAIC MODULE INSTALLATION

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Module - 1 | Outcome: Knowledge about Solar cells<br>● Solar cell working principle<br>● Solar cell and module types<br>● Equivalent circuit diagrams of solar cells<br>● Efficiency of solar cells and PV modules<br>● Design options for PV modules<br>● Characteristic I-V curves for modules<br>● Irradiance dependence and temperature characteristics<br>● Shading, Hot spots and bypass diodes<br>● Quality certification for modules |
| 2 | Module - 2 | Outcome: Knowledge about BOS of PV panels<br>● Basics of PV array combiner/junction boxes<br>● Grid-connected inverters<br>● Grid-controlled inverters<br>● Module and string cables<br>● Connection systems<br>● DC main cable<br>● AC connection cable<br>● Direct current load switch (DC main switch)<br>● AC switch disconnector |
| 3 | Module - 3 | Outcome: Knowledge about shading of PV panels<br>● Basics of Site Surveys<br>● Shading and its types<br>● Shading Analysis - different shading analysis<br>● Methods of removal of shading losses |
| 4 | Module - 4 | Outcome: Knowledge about PV System designing |

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| | | • Planning and Sizing of inverted<br>• Planning and Sizing of cables (AC & DC),<br>• Planning and Sizing of isolators,<br>• Planning and Sizing of earthing system<br>• Planning and Sizing of protection systems |

## REMPG204 PRACTICAL- COMPUTER APPLICATIONS LAB: MATLAB

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Familiarization with MATLAB | • To familiarize the students in introducing and exploring MATLAB software.<br>• To enable the students on how to approach solving problems using MATLAB programs. |
| **2** | Area of the rectangle | • write a program to generate the area of the rectangle with a given breath and length. |
| **3** | Area and volume of the sphere | • write a program to generate the area and volume of the sphere. |
| **4** | Area and perimeter of triangle | • write a program to generate the area and perimeter of the triangle. |
| **5** | sine curve,cosine curve and circle | • write a program to plot a sine curve ,cosine curve and circle |
| **6** | stair and stem function | • write a program to plot a stair and stem function. |
| **7** | Rose function | • write a program to generate 100 random data points using the ROSE function. |
| **8** | Largest number | • Write a program to find the largest number of given n numbers. |

## REMPS205 PRACTICAL- ELECTRONICS AND PHOTOVOLTAIC MODULE INSTALLATION

| Sl. No | Modules | Outcome |
|---|---|---|
| **1** | Familiarization of electrical measuring devices | Multimeter, Ammeter, voltmeter clamp on ammeter |
| **2** | Familiarization of solar cell | I-V characteristics of solar cell, short circuit and open circuit parameters of solar cell, series and parallel connections of solar cells |
| **3** | Familiarization of semiconductor devices | Diode Characteristics, Characteristics of Zener diode, LED characteristics |
| **4** | Familiarization of tools used in Panel installation | Familiarize appropriate access equipments and basic roofing techniques for PV module installation |

# SEMESTER 3

## REMTG301 WATER AND WASTEWATER TREATMENT

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Module -1 | General awareness on Water Quality and Purification |
| 2 | Module -2 | Basic knowledge on Sedimentation and Disinfection |
| 3 | Module -3 | Basic knowledge on Filtration, Classification of filters, principle of working and design |
| 4 | Module -4 | Basic knowledge on techniques used in different wastewater treatment plants - principle of working and design |

# REMTG302 OPERATION AND MAINTENANCE OF SOLAR PV SYSTEMS

| Sl. No | Modules | Outcome |
|---|---|---|
| **1** | Module - 1 | ● Solar PV Operations<br>● Solar PV Maintenance<br>● Maintenance categorization and activities<br>● Common Tools Used<br>● Common Equipments Used |
| **2** | Module - 2 | ● Inspection and fault identification of panels<br>● Dust accumulation<br>● Module shading<br>● Module mismatch<br>● Physical integrity<br>● Maintenance and troubleshooting of panels on above mentioned faults |
| **3** | Module - 3 | ● Inspection and fault identification of Inverters<br>● Inspection and fault identification of cables,<br>● Inspection and fault identification of protection devices<br>● Inspection and fault identification of batteries<br>● Maintenance and troubleshooting of above mentioned devices |
| **4** | Module - 4 | ● Jobsite safety<br>● Understanding electricity bill<br>● Documentation and its types |

# REMTG303 SOLAR THERMAL TECHNOLOGY

| Sl.No | Module | Outcome |
|---|---|---|
| 1 | Module 1 | ● The outcome of students learning about solar radiation, measurement of radiation, and spectral distribution of extraterrestrial radiation typically involves a thorough understanding of solar energy fundamentals.<br><br>● Students should be able to explain the characteristics of solar radiation, including its intensity, composition, and variability. Proficiency in measuring solar radiation using appropriate instruments, interpreting data, and understanding factors influencing solar energy distribution on Earth is expected.<br><br>● Additionally, students should comprehend the spectral distribution of extraterrestrial radiation, recognizing the different regions of the electromagnetic spectrum and their significance in solar energy applications.<br><br>● The ultimate goal is for students to be well-equipped with the knowledge and skills to analyze, measure, and utilize solar radiation data for various purposes, such as solar energy technologies and environmental studies. |
| **2** | Module 2 | ● The outcome of students learning about flat plate collectors and solar ponds in solar thermal technology involves a comprehensive understanding of these technologies and their applications in harnessing solar energy.<br><br>● For flat plate collectors, students should be able to analyze the design, construction, and performance of these devices for capturing solar heat. Proficiency in evaluating factors affecting efficiency, such as material selection, tilt angle, and tracking systems, is essential. Additionally, students should understand how flat plate collectors contribute to solar water heating and space heating systems.<br><br>● Concerning solar ponds, students should grasp the principles behind using large, shallow ponds to collect and store solar energy. Proficiency in analyzing the thermodynamics of solar ponds, including the salinity gradient and stratification, is expected. Students should be able to assess the feasibility and applications of solar ponds for thermal energy storage and electricity generation.<br><br>● The ultimate goal is for students to be well-prepared to design, analyze, and implement flat plate collectors and solar ponds in practical solar thermal applications. |

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| **3** | Module 3 | ● The outcome of students learning about solar concentrating collectors in solar thermal technology involves developing a comprehensive understanding of these advanced systems for harnessing solar energy.<br><br>● Students should be proficient in analyzing the design and operation of solar concentrating collectors, including various types such as parabolic troughs, parabolic dishes, and solar power towers. They should understand the principles of concentrating solar radiation to achieve higher temperatures and increased energy efficiency.<br><br>● Proficiency in evaluating factors affecting the performance of concentrating collectors, such as tracking systems, optical components, and thermal storage integration, is essential. Students should be able to assess the suitability of concentrating collectors for different applications, including electricity generation and industrial process heat.<br><br>● Ultimately, the goal is for students to be well-equipped with the knowledge and skills to design, analyze, and implement solar concentrating collectors in practical solar thermal systems, contributing to advancements in renewable energy technologies. |
| **4** | Module 4 | ● The outcome of students learning about solar thermal applications involves acquiring a thorough understanding of the various ways solar energy can be harnessed for practical purposes. This includes:<br><br>1. Solar Water Heating: Proficiency in designing and implementing solar water heating systems for residential, commercial, or industrial use.<br><br>2. Space Heating and Cooling: Understanding how solar thermal technology can be applied to provide space heating in colder climates and cooling through absorption chillers in warmer regions.<br><br>3. Solar Cooking: Knowledge of solar cookers and ovens, including their design, principles, and practical applications.<br><br>4. Solar Desalination: Understanding the use of solar thermal energy in desalination processes to produce freshwater from seawater.<br><br>5. Industrial Process Heat: Proficiency in applying solar thermal energy for industrial processes, such as in the production of steam for manufacturing. |

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| | | 6. Electricity Generation: Knowledge of concentrating solar power (CSP) systems for electricity generation, including various technologies like parabolic troughs, solar power towers, and dish-engine systems.<br><br>7. Solar Thermal Storage: Understanding the principles and technologies of thermal storage to facilitate continuous energy availability even during periods without direct sunlight.<br><br>● The ultimate goal is for students to be well-prepared to contribute to the design, implementation, and optimization of solar thermal applications across diverse sectors, promoting sustainable and renewable energy practices. |

## REMTS304 WIND ENERGY

| Sl.No | Module | Outcome |
|---|---|---|
| **1** | module -1 | ● To understand the History of wind energy, Current status and future prospects, Wind Energy in India- Power available in the wind.<br>● Wind Turbine power and torque characteristics<br>● Characteristics of wind rotor-Analysis of wind regimes- Local effects, wind shear, Turbulence and acceleration effects.<br>● Familiarization about Anemometers and its different types.<br>● To understand the statistical model for wind data analysis : Weibull distribution-Energy estimation of wind regimes. |
| **2** | module -2 | ● To understand the Airfoil, lift and drag characteristics<br>● Aerodynamic theories- Axial momentum theory- Blade element theory- Strip theory.<br>● Power coefficient and tip speed ratio characteristics<br>● Students should be proficient in analyzing the design Rotor design and Performance analysis |
| **3** | module -3 | ● To understand the Wind energy conversion systems<br>● The outcome of students learning about wind electric generators- Tower, rotor, gearbox, power regulation, safety mechanisms- Generator: Induction and synchronous generator-Grid integration.<br>● Awareness about ,Wind pumps- Wind driven piston pumps, limitations and performance analysis |

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| **4** | module -4 | ● Environmental benefits and problems of wind energy.<br>● To understand the Factors influencing the wind energy economics- Site specific parameters-machine parameters- Life cycle cost analysis |

## REMPS305 PRACTICAL-THERMODYNAMICS AND SOLAR THERMAL

| Sl.No | Outcome |
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| | The outcome of students learning thermodynamics and participating in a solar thermal lab typically includes:<br><br>1. Understanding Thermodynamic Principles: Mastery of fundamental thermodynamic concepts, including laws of thermodynamics, heat transfer mechanisms, and thermodynamic cycles relevant to solar thermal systems.<br><br>2. Analyzing Solar Thermal Systems: Proficiency in applying thermodynamic principles to analyze and evaluate the performance of solar thermal systems, including efficiency calculations, energy conversion, and heat transfer analysis.<br><br>3. Lab Skills: Developing practical skills through hands-on experiences in a solar thermal lab, including setting up experiments, measuring parameters, and analyzing experimental data.<br><br>4. Instrumentation Use: Familiarity with instruments used in solar thermal labs, such as sensors, data loggers, and solar radiation measurement devices.<br><br>5. System Optimization: Ability to optimize solar thermal systems based on thermodynamic principles, considering factors like collector design, heat exchangers, and overall system efficiency.<br><br>6. Problem Solving: Proficiency in identifying and solving thermodynamic challenges and issues encountered in solar thermal applications.<br><br>The ultimate goal is for students to be well-equipped with both theoretical knowledge and practical skills, enabling them to contribute effectively to the design, analysis, and optimization of solar thermal systems from a thermodynamic perspective. |

## REMPS306 PRACTICAL- FLUID DYNAMICS AND WIND ENERGY

| Sl.No | Outcome |
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| | The outcome of students learning about the Q blade software projects<br><br>1. Understanding the importance and features of Q blade software projects.<br>2. familiarization of airfoil and its simple design.<br>3. To stimulate the required flow around the airfoil and to find AoA at which maximum Cl/Cd value occurs.<br>4. To stimulate the extrapolation of a circle with a diameter ,same as the chord of the airfoil<br>5. Students should be proficient in analyzing the design of wind blades. |

# SEMESTER 4

## REMTG401 PLANNING AND INSTALLING SOLAR THERMAL SYSTEMS

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Module 1 | The outcome of students learning about the components of solar thermal systems for single-family houses, along with their installation, commissioning, maintenance, and servicing, typically includes:<br><br>1. Component Understanding: Proficiency in identifying, understanding, and selecting the key components of solar thermal systems, such as solar collectors, heat exchangers, pumps, storage tanks, and control systems.<br><br>2. System Design for Single-Family Houses: Ability to design solar thermal systems tailored for single-family residential applications, considering factors like energy demand, available space, and local climate conditions.<br><br>3. Installation Skills: Hands-on experience in installing solar thermal systems, including mounting collectors, connecting plumbing, and integrating components into existing household systems.<br><br>4. Commissioning Procedures: Knowledge of commissioning processes, ensuring that the solar |

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| | | thermal system is correctly installed, functional, and optimized for efficient operation.<br><br>5. Maintenance Practices: Understanding routine maintenance tasks, such as cleaning collectors, checking fluid levels, and inspecting components to ensure the long-term performance and reliability of the solar thermal system.<br><br>6. Troubleshooting and Servicing: Proficiency in diagnosing and addressing common issues that may arise in solar thermal systems, along with the ability to provide effective servicing and repairs.<br>7. Regulatory Compliance: Awareness of local regulations, building codes, and safety standards related to the installation and operation of solar thermal systems in residential settings.<br><br>The ultimate goal is for students to be well-prepared to contribute to the successful deployment and ongoing operation of solar thermal systems in single-family houses, promoting the use of sustainable and renewable energy in residential settings. |
| 2 | Module 2 | The outcome of students learning about large-scale solar thermal systems and solar concentrating systems typically includes:<br><br>1. Understanding Large-Scale Systems: Proficiency in comprehending the design, components, and operation of solar thermal systems at a larger scale, often used for industrial or utility-scale applications.<br><br>2. Solar Concentrating Systems Knowledge: Mastery of solar concentrating technologies, including parabolic troughs, solar power towers, and dish-engine systems, with a focus on principles, advantages, and challenges associated with each.<br><br>3. System Integration: Ability to integrate large-scale solar thermal systems into existing industrial processes or utility infrastructure, considering the overall energy needs and efficiency improvements.<br><br>4. Performance Analysis: Proficiency in analyzing and evaluating the performance of large-scale solar thermal systems, including efficiency calculations, energy output predictions, and system optimization. |

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| | | 5. Economic and Environmental Impact: Awareness of the economic feasibility and environmental impact of large-scale solar thermal projects, including considerations of cost-effectiveness, return on investment, and sustainability.<br><br>6. Regulatory Compliance: Knowledge of relevant regulations, permits, and safety standards associated with deploying large-scale solar thermal projects.<br><br>The ultimate goal is for students to be well-equipped with the knowledge and skills necessary to contribute to the planning, implementation, and management of large-scale solar thermal systems, addressing the growing demand for sustainable and renewable energy solutions on a broader scale. |
| **3** | Module 3 | The outcome of students learning about solar air systems and solar cooling typically includes:<br><br>1. Understanding Solar Air Systems: Proficiency in understanding the principles and components of solar air systems, including solar air heaters and solar ventilation systems.<br><br>2. Solar Cooling Technologies: Mastery of solar cooling technologies, which use solar energy for air conditioning or cooling purposes, and understanding their applications in different climates.<br><br>3. System Design and Sizing: Ability to design and size solar air systems, considering factors such as building characteristics, local climate conditions, and energy demand for heating or cooling.<br><br>4. Integration with HVAC Systems: Knowledge of integrating solar air systems with conventional heating, ventilation, and air conditioning (HVAC) systems to enhance overall energy efficiency.<br><br>5. Performance Analysis: Proficiency in analyzing and evaluating the performance of solar air systems, including efficiency calculations, temperature control, and system optimization.<br><br>6. Installation and Maintenance: Hands-on experience in installing solar air systems and understanding routine maintenance tasks to ensure optimal and reliable performance. |

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| | | 7. Economic Viability: Awareness of the economic feasibility of solar air systems, including considerations of cost-effectiveness, return on investment, and potential energy savings.<br><br>8. Environmental Impact: Understanding the environmental benefits of solar air systems, including reduced carbon emissions and the overall contribution to sustainable and eco-friendly building practices.<br><br>The ultimate goal is for students to be well-prepared to contribute to the design, implementation, and maintenance of solar air systems and solar cooling solutions, supporting the adoption of renewable energy technologies in the heating and cooling sectors. |
| **4** | Module 4 | The outcome of students learning simulation programs for solar thermal systems typically includes:<br><br>1. Software Proficiency: Proficiency in using simulation software specific to solar thermal systems, such as TRNSYS, SAM (System Advisor Model), or other relevant tools.<br><br>2. System Modeling Skills: Ability to create accurate and detailed models of solar thermal systems within simulation software, including components like collectors, storage, pumps, and heat exchangers.<br><br>3. Performance Prediction: Capability to use simulation tools to predict the performance of solar thermal systems under various conditions, considering factors such as solar radiation, ambient temperature, and system parameters.<br><br>4. Optimization Techniques: Understanding how to use simulation results for optimizing system design, component selection, and overall efficiency.<br><br>5. Sensitivity Analysis: Proficiency in conducting sensitivity analyses using simulation software to identify the impact of different variables on the performance of solar thermal systems.<br><br>6. Data Interpretation: Ability to interpret and analyze simulation results to make informed decisions about system improvements, troubleshooting, and overall performance enhancement. |

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| | | 7. Scenario Analysis: Skill in conducting scenario analyses to assess the impact of changes in operating conditions, component specifications, or system configurations on the performance of solar thermal systems.<br><br>8. Report Generation: Capability to generate comprehensive reports based on simulation results, conveying findings and recommendations effectively to stakeholders.<br><br>The ultimate goal is for students to be well-equipped with the skills to use simulation software as a powerful tool for designing, optimizing, and analyzing the performance of solar thermal systems in diverse applications. |

## REMTG402 WASTE TO ENERGY CONVERSION

| Sl. No | Modules | Outcome |
|---|---|---|
| **1** | Module - 1 | ● To understand the waste and waste processing, Definitions, sources, types and composition of various types of wastes.<br>● Awareness about the Characterization of Municipal Solid Waste (MSW) , Industrial waste and Biomedical Waste (BMW), Waste collection and transportation<br>● To understand the various waste management processes. |
| **2** | Module - 2 | ● Students should be able to identify and classify different types of waste, including hazardous and non-hazardous waste.<br>● Knowledge of relevant environmental regulations and standards governing waste management to ensure compliance with legal requirements.<br>● Understanding the principles of site remediation and soil and water treatment in the context of waste management. |
| **3** | Module- 3 | ● Acquire knowledge about various waste-to-energy conversion technologies, such as incineration, anaerobic digestion, gasification, and pyrolysis.<br>● Understand the working principles, advantages, and limitations of each technology.<br>● Analyze the environmental impacts of waste-to-energy processes, including emissions and waste reduction.<br>● Evaluate the economic feasibility and benefits of waste-to-energy projects. |

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| **4** | Module -4 | • Identify and assess various waste-to-energy technologies and their environmental implications.<br>• Compare and contrast the environmental performance of incineration, anaerobic digestion, gasification, and other waste-to-energy technologies.<br>• Awareness about Environmental and health impacts of incineration and other waste to energy conversion systems.<br>• Identify and evaluate potential risks associated with waste-to-energy projects. |

## REMTG403 BIOENERGY

| Sl. No | Modules | Outcome |
|---|---|---|
| **1** | Module - 1 | Outcome: Knowledge about Biomass<br>• Sources and Classification<br>• Chemical composition<br>• Properties of biomass<br>• Energy plantations<br>• Size reduction techniques of Biomass<br>• Drying, Storage and handling of biomass |
| **2** | Module - 2 | Outcome: Knowledge about Biogas and biogas plants<br>• Feedstock for biogas<br>• Microbial and biochemical aspects<br>• Operating parameters for biogas production<br>• Working of biogas plants<br>• Types of biogas plants |
| **3** | Module - 3 | Outcome: Knowledge about Thermochemical conversions, Gasifiers<br>• Thermochemical conversion of lignocelluloses biomass<br>• Incineration<br>• Processing for liquid fuel production.<br>• Pyrolysis |

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| | | • Thermo chemical Principles<br>• Working of Gasifiers<br>• Types of Gasifiers |
| **4** | Module - 4 | Outcome: Knowledge about wood combustion, Cogeneration plants<br>• Combustion of woody biomass<br>• Design of equipment<br>• Cogeneration using bagasse-<br>• Case studies: Combustion of rice husk. |

## REMTS404 ENERGY STORAGE SYSTEMS

| Sl. No | **Modules** | **Outcome** |
|---|---|---|
| 1 | Module 1 | • Students learning about energy storage can gain a deeper understanding of sustainable technologies, grid management, and renewable energy integration.<br>• This knowledge equips them for careers in fields like engineering, environmental science, and energy management, contributing to advancements in clean energy solutions. |
| 2 | Module 2 | • Students studying electrochemical, electrical, and magnetic energy storage systems can develop expertise in designing, analyzing, and implementing various energy storage technologies.<br>• This knowledge prepares them for roles in renewable energy, electric vehicles, and smart grid development, contributing to the innovation and sustainability of the energy sector. |
| 3 | Module 3 | • Students learning about sensible heat storage can understand the principles of storing thermal energy using materials like water or rocks.<br>• This knowledge is valuable for designing efficient heating and cooling systems, renewable energy applications, and sustainable building designs, contributing to advancements in energy efficiency and environmental sustainability. |
| 4 | Module 4 | • Students studying latent heat thermal energy storage gain insights into advanced methods of storing energy through phase change materials.<br>• This knowledge is crucial for designing efficient systems in areas like solar energy storage, HVAC systems, and industrial processes, fostering innovation in sustainable energy solutions and |

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| | | environmental conservation. |

## REMPS405 PRACTICAL- SOLAR PHOTOVOLTAICS AND ENERGY STORAGE SYSTEMS

| Sl. No | Outcome | |
|---|---|---|
| 1 | Determination of solar cell parameters | Temperature dependent conductivity of semiconductor.<br>Illuminated I-V characteristics of a solar cell<br>Calculation of Fill Factor and Efficiency. |
| 2 | Comparison of solar cell with other semiconductor devices | Comparison of the illuminated I-V characteristics of a photodiode with that of a solar cell. |
| 3 | Importance of Battery in an Off-grid system | Battery charging and discharging characteristics. |
| 4 | Performance analysis of panels at different loads | Combine AC and DC load system with battery. |
| 5 | Shading analysis | Effects of horizontal and vertical shading on loaded and unloaded panels. |

# SEMESTER 5

## BOCG501 ENVIRONMENTAL STUDIES

| Sl. No | Modules | Outcome |
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| 1 | Module 1 | 1. Understanding Resource Classification: Proficiency in distinguishing between renewable and non-renewable resources, grasping the finite nature of non-renewables and the potential for sustainable use of renewables.<br><br>2. Renewable Energy Knowledge: Mastery of various renewable energy sources, such as solar, wind, hydro, geothermal, and biomass, including their applications, benefits, and challenges. |

| Sl. No | Modules | Outcome |
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| | | 3. Non-Renewable Resource Awareness: Recognition of the finite nature of non-renewable resources like fossil fuels and minerals, understanding their extraction, usage, and environmental impacts.<br><br>4. Sustainability Principles: Ability to analyze the sustainability of resource use, considering ecological, economic, and social dimensions.<br><br>5. Environmental Impact Assessment: Proficiency in assessing and evaluating the environmental impact of both renewable and non-renewable resource extraction, production, and consumption.<br><br>6. Energy Transition Understanding: Awareness of global energy transition efforts, policies, and initiatives aimed at reducing reliance on non-renewable resources and promoting sustainable alternatives.<br><br>The ultimate goal is for students to be well-informed, environmentally conscious individuals capable of making informed decisions and contributing to sustainable resource use in both their personal and professional lives. |
| 2 | Module 2 | 1.Ecosystem Understanding: Proficiency in understanding the structure and functioning of ecosystems, recognizing the interactions between biotic and abiotic components.<br><br>2. Biodiversity Knowledge: Mastery of biodiversity concepts, including the variety of species, genetic diversity, and ecosystem diversity, along with the significance of maintaining biodiversity.<br><br>3. Species Identification: Ability to identify and classify different species, recognizing their ecological roles and contributions to ecosystem stability.<br><br>4. Ecosystem Services Awareness: Understanding the ecosystem services provided by diverse ecosystems, including pollination, water purification, climate regulation, and soil fertility.<br><br>5. Threats to Biodiversity: Recognition of human-induced and natural threats to biodiversity, including habitat loss, pollution, climate change, invasive species, and overexploitation.<br><br>6. Conservation Strategies: Proficiency in various conservation strategies, such as protected area management, habitat restoration, captive breeding programs, and sustainable resource management.<br><br>7. Community Engagement: Skills in engaging local communities in conservation efforts, fostering awareness, and promoting sustainable practices to mitigate threats to biodiversity. |

| Sl. No | Modules | Outcome |
|---|---|---|
| | | 8. Conservation Policy Understanding: Knowledge of national and international conservation policies, agreements, and initiatives aimed at preserving biodiversity and ecosystems.<br><br>9. Ethical Considerations: Awareness of ethical considerations in conservation, including the rights of indigenous communities, ethical treatment of wildlife, and considerations for sustainable development.<br><br>11. Interdisciplinary Approach: Understanding the interdisciplinary nature of conservation, recognizing the contributions of ecology, biology, sociology, economics, and other fields to holistic conservation practices.<br><br>The ultimate goal is for students to be well-equipped with the knowledge and skills necessary to contribute to the conservation of ecosystems and biodiversity. This includes fostering a deep appreciation for the interconnectedness of life and promoting sustainable practices that ensure the health and resilience of our natural world. |
| 3 | Module 3 | 1. Pollution Understanding: Proficiency in understanding various forms of environmental pollution, including air, water, soil, and noise pollution, along with their sources, impacts, and mitigation measures.<br><br>2. Pollutant Identification: Mastery of identifying common pollutants and hazardous substances, recognizing their effects on ecosystems, wildlife, and human health.<br><br>3. Pollution Monitoring Techniques: Ability to employ monitoring techniques to assess pollution levels, interpret data, and analyze trends over time.<br><br>4. Regulatory Knowledge: Understanding environmental regulations and policies related to pollution control, waste management, and emission standards at local, national, and international levels.<br><br>5. Environmental Impact Assessment: Proficiency in conducting environmental impact assessments to evaluate the potential consequences of human activities on the environment.<br><br>6. Population Dynamics Awareness: Knowledge of human population dynamics, including factors influencing population growth, distribution, and demographic transitions.<br><br>7. Population and Resource Interaction: Understanding the interaction between human population growth and resource consumption, recognizing the implications for environmental sustainability. |

| Sl. No | Modules | Outcome |
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| | | 8. Urbanization Effects: Recognition of the environmental impacts of urbanization, including issues related to infrastructure development, waste generation, and changes in land use.<br><br>The ultimate goal is for students to be well-informed and proactive individuals capable of addressing environmental challenges associated with pollution and population dynamics. This includes contributing to solutions, promoting sustainable practices, and advocating for policies that ensure a healthy and balanced relationship between human activities and the environment. |
| 4 | Module 4 | 1. Understanding Social-Environmental Interactions: Proficiency in recognizing the intricate connections between social issues and environmental challenges, understanding how human activities impact the environment and vice versa.<br><br>2. Environmental Justice Awareness: Mastery of concepts related to environmental justice, including the fair distribution of environmental benefits and burdens, and recognition of how vulnerable communities are disproportionately affected by environmental problems.<br><br>3. Community Empowerment: Skills in empowering communities to actively engage in environmental decision-making processes, advocating for their rights, and promoting sustainable practices.<br><br>4. Public Health Considerations: Understanding the health implications of environmental issues, including air and water pollution, hazardous waste, and the impact of environmental degradation on human well-being.<br><br>5. Socioeconomic Factors: Recognition of the role socioeconomic factors play in shaping environmental conditions, addressing issues of poverty, inequality, and access to resources.<br><br>6. Environmental Education: Proficiency in designing and implementing environmental education programs that address social issues, fostering awareness and promoting responsible behavior.<br><br>7. Advocacy and Activism: Ability to advocate for environmental causes and engage in environmental activism, recognizing the importance of grassroots movements in addressing social-environmental challenges.<br><br>The ultimate goal is for students to be well-equipped with the knowledge and skills necessary to address social-environmental challenges. This includes fostering inclusive and sustainable practices, advocating for environmental justice, and contributing to the development of solutions |

| Sl. No | Modules | Outcome |
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| | | that benefit both communities and the planet. |

## REMTG502 MATERIAL SCIENCE FOR ENERGY APPLICATIONS

| Sl. No | Modules | Outcome |
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| 1 | Module 1 | ● To understand the Fundamental Principles of Materials Science<br>● Awareness about Electronic and Atomic Structures, Atomic Bonding in Solids, Crystal Structure, Microstructure, Solidification, Alloys, Semiconductors, Ceramics, Polymers. |
| 2 | Module 2 | ● To learn about the properties of various materials like Mechanical, Optical , Thermal Electrical and Magnetic Properties of Metals, Alloys, Semiconductors, Polymers, Glass, Nanomaterials and Magnetic Materials. |
| 3 | Module 3 | ● To understand the testing of materials behavior suitable for application in solar energy systems |
| 4 | Module 4 | ● Gain knowledge of the fundamental properties of materials, including mechanical, thermal, electrical, and magnetic properties.<br>● Analyze factors influencing material deformation, fracture, and fatigue. |

## REMTS503 ENERGY CONSERVATION TECHNIQUES

| Sl. No | Modules | Outcome |
|---|---|---|
| **1** | Module -1 | ● To impart knowledge in the domain of energy conservation & its importance<br>● Awareness about Need of waste minimization - Waste minimization method & its classification.<br>● To understand the effects of waste environment & Role of pollution control board - Case study. |
| **2** | Module -2 | Define and explain the basic principles of energy conservation in electrical systems.<br>Identify and describe the key components of |

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| | | electrical systems.<br>Analyze the operation of various electrical devices and systems.<br>Understand methods for optimizing the performance of electrical equipment to minimize energy consumption. |
| 3 | Module -3 | ● Gain a solid understanding of the fundamental principles of energy conservation in thermal systems.<br>● Comprehend the laws of thermodynamics and their application to energy systems.<br>● develop the ability to analyze various thermal systems, such as boilers, heat exchangers, and power plants, to identify areas for energy conservation.<br>● Learn techniques and strategies to improve the efficiency of thermal systems.<br>● Understand the importance of optimizing energy conversion processes. |
| 4 | Module -4 | ● Demonstrate an understanding of the principles and factors influencing energy consumption in residential and commercial buildings.<br>● Identify and analyze various building systems and components that contribute to energy usage, such as HVAC (Heating, Ventilation, and Air Conditioning) systems, lighting, insulation, and appliances.<br>● Explore sustainable building practices and materials that contribute to energy conservation and environmental sustainability. |

## REMTG504 INDUSTRIAL HEALTH AND SAFETY

| Sl. No | Modules | Outcome |
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| | Module 1 | ● Importance of a better Environment, Health and Safety systems in workplaces.<br>● Status and relationship of Acts, Regulations and Codes of Practice.<br>● International initiatives.<br>● Ergonomics and workplace. |

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| | | ● Categories of health hazards.<br>● Exposure pathways and human responses<br>● Environmental monitoring and occupational exposure limits<br>● Hierarchy of control measures for occupational health risks<br>● Role of PPE<br>● Effects of noise, radiation and excessive stress on humans |
| | Module 2 | ● Satisfactory design of work premises HVAC<br>● Safe installation and use of electrical supplies<br>● Fire safety and first aid provision<br>● Effectiveness of safe systems<br>● Safe systems of work for manual handling operations<br>● Control methods to eliminate the risks arising from the use of work equipment<br>● Requirements for the safe use of DSE<br>● Handling hazardous substances<br>● Contingency arrangements |
| | Module 3 | ● Health and safety policy<br>● Risk assessment techniques<br>● Safety inspections and audits<br>● How to investigate accidents<br>● Principles of quality management systems in health and safety management.<br>● Records and documentation required for health and safety<br>● Industry specific EHS issues. |

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| | Module 4 | • Provision of information<br>• Factors to be considered in the development of effective training programmes<br>• Principles and methods of effective training<br>• Feedback and evaluation mechanism. |

## REMPS505 PRACTICAL-ADVANCED SOLAR PHOTOVOLTAIC LAB

| Sl. No | Outcome | |
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| | Solar cell performance on different loading and climatic conditions | Study the temperature dependence of open-circuit voltage (Voc) and short-circuit current (Isc) of a solar cell<br>Study the variation of Voc and Isc of a solar cell with light intensity<br>I-V characteristics of a PV module with variation in intensity of radiation.<br>P-V characteristics of a PV module with variation in intensity of radiation.<br>I-V characteristics of a PV module at different temperatures<br>P-V characteristics of a PV module at different temperatures |
| | Performance of series combination of panels on different load conditions | I-V characteristics with a series combination of modules.<br>P-V characteristics with a series combination of modules. |
| | Performance of parallel combination of panels on different load conditions | I-V characteristics with parallel combination of modules. |

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| | | P-V characteristics with parallel combination of modules. |

## REMPS506 PRACTICAL-ADVANCED SOLAR THERMAL LAB

| Sl. No | Outcome |
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| 1 | The outcome of students conducting a practical lab focused on the evaluation of different parameters of flat plate collectors and parabolic trough collectors typically includes:<br><br>1. Experimental Design: Proficiency in designing experiments to evaluate various parameters of flat plate collectors and parabolic trough collectors, considering factors such as solar radiation, collector efficiency, and heat transfer.<br><br>2.Data Collection and Measurement: Mastery of collecting accurate data using appropriate instruments to measure parameters like collector temperature, incident solar radiation, and fluid flow rates.<br><br>3.Efficiency Calculations: Ability to calculate the thermal efficiency and other relevant performance metrics for flat plate collectors and parabolic trough collectors based on experimental data.<br><br>4.Comparative Analysis: Skills in comparing the performance of different collectors, understanding how design variations impact efficiency and effectiveness.<br><br>5. Heat Transfer Analysis: Proficiency in analyzing heat transfer mechanisms within the collectors, including conduction, convection, and radiation.<br>7. System Optimization: Ability to identify opportunities for optimizing collector performance based on experimental results, suggesting design improvements or operational adjustments.<br><br>8.Report Writing Skills: Mastery of documenting experimental procedures, results, and conclusions in a structured and clear manner within a comprehensive lab report.<br><br>9. Graphical Representation: Capability to create graphical representations of experimental data, aiding in visualizing trends and patterns in collector performance.<br><br>10. Problem Solving: Skills in identifying and troubleshooting issues that may arise during experiments, ensuring the reliability and accuracy of |

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| | collected data.<br><br>11. Safety Protocols: Adherence to safety protocols and guidelines while conducting experiments, ensuring a secure lab environment for both students and equipment.<br><br>12. Critical Thinking: Development of critical thinking skills to interpret results, draw conclusions, and propose recommendations for further research or improvements.<br><br>The ultimate goal is for students to gain hands-on experience in evaluating the performance of solar thermal collectors, applying theoretical knowledge to practical scenarios, and contributing to the advancement of solar energy technology through informed experimentation and analysis. |

# SEMESTER 6

## BRCTG601 PROJECT MANAGEMENT AND ENTREPRENEURSHIP

| Sl. No | Modules | Outcome |
|---|---|---|
| 1 | Module 1 | The outcome of students learning about the introduction to entrepreneurship, qualities, and functions of entrepreneurs typically includes:<br><br>1. Understanding Entrepreneurship: Proficiency in grasping the fundamental concepts of entrepreneurship, including the nature of entrepreneurial activities and the role of entrepreneurs in the business ecosystem.<br><br>2. Entrepreneurial Qualities: Identification and development of key qualities associated with successful entrepreneurs, such as creativity, risk-taking, resilience, adaptability, and a proactive mindset.<br><br>3. Innovation and Creativity: Ability to foster innovation and creativity, recognizing opportunities, and generating unique business ideas that address market needs.<br><br>4. Business Planning: Proficiency in developing a |

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| | | comprehensive business plan, including aspects such as market analysis, financial projections, and strategic planning for the successful launch and growth of a venture.<br><br>5. Networking and Relationship Building: Skills in building and maintaining professional networks, establishing relationships with mentors, investors, and other entrepreneurs to leverage resources and support.<br><br>6. Market Research: Proficiency in conducting market research to identify target audiences, analyze competitors, and assess the feasibility of a business idea within a given market.<br><br>7. Execution and Operations: Knowledge of the practical aspects of running a business, including day-to-day operations, team management, and adapting to changing market conditions.<br><br>The ultimate goal is for students to be well-prepared to embark on entrepreneurial ventures, equipped with both the knowledge and practical skills required to navigate the challenges and opportunities of the business world. |
| 2 | Module 2 | The outcome of students learning about the classification of entrepreneurship, dealership, franchising, and MSME (Micro, Small, and Medium Enterprises) typically includes:<br><br>1. Understanding Entrepreneurship Classification:<br>- Proficiency in differentiating various types of entrepreneurship, such as small business entrepreneurship, scalable startup entrepreneurship, social entrepreneurship, and corporate entrepreneurship.<br>- Recognition of the unique characteristics, goals, and challenges associated with each type of entrepreneurship.<br><br>2. Dealership Knowledge:<br>- Understanding the concept of dealership as a business model where individuals or entities sell products or services on behalf of a larger company.<br>- Proficiency in assessing the advantages and challenges of operating a dealership business.<br><br>3. Franchising Skills:<br>- Mastery of the franchising model, including the legal and contractual aspects involved in establishing and operating a franchise.<br>- Ability to analyze franchise opportunities, evaluate franchise |

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| | | agreements, and understand the responsibilities of both franchisors and franchisees.<br><br>4. MSME Awareness:<br>- Knowledge of the classification criteria for Micro, Small, and Medium Enterprises based on factors like investment, turnover, and employment.<br>- Understanding the government policies and support mechanisms for MSMEs, as well as the role of MSMEs in economic development.<br><br>5. Business Model Evaluation:<br>- Proficiency in evaluating and comparing different business models, including entrepreneurship classifications, dealership models, franchising, and MSMEs.<br>- Ability to identify the most suitable business model based on specific industry, market conditions, and individual entrepreneurial goals.<br><br>6. Regulatory Compliance:<br>- Awareness of the legal and regulatory requirements associated with different forms of entrepreneurship, including licensing, contracts, and compliance with MSME regulations.<br><br>The ultimate goal is for students to gain a comprehensive understanding of various entrepreneurial classifications and business models, empowering them to make informed decisions and successfully navigate the diverse landscape of entrepreneurship. |
| 3 | Module 3 | The outcome of students learning about project identification and management, legal identification in India, trademark, copyright, patent, and subsidy typically includes:<br><br>1. Project Identification and Management:<br>- Proficiency in identifying viable projects through market analysis, feasibility studies, and assessment of resource requirements.<br>- Skills in project management, including planning, execution, monitoring, and evaluation to ensure successful project outcomes.<br><br>2. Legal Identification in India:<br>- Understanding the legal frameworks and business registration processes in India, including the different business structures such as sole proprietorship, partnership, private limited, and public limited companies. |

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| | | - Knowledge of compliance requirements, taxation, and regulatory aspects relevant to businesses operating in India.<br><br>3. Trademark Knowledge:<br>- Mastery of trademark concepts, including the registration process, protection of brand identity, and the importance of trademarks in establishing and safeguarding a business's identity.<br><br>4. Copyright Awareness:<br>- Understanding the principles of copyright, including the protection of original literary, artistic, and creative works.<br>- Knowledge of copyright registration processes and the rights associated with copyrighted material.<br><br>5. Patent Understanding:<br>- Proficiency in the patenting process, including the criteria for patentability, application procedures, and the legal protection of inventions.<br>- Recognition of the strategic importance of patents in fostering innovation and competitive advantage.<br><br>6. Subsidy Knowledge:<br>- Understanding government subsidy programs available for various sectors, including eligibility criteria, application procedures, and compliance requirements.<br>- Proficiency in assessing and accessing subsidies to support business initiatives and projects.<br><br>7. Risk Management:<br>- Ability to assess legal and regulatory risks associated with project identification and business operations.<br>- Skills in developing strategies to mitigate legal and regulatory challenges.<br><br>8. Strategic Planning:<br>- Capability to integrate legal considerations into strategic business planning, ensuring compliance and minimizing legal risks.<br>- Ability to align legal frameworks with business goals for sustainable and compliant operations.<br><br>The ultimate goal is for students to be well-prepared to navigate the legal and managerial aspects of project identification and management, ensuring legal compliance, protecting intellectual property, and leveraging government subsidies for business success in the Indian context. |

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| 4 | Module 4 | The outcome of students learning about project formulation and report preparation typically includes:<br><br>1. Project Formulation Skills:<br>- Proficiency in identifying project goals, objectives, and scope, considering factors such as feasibility, resources, and potential impacts.<br>- Ability to conduct thorough project needs assessments and stakeholder analyses.<br><br>2. Effective Planning:<br>- Skills in creating detailed project plans, outlining tasks, timelines, and resource requirements.<br>- Ability to develop strategies for risk management and mitigation during project implementation.<br><br>3. Budgeting and Resource Allocation:<br>- Proficiency in preparing project budgets, including cost estimation, resource allocation, and financial planning.<br>- Capability to align budgetary considerations with project objectives and deliverables.<br><br>4. Stakeholder Engagement:<br>- Ability to identify and engage stakeholders effectively, ensuring their involvement and support throughout the project lifecycle.<br>- Skills in communication and collaboration with diverse stakeholders.<br><br>5. Data Collection and Analysis:<br>- Proficiency in designing methodologies for data collection and analysis relevant to the project.<br>- Capability to use data to inform decision-making and project adjustments.<br><br>6. Report Writing Skills:<br>- Mastery of report writing techniques, including clear and concise presentation of project objectives, methodologies, findings, and recommendations.<br>- Skills in structuring reports for different audiences, such as project sponsors, stakeholders, and the general public.<br><br>7. Presentation Skills:<br>- Capability to effectively present project findings and recommendations through oral presentations.<br>- Skills in using visual aids and communication techniques to convey complex information.<br><br>The ultimate goal is for students to be well-equipped with the |

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| | | knowledge and skills necessary to formulate, plan, implement, and report on projects effectively. This includes the ability to adapt to challenges, engage stakeholders, and contribute meaningfully to the success of projects across various domains. |

## REMTG602 ENERGY MANAGEMENT AND AUDITING

| Sl. No | Modules | Outcome |
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| **1** | Module -1 | • Students may learn about various energy sources, such as fossil fuels, renewable energy, nuclear energy, etc.<br>• To understand the basics of energy & its various forms . |
| **2** | Module -2 | • Gain a solid understanding of the fundamental principles of energy management, including energy conservation, efficiency, and sustainability.<br>• Develop the skills to identify and assess potential energy-saving opportunities in different contexts, such as industrial facilities, commercial buildings, and residential settings.<br>• To understand ,Energy Audit Reporting format, energy carts Benchmarking & energy performance, Matching energy usage to requirement Maximizing System - Fuel & energy Substitution |
| **3** | Module -3 | • Gain a comprehensive understanding of the principles and concepts related to energy management.<br>• Understand the role of energy policies and strategies in organizational energy management.<br>• To understand the Key Elements - Force Field Analysis - Energy Policy .<br>• Organizing – Location of energy Manager - Top Management Support - Energy Manager:<br>• To understand Responsibilities & duties to be assigned under energy conservation Act 2001 - accountability |
| 4 | Module -4 | • Acquire knowledge about different energy audit instruments used for measuring energy consumption in buildings, industrial processes, and other systems. |

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| | | • Understand the criteria for selecting appropriate instruments based on the type of energy audit and the specific requirements of the facility. |

## REMTG603 GRID INTEGRATION

| Sl. No | Modules | Outcome |
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| | Module 1 | Outcome: basics of power flow from different renewable sectors into the power grid<br>• Basics of Power Grid-Generation, transmission and distribution,<br>• Substation: basic layout, substation components: protection and metering equipments,<br>• major faults, earthing - synchronisation |
| | Module 2 | Outcome: Basics of RTPV installation, Guidelines, standards and regulations provided by the utility and regulatory commission are discussed<br>• Type of Rooftop Solar PV Power Plants and working principles<br>• System components and operating principles<br>• Metering arrangement for Rooftop Solar-Policy and regulatory framework<br>• regulatory parameters for interconnection and metering arrangement including power quality of the grid<br>• IEC standards or relevant Indian standards for rooftop PV-safety of earthing and lightning protection of the rooftop solar PV power plant |

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| | | ● Single line diagram of a rooftop solar PV power plant |
| | Module 3 | Outcome: Power quality issues, basics of major power system components are studied<br>● Metering system-import and export of energy<br>● inverter operation, including anti-islanding functionality, overload<br>● power quality of rooftop PV power plant: harmonics, current, voltage-power factor<br>● Generators (Basic Working and types)<br>● Transformers (Basic Working and types)<br>● Basic concepts of smart grid and micro grid |
| | Module 4 | Outcome: Idea about hybrid systems, electric vehicles are obtained<br>● Types of hybrid systems: PV hybrid with Diesel generator, Wind-diesel hybrid systems, Biomass diesel hybrid system, Wind-PV hybrid system, Micro Hydel- PV hybrid system, Biogas-Solar thermal hybrid system (a case study), Solar-cum-Biomass dryer Hybrid (a case study)<br>● Electric and Hybrid electric vehicles<br>● E-Vehicles need-Emissions-Limitations<br>● Hydrogen powered electric vehicles -Clean mobility options |

# REMPS604 PRACTICAL- RENEWABLE ENERGY SYSTEM DESIGN USING SOFTWARE

| Sl. No | Modules | Outcome |
|---|---|---|
| **1** | Familiarization of Autocad | ● To familiarize the students in introducing and exploring Autocad software |
| **2** | Draw and Dimension toolbar | ● To study about draw and dimension toolbar like line,polyline,circle,arc,polygon etc. |
| **3** | Autocad commands | ● To study of mirror ,offset and array command<br>● To study Trim,extend,chamfer and fillet command.<br>● To study, copy,move, scale, and rotate commands. |