SDG 7: AFFORDABLE AND CLEAN ENERGY

SDG 7 highlights affordable and clean energy solutions. Integrating this SDG builds understanding of renewable energy and energy efficiency. Students explore sustainable power systems and technologies. This supports clean energy transitions.



List of Courses mapped to SDG 7:

S.No	Course Title	Name of the Program	Justification for SDG Mapping
1	ENERGY MANAGEMENT AND GREEN BUILDINGS	B.Tech - Electrical and Electronics Engineering	Focuses on energy auditing and efficient energy use in buildings, reducing consumption and cost.
2	AI AND IOT FOR GREEN INTEGRATION	B.Tech - Electrical and Electronics Engineering	Uses AI and IoT to monitor and optimise energy systems and enable smarter integration of green energy.
3	GRID INTEGRATION OF RENEWABLE ENERGY RESOURCES	B.Tech - Electrical and Electronics Engineering	Covers connecting solar, wind and other renewables to the power grid reliably.
4	RENEWABLE ENERGY SOURCES	B.Tech - Electrical and Electronics Engineering	Introduces solar, wind, biomass and other renewable technologies for clean, affordable energy.
5	ADVANCED ENERGY STORAGE SYSTEMS	B.Tech - Mechanical Engineering	Covers batteries and other storage technologies that make renewable energy dependable.
6	INSIGHTS TO SUSTAINABLE DEVELOPMENT GOALS	All B.Tech Programs	Module 4 covers Affordable and Clean Energy, with a case study on a clean-energy initiative such as the national solar mission.

Course Outcomes and Syllabus

Energy Management and Green Buildings

SDG 7

Course code: 22EE3223 | L-T-P-S: 2-1-0-0 | Credits: 3 | Programme: B.Tech - Electrical and Electronics Engineering

CO	Course Outcome	PO / PSO	BTL
CO1	Apply energy audit for energy management in buildings	PO2 / PSO1	3
CO2	Interpret energy conservation opportunities in electrical systems	PO7/ PSO2	2
CO3	Identify energy management strategies for energy efficiency	PO7/ PSO1	3
CO4	Identify practices for energy efficiency green buildings	PO2 / PSO1	3

Syllabus

Energy Audit: Need, types, methodology and approach, Instruments for energy audit, Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, matching energy usage to requirements, maximizing system efficiency, Return of Investment. Energy conservation opportunities: Energy conservation in HVAC, Refrigeration and Air Conditioning, Pumping Systems, lighting control, lighting control, Energy Conservation Building Code, Energy Conservation opportunities in Transformers and cables, Transmission lines. Energy Management: Definition and Objective of Energy Management, General Principles, Energy Management Strategy, Energy Balance sheet and Management Information System (MIS), Energy Modelling and Optimization, Demand Side management (DSM), Peak Demand control- Methodologies. Green Building Practices: Energy efficiency-life cycle perspective, Environmental product declaration, Building information model, choice of heat insulation materials, high thermal mass materials, phase change materials, Green building certifications.

AI and IoT for Green Integration

SDG 7

Course code: 22EE4121 | L-T-P-S: 2-0-2-0 | Credits: 3 | Programme: B.Tech - Electrical and Electronics Engineering

CO	Course Outcome	PO / PSO	BTL
CO1	Utilize AI techniques for PV based Power generation	PO4	3
CO2	Utilize AI techniques for wind and hybrid power generation	PO4	3
CO3	Demonstrate IoT devices and tools for Green energy systems	PO2	2
CO4	Build IoT Systems for Green Energy Integration	PO7	3

Syllabus

AI for solar PV Power generation: Fuzzy logic based PV MPP techniques, RMSE and MAPE analysis for short term irradiance, solar energy and load forecasting, Machine learning algorithms for short term irradiation and temperature forecasting, Day ahead power output forecasting for PV systems with regression, machine learning and deep learning techniques, case studies AI for Wind and Hybrid Power generation: Wind speed forecasting, Frequency control of induction generator using genetic algorithm, stochastic wind generation and congestion management, Intelligent Energy Management System of Hybrid Solar/Wind/Battery Power Sources, Islanding detection, case studies IoT Devices and Tools for Green Energy systems: Sensors- temperature, vibration, irradiance, wind speed, PIR, proximity, current, voltage Controllers, networking, Cloud computing, Data analytics IoT Applications for green energy systems: Cloud based Real- time Monitoring systems: PV Power output, State of Health of Battery Storage, wind turbine vibration, M2M communication case study

Grid Integration of Renewable Energy Resources

SDG 7

Course code: 22EE4122 | L-T-P-S: 2-0-2-0 | Credits: 3 | Programme: B.Tech - Electrical and Electronics Engineering

CO	Course Outcome	PO / PSO	BTL
CO1	Apply the control principles for PV - grid integration control	PO5	3
CO2	Apply the control principles for wind power integration control	PO4	3
CO3	Identify power quality challenges in grid integration of renewable energy	PO4	3
CO4	Identify challenges in grid integration of multiple renewable sources	PO5	3

Syllabus

PV Integration Technology: Photovoltaic (PV) inverter topologies- configurations and control strategies, Grid codes and technical regulations of Solar PV integration Wind Power Integration Technology: Wind power and voltage control for synchronous and induction generators-based integration; active and reactive power control, Grid codes and technical regulations of Wind power integration Power quality management: THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, effects on system stability Challenges: Integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection

Renewable Energy Sources

SDG 7

Course code: 22EE40A1 | L-T-P-S: 3-0-0-0 | Credits: 3 | Programme: B.Tech - Electrical and Electronics Engineering

CO	Course Outcome	PO / PSO	BTL
CO1	Understand the different solar thermal applications and solar photovoltaic cells	PO-4,PO-10/ PSO-1	2
CO2	Understand the operation of wind turbine ,different types of wind turbines and wave energy conversion	PO-4,PO-10/ PSO-1	2
CO3	Understand the energy conversion of Tidal, ocean thermal and various the geo thermal power plants	PO-4,PO-10/ PSO-1	2
CO4	Understand the operation of Bio energy conversion method and the different bio gas plants	PO-4,PO-10/ PSO-1	2

Syllabus

Extraterrestrial solar radiation, terrestrial solar radiation, solar thermal conversion,flat plate and concentrated solar thermal collectors, solar ponds, solar heating/cooling technique, solar distillation, photovoltaic energy conversion, solar cells – 4 models. Planetary and local winds, vertical axis and horizontal axis wind mills, principles of wind power, maximum power, actual power, wind turbine operation, yaw control, pitch control and stall control mechanisms, derivation of power coefficient. Ocean temperature differences, principles of OTEC plant operations, wave energy, devices for energy extraction, tides, simple single pool tidal system. Origin and types, Bio fuels, classification, direct combustion for heat and electricity generator, anaerobic digestion for biogas, biogas digester, power generation. Biomass energy conversion technologies, Biogas generation – classification of Biogas plants. Micro hydro electric systems- different types of turbines.

Advanced Energy Storage Systems

SDG 7

Course code: 22ME4103 | L-T-P-S: 2-0-2-0 | Credits: 3 | Programme: B.Tech - Mechanical Engineering

CO	Course Outcome	PO / PSO	BTL
CO1	Understand the basics of Energy storage systems and its applications	PO1	2
CO2	Modelling of various thermal energy storage systems	PO2	4
CO3	Understand the construction and working of various electrical storage systems	PO1	2
CO4	Understand the principles of alternate energy storage technologies	PO1	2
CO5	Analyze various energy storage systems using MATLAB/Simulink	PO5	4

Syllabus

Introduction: Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications. Applications of Energy Storage: Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application- Portable storage systems and medical devices, Mobile storage Applications. Modelling of thermal energy storage systems: Thermal storage – Types – Modelling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach. Electrical Energy storage systems – Fundamental concept of batteries – measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel –Cadmium, Zinc Manganese dioxide and modern batteries for example (i) zinc-Air (ii) Nickel Hydride, (iii) Lithium Battery. Application to EVs. Alternate energy storage technologies: Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications Experiments: • Modelling of Li ion battery • Performance Analysis of Li ion battery • Thermal management of battery pack • Structural reliability of a battery pack • Thermal analysis of sensible heat storage unit • Analysis of packed bed storage system • Modelling and analysis of energy storage unit through porous medium approach • Simulation of ice based latent heat thermal energy storage • Modelling of supercapacitor • Analysis of supercapacitor

Insights to Sustainable Development Goals

SDG 7

Course code: 25UC0032E | L-T-P-S: 2-0-0-0 | Credits: 0 | Programme: All B.Tech Programs

CO	Course Outcome	PO / PSO	BTL
CO1	Understand sustainable development — concept, pillars, and the road to the SDGs.	PO6, PO7, PSO1	2
CO2	Understand the 17 SDGs, their targets, and their interlinkages.	PO6, PO7, PSO1	2
CO3	Analyze the people-and-prosperity SDGs in the Indian and global context.	PO6, PO7, PSO2	4
CO4	Analyze the planet SDGs — climate, energy, water, and ecosystems.	PO6, PO7, PSO2	4
CO5	Apply SDG measurement, governance, and localisation.	PO7, PO11, PSO2	3
CO6	Analyze how technology, AI, and innovation can accelerate the SDGs.	PO5, PO7, PSO2	4

Syllabus

Module 1: Foundations of Sustainable Development. Topics: What sustainable development means; The Brundtland definition; The three pillars - economic, social, environmental; Planetary boundaries; From MDGs to SDGs; The 2030 Agenda and 'leave no one behind'; Sustainability vs growth debates; India's sustainability context. Labs: Map a real project against the three pillars of sustainability; Footprint lab: estimate and reduce a sustainability footprint. Case Study: a development-vs-environment trade-off (e.g., a dam/infrastructure project): analyse how the three pillars of sustainability were balanced or violated.

Module 2: The 17 SDGs Overview. Topics: Overview of all 17 goals; Targets and indicators; The SDG 'wedding cake' model; Interlinkages and trade-offs among goals; Synergies across goals; 'Leave no one behind'; The global indicator framework; Tracking progress. Labs: Build an SDG interlinkage map for a chosen development problem; Indicator lab: interpret SDG progress data for a country/state. Case Study: SDG interlinkages in practice (e.g., clean energy enabling health and education): analyse how progress on one goal advances others.

Module 3: People & Prosperity SDGs. Topics: No poverty and zero hunger; Good health and well-being; Quality education; Gender equality; Decent work and economic growth; Reduced inequalities; Industry, innovation, and infrastructure; India's progress on people/prosperity goals. Labs: Analyse a region's people/prosperity indicators and gaps; Design an intervention targeting a people/prosperity SDG. Case Study: an Indian social initiative (e.g., a health/education/livelihood program): analyse its SDG contribution and outcomes.

Module 4: Planet SDGs. Topics: Clean water and sanitation; Affordable and clean energy; Climate action; Life below water; Life on land; Sustainable cities and communities; Responsible consumption and production; Circular economy. Labs: Audit a setting for responsible consumption and propose circular fixes; Design a planet-SDG (energy/water/waste) solution for a community. Case Study: a clean-energy or water initiative in India (e.g., solar mission / river rejuvenation): analyse its planet-SDG impact and scalability.

Module 5: Partnership, Governance & Measurement. Topics: Peace, justice, and strong institutions (SDG16); Partnerships for the goals (SDG17); Financing the SDGs; Indicators and the SDG India Index; Localising the SDGs; Voluntary National Reviews; Role of governments, business, and civil society; Accountability and reporting. Labs: Build an SDG scorecard for an organisation/community; Design a multi-stakeholder partnership for an SDG target. Case Study: the SDG India Index / a state's SDG localisation: analyse how SDGs are measured and localised, and what drives improvement.

Module 6: Technology, AI & Innovation for the SDGs. Topics: Technology as an SDG accelerator; AI for good - use cases across goals; Social entrepreneurship and impact ventures; Frugal and inclusive innovation; Digital public infrastructure for development; Measuring impact (theory of change); The engineer's and youth's role; Designing an SDG-aligned solution. Labs: Design a technology/AI-enabled solution mapped to an SDG with a theory of change; Pitch a social-impact venture targeting one or more SDGs. Case Study: AI/technology for an SDG (e.g., AI in healthcare access or precision agriculture): analyse how technology accelerates a specific goal, with its risks.