

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT-3	Sheet No. 1/5
Branch	Electrical Engineering			Semester	Sixth
Course Code	611	Course Name	Renewable Energy Technologies		
Course Outcome - 1	Apply concepts of energy conservation, management and audit.			Teach Hrs	Marks
Learning Outcome E0161111	Describe energy scenario and environmental issues. [Cognitive Domain]			03 Hrs	05 Marks
Contents	<ul style="list-style-type: none"> • Energy Scenario: Energy demand and supply (Global and National). • Type of energy sources: Primary and secondary, renewable and non-renewable. • Environmental issues: Global warming, climate change. • Need for sustainable energy sources. 				
Method of Assessment	Internal: Mid semester- I theory examination (Pen paper test).				
Learning Outcome E0161112	Infer energy conservation act and explain energy management and audit. [Cognitive Domain]			04 Hrs	05 Marks
Contents	<ul style="list-style-type: none"> • Energy conservation act-2001 and its salient features. • Energy managements and its objectives. • Energy audit: Need, types and energy auditing instruments. • Energy audit report format. 				
Method of Assessment	Internal: Mid semester- I theory examination (Pen paper test).				
Learning Outcome E0161113	Choose energy efficient equipment, energy conservation methods and analyse economic feasibility. [Cognitive Domain]			7 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> • Energy efficient equipment: Electric motor, transformer. • Star ratings systems, Co-generation systems, heating ventilation and air conditioning systems, Waste heat recovery system. • Estimation of energy bills. • Economic analysis: Payback period (PBP), Net present value (NPV), Internal rate of return (IRR). 				
Method of Assessment	External: End semester theory examination (Pen paper test).				
Learning Outcome E0161114	Analyse electricity bill and perform energy audit for a given building. [Psychomotor & Affective Domain]			06 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> • To analyse electricity bill of educational institution for optimising it as per energy consumption patterns. • To perform energy audit of a given building. 				
Method of Assessment	Internal: Performance of task and viva voce.				

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Branch	Electrical Engineering			Semester	Sixth
Course Code	611	Course Name	Renewable Energy Technologies		
Course Outcome -2	Use solar PV module for various applications.			Teach Hrs	Marks
Learning Outcome E0161121	Describe solar radiation and solar energy systems. [Cognitive Domain]			06 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> • Introduction to solar energy. • Solar radiation: Solar spectrum, radiation on the earth surface, direct, diffuse and global, solar insolation, annual variation in solar radiation, optimal tilt for solar radiation. • Solar-photovoltaic (SPV) and solar-thermal systems. 				
Method of Assessment	External: End semester theory examination (Pen paper test).				
Learning Outcome E0161122	Explain fundamentals of solar cell, module and arrays. [Cognitive Domain]			8 Hrs	15 Marks
Contents	<ul style="list-style-type: none"> • Solar cell – types, working. • Solar PV module: Types, rated power and actual power from module, standard test condition (STC). • Curve: I-V and P-V curve and module parameters. • PV module ratings and cost. • Blocking and bypass diode. • PV arrays. • Numerical problems on arrays. 				
Method of Assessment	External: End semester theory examination (Pen paper test).				
Learning Outcome E0161123	Perform experiments on solar PV module. [Psychomotor & Affective Domain]			09 Hrs	15 Marks
Contents	<ul style="list-style-type: none"> • To draw I-V and P-V curve of a solar PV module. • To draw I-V and P-V curve for series and parallel combinations of solar PV module. • To draw I-V and P-V curve for different tilt angle of solar PV module and find the optimum tilt angle. • To demonstrate shadow effect on solar PV module. 				
Method of Assessment	External: Performance of task and viva voce.				

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Branch	Electrical Engineering			Semester	Sixth
Course Code	611	Course Name	Renewable Energy Technologies		
Course Outcome –3	Classify power conditioning devices and solar PV power plant.			Teach Hrs	Marks
Learning Outcome E0161131	Define battery parameters and power conditioning devices used in solar PV system. [Cognitive Domain]			6 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> Batteries: Types, parameters, state of charge and depth of discharge. Working with block diagram: Solar Inverter, PWM Charge Controller, MPPT Charge Controller. 				
Method of Assessment	External: End semester theory examination (Pen paper test).				
Learning Outcome E0161132	Compare different solar PV power plant. [Cognitive Domain]			6 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> Block diagram, functioning and application: <ul style="list-style-type: none"> ➤ Standalone solar PV system. ➤ Net metering solar PV system. ➤ Gross metering solar PV system. 				
Method of Assessment	Internal: Assignment & Quiz.				
Learning Outcome E0161133	Assemble standalone solar PV plant. [Psychomotor & Affective Domain]			9 Hrs	15 Marks
Contents	<ul style="list-style-type: none"> To assemble standalone solar PV system and measure power flow. 				
Method of Assessment	External: Performance of task and viva voce.				

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Branch	Electrical Engineering			Semester	Sixth
Course Code	611	Course Name	Renewable Energy Technologies		
Course Outcome –4	Identify wind energy as alternative form of energy and its mechanism for producing electrical energy.			Teach Hrs	Marks
Learning Outcome E0161141	Illustrate concepts of wind energy and components used in wind turbine. [Cognitive Domain]			8 Hrs	15 Marks
Contents	<ul style="list-style-type: none"> • Working of wind turbine. • Drag and lift principle. • Conversion of wind energy into electrical energy. • Power content in Wind. • Selection of site for wind power plant. • Efficiency limit for wind energy conversion. • Orientation of wind turbines: Vertical axis and horizontal axis wind turbines. • Components of a horizontal axis wind turbine: Nacelle assembly, rotor assembly, bearings, gearbox, generator, braking system. • Wind power scenario in India. 				
Method of Assessment	External: End semester theory examination (Pen paper test).				
Learning Outcome E0161142	Explain turbine control and salient features of wind generators. [Cognitive Domain]			6 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> • Type of rotor: Savonius and Darrieus. • Power- speed characteristics. • Torque- speed characteristics. • Wind turbine control: Pitch angle, stall and yaw control. • Salient features of electric generators used in wind power plants: <ul style="list-style-type: none"> ➤ Squirrel cage induction generators (SCIG). ➤ Wound rotor induction generator (WRIG). ➤ Doubly-Fed induction generator (DFIG). ➤ Synchronous generator. ➤ Permanent magnet synchronous generator (PMSG). ➤ Switch reluctance generator (SRG). 				
Method of Assessment	Internal: Mid semester-II theory examination (Pen paper test).				
Learning Outcome E0161143	Identify major components used in wind turbine and measure wind velocity at different time intervals for given location. [Psychomotor & Affective Domain]			6 Hrs	10 Marks
Contents	<ul style="list-style-type: none"> • To prepare a report on components of a wind turbine by visiting/ watching the video clip of the wind power plant. • To measure wind velocity at different time intervals for given location using anemometer. 				
Method of Assessment	Internal: Performance of task and viva voce.				

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Branch	Electrical Engineering			Semester	Sixth
Course Code	611	Course Name	Renewable Energy Technologies		
Course Outcome –5	Identify different renewable energy technologies and need of hybrid energy system.			Teach Hrs	Marks
Learning Outcome E0161151	Summarize alternative energy sources. [Cognitive Domain]			3 Hrs	05 Marks
Contents	<p>Working principle and applications:</p> <ul style="list-style-type: none"> • Geothermal energy. • Hydrogen energy. • Biomass energy. <p>Construction/installation, working principle and applications:</p> <ul style="list-style-type: none"> • Biogas plant. 				
Method of Assessment	External: End semester theory examination (Pen paper test).				
Learning Outcome E0161152	Relate wind and solar photovoltaic energy system. [Cognitive Domain]			3 Hrs	05 Marks
Contents	<p>Wind -Photovoltaic hybrid energy system:</p> <ul style="list-style-type: none"> • Advantages and disadvantage of system. • Block diagram representation. • Current status in the context of Indian scenario. 				
Method of Assessment	External: End semester theory examination (Pen paper test).				

REFERENCE BOOKS:

S.N.	Title & Publication	Author
1.	Renewable Energy Technologies: A Practical guide for Beginners, PHI Learning, New Delhi.	Chetan Singh Solanki
2.	Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi.	D. P. Kothari, K. C. Singal, Rakesh Ranjan
3.	Energy Conservation & Management, Satya Prakashan New Delhi.	Suresh Kumar Soni Manoj Nair
4.	Solar Photovoltaics: Fundamentals, Technologies And Applications, PHI Learning, New Delhi.	Chetan Singh Solanki
5.	Wind Power Plants & Project Development, PHI Learning, New Delhi.	Joshua Earnest Tore Wizelius
6.	Non-conventional Energy Sources, Khanna Publishers.	G. D. Rai
7.	From Sunlight to Electricity: a practical handbook on solar photovoltaic application, TERI, New Delhi.	Suneel Deambi
8.	Wind Electrical Systems installation; Oxford University Press, New Delhi.	S. N. Bhadra, D. Kastha, S. Banerjee
9.	Wind Power: Practical Aspects, TERI, New Delhi.	Shambhu Ratan Awasthi