Model Template for Scheme of Course Work

to be submitted by the Faculty of B.Tech/M.Tech/MCA I semester on or before 11.10.2013 to bhanucvk@gvpce.ac.in and yadavalliraghu@yahoo.com

SCHEME OF COURSE WORK

Course Details:

Course Title	**RENEWABLE ENERGY RESOURCES**		
Course Code	**:** 13ME2313	**L T P C**	**:4 0 0 3**
Program:	**: M.Tech.**		
Specialization:	**: THERMAL ENGINEERING**		
Semester	**:II**		
Prerequisites	**:Thermodynamics, Heat Transfer, Thermal Engineering**		
Courses to which it is a prerequisite	**:NO**		

Course Outcomes (COs):

1	Explain solar energy radiation, analyze different solar collectors, energy conversion systems
2	Discuss power generation using geothermal and wind energy.
3	Describe power generation in biomass and bio-fuels
4	Analyze the electro chemical effects and fuel cells, hydrogen energy cycle.
5	Apply the direct energy conversion methods, wave and tidal energy.

Program Outcomes (POs)

At the end of the programme, the students in THERMAL ENGINEERING will be able to

PO Code	Program Outcome (PO)
PO 1	exhibit in-depth knowledge in thermal engineering specialization
PO 2	think critically and analyze complex engineering problems to make creative advances in theory and practice
PO 3	solve problem, think originally and arrive at feasible and optimal solutions with due consideration to public health and safety of environment
PO 4	use research methodologies, techniques and tools, and will contribute to the development of technological knowledge
PO 5	apply appropriate techniques, modern engineering tools to perform modeling of complex engineering problems with knowing the limitations
PO 6	understand group dynamics, contribute to collaborative multidisciplinary scientific research
PO 7	demonstrate knowledge and understanding of engineering and management principles and apply the same with due consideration to economical and financial factors
PO 8	communicate complex engineering problems with the engineering community and society, write and present technical reports effectively
PO 9	engage in life-long learning with a high level of enthusiasm and commitment to improve knowledge and competence continuously
PO 10	exhibit professional and intellectual integrity, ethics of research and scholarship and will realize the responsibility towards the community
PO 11	examine critically the outcomes of actions and make corrective measures

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Course Outcome Versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	M	S			M		S			
CO2	M	S	M			M	M		M			
CO3		S	M				M					
CO4		S	M	S			M		S			
CO5		S	M				M					

S - Strongly correlated, *M - Moderately* correlated, *Blank - No correlation*

AssessmentMethods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Introduction – Renewable Energy sources-energy parameters-cogeneration-new technologies-distributed energy systems-impact of renewable energy generation on environment-solar energy, wind energy, biomass energy, geothermal energy, ocean energy. Scenario - survey of energy resources – classification – need for non-conventional energy resources. Solar Radiation and its Measurement**:** The Sun – sun-earth relationship –solar radiation – radiation measuring instruments.	CO1	1. Briefly discuss the power scenario in India. 2. Explain cogeneration of heat and electricity can be dealt with Topping cycle and bottoming cycle. 3.Compute the monthly average hourly solar flux received on a flat plate collector facing due south($\gamma = 0^0$) having a slope of 12^0. The collector is located at a place 15^0 00′ N on 20 th day of October. The data given are: Time 11:12 h(local apparent time) H_g = 2408 kJ/m^2/h H_d = 1073 kJ/m^2/h Ground reflectivity, ρ= 0.25,ω =7.5^0	▫ Lecture ▫ Problem solving	Assignment (Week 3 - 5) Mid-Test 1 (Week 8)
2	Solar Collectors: Solar collectors- flat plate collector- performance analysis of flat plate collector- solar air collectors-solar concentrating collectors- performance analysis -types of concentrating collectors-compound parabolic concentrator (CPC)-Tracking CPC and solar swing - performance analysis.	CO1	Calculate the heat removal factor, the useful heat gain, the exit fluid temperature and the collection efficiency for a cylindrical parabolic concentrator having 2.5m width and 9m length, the outside diameter of the absorber tube being 6.5cm. Th temperature of the fluid to be heated at the inlet is 16^0Cwith a flow rate of 450kg/h. The incident beam radiation is 700 W/m^2. The ambient temperature is 28^0C. The optical properties are ρ = 0.85,product of transmitivity and absorptivity= 0.78, transmitivity = 0.93	▫ Lecture / Discussion ▫ Problem solving	Mid-Test 1 (Week 8)
3	Solar Thermal Energy Storage: Different systems. Solar Thermal Energy Conversation Systems**:** solar water Heating– heating of swimming pool-solar thermal power plant-central receiver power plants– solar ponds-Solar pumping systems-solar air heaters-	CO1	1. With the help of a schematic diagram explain the medium temperature solar plants and central receiver power plants. 2. Explain difference between active and passive solar heating systems.	▫ Lecture	Seminar (Week 3 – 4) Mid-Test 1 (Week 8)

	solar crop drying –solar kilns-integrated solar dryers- solar cooker-solar passive techniques-solar air conditioning & refrigeration-solar green houses.				
4	Solar Photovoltaic system: Semi conductor materials and doping-p-n junction-photovoltaic effect- efficiency of solar cells- semiconductor materials for solar cells- solar photovoltaic system (SPS)-application-plastic solar cells with nanotechnology.	CO1	1. Discuss the reasons for low efficiency of solar cells. 2. With a neat sketch describe how photovoltaic power can be used to desalinate sea water for drinking purposes.	▫ Lecture / Discussion	Assignment (Week 3 - 5) Mid-Test 1 (Week 8)
5	Geothermal Energy: Introduction-structure of earth – plate tectonic theory-geothermal field–geothermal gradients- geothermal power generation-preheat hybrid with conventional plant- resources in India.	CO-2	1. What is plate teconic theory and how it is related to geothermal energy. 2. Define and discuss geothermal gradients.	▫ Lecture	Mid-Test 1 (Week 8)
6	Wind Energy: Introduction- classification of wind turbines-types of rotors-terms used-aerodynamic operation –wind energy extraction-extraction of power-wind characteristics-mean wind speed & energy estimation-power density duration curve-types of wind machines- modes of wind power generation	CO2	1. Design the rotor radius for a multiblade wind turbine that operates in a wind speed of 3kmph to pump water at a rate of $6m^3/h$ with a lift of 6m. Also calculate the angular velocity of the rotor. 2. Prove that the maximum turbine output can be achieved when $V_d = (1/3)\ V_u$.	▫ Lecture ▫ Problem solving	Mid-Test 1 (Week 8)
7	Bio – Energy: Introduction-biomass resources-bio fuels-biogas-producer gas-biomass conversion technologies-biochemical conversion-biomass gasification-biogas technology-biogas plants-energy recovery from urban waste	CO3	1.Discuss the different technologies to produce biogas . Also discuss the factors affecting the production of biogas. 2. With a neat diagram discuss the biomass gasification method.	▫ Lecture ▫ Problem solving	Seminar(week 5 -6) Mid-Test 1 (Week 8)
8	**Mid-Test 1**	CO1, CO2, CO3			
9	MSW based power project-power generation from land fill gas- power generation from liquid waste-biomass cogeneration-ethanol from biomass-bio diesel-bio fuel petrol-biomass resource development in India-environmental benefits.	CO3	1.Discuss the process of production of ethanol from biomass. 2. What is biodiesel ? Discuss the production of biodiesel from Jatropha.	▫ Lecture ▫ Discussion	Seminar (Week 9) Mid-Test 2 (Week 16)
10	Electro Chemical Effects and Fuel Cells: Principle of operation of an acidic fuel cell-technical parameter of fuel cell-fuel processor-methanol fuel cell-classification of fuel cells- Other types of fuel cells-comparison between acidic and alkaline hydrogen oxygen fuel cells- efficiency and EMF of fuel cells- operating characteristics of fuel cells- advantages of fuel cell power plants- future potential of fuel cells.	CO4	1.Derive the expression for the power output and efficiency of a fuel cell. 2. Draw a neat sketch of a matrix type hydrogen oxygen alkaline cell with facilities for electrolyte recirculation and water removal. How is this accomplished in other types?	▫ Lecture ▫ Discussion Problem solving	Seminar(week 10) Mid-Test 2 (Week 16)
11	Hydrogen Energy: Properties of hydrogen in respect of its use as source of renewable	CO4	1.Why is hydrogen called a secondary energy source? Name various methods of hydrogen production?	▫ Lecture ▫ Discussion	Seminar (Week 11) (Mid-Test 2

	energy- sources of hydrogen- production of hydrogen- storage and transportation- safety and management-development of hydrogen cell- economics of hydrogen fuel and – I.C. Engines applications – utilization strategy – performances.		2. Write short notes on 1. Metal hybride 2. Hydrogen storage using nano- crystalline Mg based Ni – hybride.		(Week16)
12	Energy from Oceans: Tidal Energy: Introduction to -tidal characteristics-range-energy estimation for tidal power project-double cycle system-development of tidal power scheme-components of power plant-advantages and disadvantages-global scenario-power development in India.	CO5	1.Discuss the relative advantages and limitations of tidal power plant. 2. Write three important components of tidal power plant . 3. What are important factors needed to absorb tidal power into grid supply? Draw load – duration curve.	▫ Lecture ▫ Discussion	Seminar (Week 12) (Mid-Test 2 (Week 13)
13	Wave Energy: Introduction -factors effecting wave energy-ocean wave parameters-energy from waves-wave power data-energy resource in India-wave area-analysis of wave energy-wave energy conversation-principles of wave energy-wave power development in India-OTEC.	CO5	1.Establish the equation for the power extracted from ocean waves in terms of wavelength, amplitude, period, ocean water density, etc. 2. Explain carnot efficiency of an OTEC plant with the help of a thermodynamic cycle on T – s plane. 3. Explain basic principle of ocean thermal energy.	▫ Lecture	Assignment (Week 14 - 16) (Mid-Test 2 (Week 16)
14	Direct Energy Conversion: Need for DEC-Carnot cycle- limitations- Principles of DEC. Thermo-electric generators-Seebeck-Peltier and Joule-Thompson effects- figure of merit- materials- applications.	CO5	1. Explain Seebeck – Peltier effects.	▫ Lecture Problem solving	Assignment (Week 14 - 16) (Mid-Test 2 (Week 16)
15	MHD generators- principles- dissociation and ionization- Hall effect-magnetic flux-MHD accelerator- MHD engine- power generation systems-electron gas dynamic conversion- economic aspects.	CO5	1. Explain principle of MHD generators.	▫ Lecture Problem solving	Assignment (Week 14 - 16) (Mid-Test 2 (Week 16)
16	**Mid Test 2**	CO3, CO4, CO5			
17/18	**End Exam**				