M.E. Power Engineering First Year First Semester Examination – 2018

Subject: Power Generation Methodologies

Time: 3 hr.

Full Marks: 100

Questions No.	Answer any *Five* Questions	Marks
1.	a) What are the different types of power generating plants?	4
	b) Briefly explain with neat sketch the operation of Gas-cooled reactor (GCR) of Nuclear power plant.	8
	c) With neat sketch briefly explain the operation of Hydel power plant.	8
2.	a) What is Air Mass? What is the significance of Air Mass in determining the power output from solar PV?	2+4
	b) What are the different components of solar irradiance at ground level? State the differences between Solar Radiation, Solar Irradiance and Irradiation.	3+3
	c) Calculate the angle of incidence of beam radiation on a plane surface, titled by 45^0 from the horizontal plane and pointing 30^0 west of south location at Kolkata at 1.30 P.M. (IST) on 15th November. The latitude and longitude of Kolkata are 22.56^0 N and 88.41^0 E respectively. The standard longitude for IST is 82.5^0E.	8
3.	a) Define the following terms: i) Hour angle ii) Declination angle iii) Elevation angle iv) Zenith angle v) Azimuth angle	10
	b) Derive the expression for global solar radiation incident on PV array explaining each term used.	10
4.	a) Develop the I-V characteristic of solar cell. Define I_{ph}, I_d, V_{oc} and I_{sc} relating to solar cell with neat circuit diagram.	4+4
	b) What is Fill factor and describe its significance on solar cell performance characterization.	2+4
	c) Derive the expression for PV cell temperature.	6
5.	a) Using Betz model of a wind turbine, derive the expression for power extracted from wind. What is maximum theoretical power that can be extracted and under what condition?	6+2+2
	b) Sketch the diagram of HAWT and explain the function of its main components.	10
6.	a) With the help of a diagram, explain the nature of variation of wind speed with height from the ground.	4
	b) Explain the terms: i) Angle of Attack ii) Pitch Angle iii) Drag Force iv) Lift Force v) Solidity	10
	c) A HAWT is installed at a location having free wind velocity of 15 m/s. The 80-m diameter rotor has three blades attached to the hub. Find the rotational speed of the turbine for optimal energy extraction.	6
7.	Write short notes (any *four*) a) Magnetohydrodynamic (MHD) generator b) Fuel cell power plant c) Water tube steam generator d) Gas turbine power plant e) Effects of temperature and series resistance on I-V characteristics.	4x5