 EX/PE/PC/B/T/314/2024

B.E Power Engineering 3rd Year 1st Semester Examination – 2024
Subject: Non-conventional Power Generation

Time: Three hours **Full Marks: 100**

	Each question must be answered as per given instructions	Marks
[1]	**Answer *any ten* from this module**	[20]
(a)	What are the main constraints of renewable energy?	10×2
(b)	Define: Solar constant.	
(c)	Define: solar zenith angle.	
(d)	Classify solar thermal power generation scheme.	
(e)	Define Betz's limit of wind power extraction.	
(f)	Define pitch control & furl control of wind turbine.	
(g)	Classify solar cell.	
(h)	Define: Anaerobic Digestion process.	
(i)	What is Hall current in MHD generation system?	
(j)	What are the different types of Fuel cell?	
(k)	Define Group velocity of ocean wave.	
(l)	Classify Tide according to height & lunar phases.	
(m)	What is solar collector efficiency?	
(n)	Define Continental Drift of geothermal region.	
(o)	How do the salinity gradient & density gradient influence heat trapping in solar pond?	
[2]	**Answer *any one* from this module**	[10]
(a)	Briefly explain characteristics of perturbation factor Vs. power coefficient in wind turbine system with a graphical representation.	[8+2]
(b)	Briefly explain with a neat sketch of any one solar thermal power generation scheme.	[8+2]
[3]	**Answer *any two* from this module**	[20]
(a)	Briefly explain any one type fuel cell with a neat sketch.	[8+2]
(b)	Classify Municipal Solid Waste (MSW). Briefly explain MSW management scheme with flow chart.	[2+8]
(c)	Classify energy storage methodology & briefly explain any one type.	[2+8]
[4]	***Answer any two* from this module**	[20]
a)	Derive the expression of total wave power is carried forward per unit width across wave front of water surface of natural ocean wave resource.	[10]
b)	Derive useful heat content per square Kilometer of dry rock granite & then time constant of useful heat extraction using water flow & useful heat extraction rate.	[4+3+3]
(c)	Derive theoretical power can be generated in any Tidal power plant. Draw a neat sketch showing basic components of Tidal power plant.	[8+2]
[5]	**Answer *any three* from this module**	[30]
(a)	A horizontal axis wind turbine is installed at a location having wind speed of 18 m/s. The 30 m diameter rotor has two blades attached to the hub. Find the rotational speed of turbine for optimum energy extraction.	[10]
(b)	For any solar thermal collector assume the following data: optical efficiency (γ)=0.85, incident solar radiation(q_{in})=850W/m^2, ambient temperature(T_a)=27^{0}C, heat loss co-efficient (U)=26 W/m^{2}K, collector efficiency factor(F')=1, receiver effective temperature (T)=85^{0}C, thermodynamic 1st law efficiency $\varepsilon_1=\varepsilon_2(1-T_a/T)$, & 2nd law efficiency ε_2=0.75, where receiver thermal output $Q_{out}=F'[\gamma.A_{in}.q_{in} - UA_{rec}(T-T_a)]$; $\gamma=[U.A_{rec}(T_{max}-T_a)/A_{in}.q_{in}]$; a) Find the stagnation temperature (T_{max}) & collector efficiency (ε_c) if concentration ratio ($CR=A_{in}/A_{rec}$) are 1 & 10; b) Find optimal temperature of receiver ($T=T_{opt}$) at which overall efficiency($\varepsilon=\varepsilon_c\varepsilon_1$) is maximum along with maximum efficiency(ε_{max}) for CR=10.	[10]
(c)	Calculate the following of a dry rock granite to a depth of 7 Km. Take the Geothermal temperature gradient is at 30°K/Km, minimum useful temperature is 150°K above the surface temperature T_o, rock density(ρ_r)=2700 kg/m^3, Specific heat capacity(C_r) =750 J/kg/°K. i) Useful heat content per square kilometer, ii) Time constant of heat extraction using water flow at a rate of 1.5 m^3/sec/km^2, iii) Useful heat extraction rate at initially & after 10 years. Assume water density 1000 kg/m^3& specific heat capacity 4200 J/kg/^{0}K.	[10]
(d)	Calculate the following for deep Atlantic Ocean wave having wave length 40 m & amplitude 1.5 m, water density1025kg/m^3: i) Phase velocity, ii) Group velocity, iii) Total energy per unit area of wave surface, iv) Power develops per unit width across wave front.	[10]

(e)	A school in a remote place has the following energy requirements:- 25 lamps each of 100 CP that operate for 8 hours daily, 8 computers each of 250 watt those operate for 5 hours daily by a duel fuel engine driven generator, 1 H.P water pump is driven by duel fuel engine for 2 hours daily. Calculate the volume of cow dung in a biogas plant & also calculate the required number of cows to feed the plant. (Assume biogas required for each 100C.P lamp is $0.126 m^3/hr.$, conversion efficiency for generator is 80%, thermal efficiency of engine is 20%, heating value of biogas is 25 MJ/m^3, cow dung production rate: 7kg/cow/day, cow dung having 17% solid mass content, biogas yield of $0.34 m^3/kg$ of dry mass, slurry density: $1090 kg/m^3$, 1 H.P=735.5 watts in S.I).	[10]