Master of Power Engineering 1st Year 2nd Semester– 2024
Subject: Non-conventional Power Engineering

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

	Each question must be answered as per given instruction	Marks
[1]	**Answer *any TEN* from this question**	**[10×2=20]**
(a)	Briefly state the blooming outcomes of non-renewable energy resource in global issue.	
(b)	Briefly state the limitations of Renewable Energy.	
(c)	How the sustainability is connected with Renewable energy?	
(d)	Define solar constant.	
(e)	Logically justify which solar thermal power generation scheme is the most suitable for micro-grid power generation issue.	
(f)	Briefly state the advantages of Thin film type solar cell over Crystalline silicon solar cell.	
(g)	State the maximum capacity limit of any hydro plant that is under jurisdiction of Ministry of New Renewable energy (MNRE).	
(h)	State the difference between vertical axis wind turbine & horizontal axis wind turbine?	
(i)	What is the basic source of renewable energy for creation of ocean wave?	
(j)	Briefly state the significance of temperature Gradient under earth crust for Geothermal energy use.	
(k)	State the major cause for size difference of tidal turbine & wind turbine.	
(l)	Classify the hydro power plant in different aspect.	
(m)	In your view point how the Hall effect in MHD generator is analogues with the armature reaction in any rotational electrical generator.	
(n)	Briefly state the name of basic components of Tidal power generation scheme.	
(o)	Briefly state your own view point regarding why till today maximum percentage of Renewable energy resources could not replace our existing conventional resource although we have enough availability of Renewable resource.	
[2]	**Answer *any TWO* from this question**	**[10×2=20]**
(a)	Briefly explain large scale Parabolic Trough Collector type solar thermal power generation scheme with a neat figure.	[8+2]
(b)	State the principle of operation of power generation from solar photo-voltaic cell. Draw a net sketch showing the basic components of grid connected solar photo-voltaic power generation scheme.	[8+2]
(c)	Explain the characteristics of Power Coefficient (Cp) Vs. Perturbation factor (a) in wind turbine. State the basic advantage of vertical axis wind turbine over horizontal axis wind turbine.	[8+2]
[3]	**Answer *any THREE* from this question**	**[10×3=30]**
(a)	Derive the expression of Ocean wave power can be harvested from nature.	
(b)	Derive the expression of Tidal energy can be harvested from nature.	
(c)	Derive the expression of useful Geothermal heat content per square kilometer of dry rock granite.	
(d)	Derive the expression of hydro power from the available resource.	
(e)	Derive the expression of e.m.f generation using Magneto Hydro Dynamic (MHD) generation system.	
[4]	**Answer *any THREE* from this question**	**[10×3=30]**
(a)	b) Calculate following parameters for Kolkata (Latitude(φ) 22.50^{0}N & Longitude(ψ) 88.37^{0}E) at 2:30 P.M, on 15th July, 2024, if the solar module surface is oriented (γ) 40^0 West of South & tilted(β) at 30^0 to the horizontal: i) angle of incidence (θ) of beam radiation on solar module, ii) Extraterrestrial Normal Radiation (E.N.R) (G_{on}), iii) Extraterrestrial Horizontal Radiation (E.H.R) (G_o), iv) Global Radiation (G.R) on solar module (G_T); v) Module Power generation (M.P). [Assume hour angle $\omega=(15^0h^{-1})$ (T_{solar}-12h), where T_{solar}= local solar time & declination $\delta=\delta_0 Sin[360^0(284+n)/365]$, where $\delta_0=23.45^0$ & n is the day of year & $\cos\theta$ = (A-B)sin δ+{C sin ω+(D+E)cos ω}cos δ, where A=sin φ.cos β, B=cos φ .sin β. cos γ, C=sin β. sin γ, D=cos φ.cos β, E=sin φ.sin β.cos γ ; Zenith Angle (Z.A)=θ_z where $\cos\theta_z$ = cos φ.cos ω cos γ+ sin φ.sin δ; $R_b=\cos\theta/\cos\theta_z$; Global Horizontal Radiation (G.H.R) in Kolkata (G)=4.92kWhr./m^2/day (i.e.0.205 kW/m^2) ; E.N.R (G_{on})=1.367{1+0.033cos(360^0×n/365)}in kW/m^2; E.H.R(G_o)= $G_{on}.\cos\theta_z$; Diffused Radiation(D.R) in Kolkata(G_d)= 1.558 kWhr./m^2/day (i.e. 0.0649 kW/m^2); Beam Radiation (B.R) (G_b)=(G- G_d) ; Aniotropy Index(A.I) (A_i)=G_b/G_o; Horizontal Brightening Factor (H.B.F)(f)= $\sqrt{G_b/G}$; Module Power generation(M.P)=D.F× Module Power Rating × G_T ; Global	

	Radiation (G.R) in module surface $(G_T)=(G_b+G_d.A_i).R_b+G_d(1-A_i).\{0.5+\cos(\beta/2)\}.(1+f.\sin(\beta/2)^3$ in kW/m^2; Derating factor (D.F)=0.8, Module Power Rating=35 Watt-peak]	
(b)	A Horizontal Axis Wind Turbine is installed at location having wind velocity of 14 m/s. The 80 m diameter rotor has two blades attached to the hub. Find the rotational speed of turbine for optimum energy extraction.	
(c)	A single basin type tidal power plant has a basin area of 4 Km^2. The tide has an average range of 16 m. Power is generated only during the ebb cycle. The turbine stops its operation when the head on it falls below 3 m. Calculate the average power generated by the plant in single emptying process of the basin if the turbine generator efficiency is 0.85. Estimate the average annual energy generation of the plant.	
(d)	Estimate the power available from a proposed micro-hydro plant at a site having a small stream with 200 litres/second flow rate at a head of 50m. Assume the density of fresh water is $985Kg/m^3$ & overall efficiency for the whole system is 70%. If this system is to be designed to supply a single phase, 220V, 50 Hz distribution system having a predicted demand of 7kW, 0.9 power factor lagging, calculate the corresponding load current.	