Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

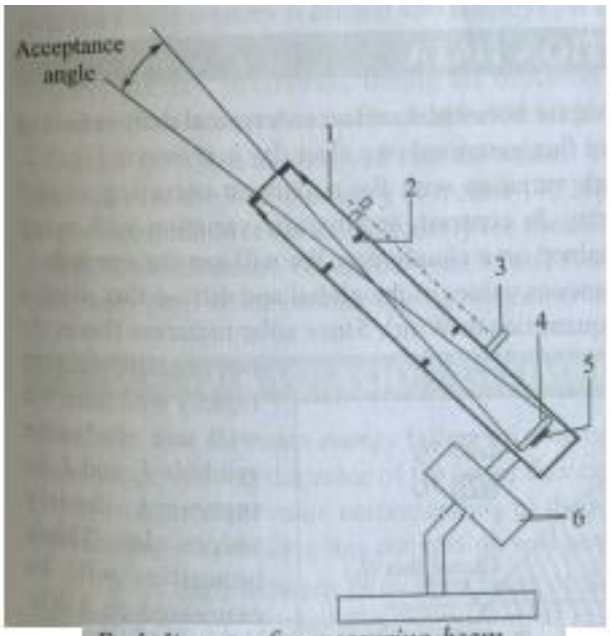
(A constituent unit of MAHE, Manipal)

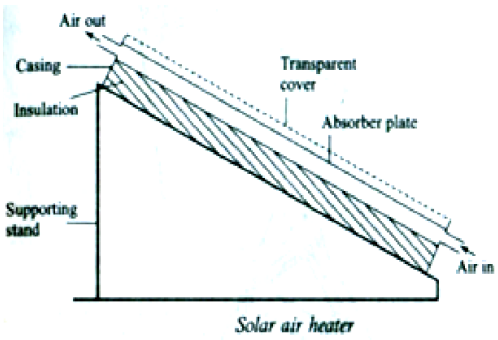
V SEMESTER B. TECH (MECHANICAL ENGINEERING) END SEMESTER EXAMINATIONS, NOVEMBER-2019

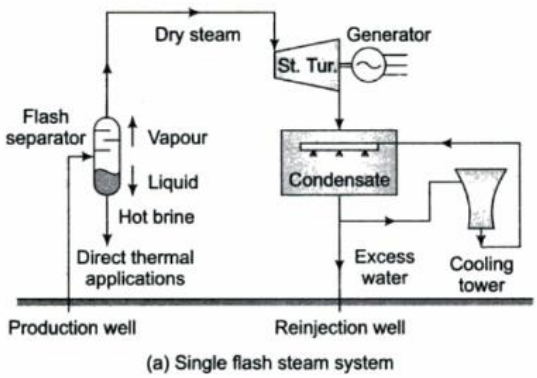
Subject: Non-Conventional Energy Sources [MME 4025]

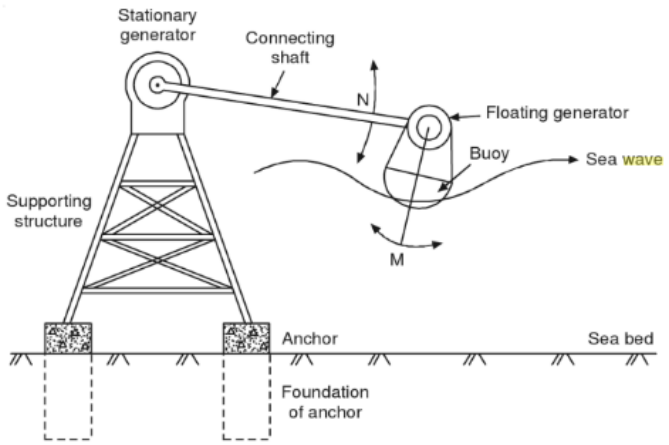
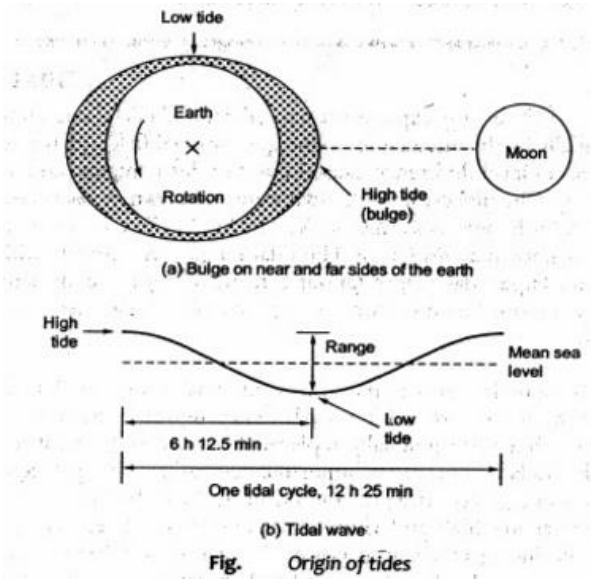
REVISED CREDIT SYSTEM

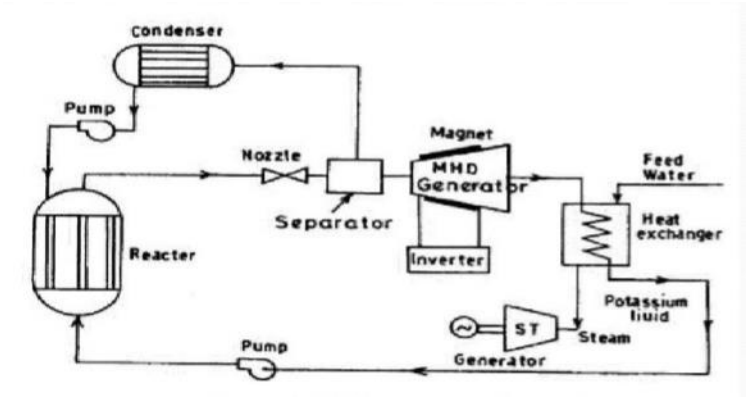
Time: 3 Hours MAX. MARKS: 50

1A.	Define w.r.t to Solar-earth geometry i) Hour angle ii) Surface azimuth angle iii) Solar radiation incident angle. **Hour angle** is defined as the **angle** of the Sun from the local MERIDAN measured along the celestial equator in the westerly direction. As the Earth rotates this **angle** increases by 15 degrees every **hour**. The **Hour Angle** ranges from 0 to 24 hours. The **surface azimuth angle** is the **angle** between south and the horizontal projection of the **surface** normal. The same sign convention is used for the **surface azimuth angle** as is used for the solar **azimuth angle**, i.e. Ψ is negative for a **surface** that faces east of south and positive for a **surface** that faces west of south. The **sun's angle** of **incidence** is the **angle** between the **solar** rays and the surface normal. (Notice that for a horizontal surface, the surface normal is the local vertical and the **incidence angle** is equal to the zenith **angle**, θH.) ... The surface tilt **angle** is the **angle** between the surface normal and vertical. **Each definition : 1 Mark**	**3**
1B.	With a neat sketch explain the working of Pyrheliometer.  *Pyrheliometer for measuring beam radiation (1. tube blackened on inside surface, 2. baffle, 3. alignment indicator, 4. black absorber plate, 5. thermopile junctions, 6. two-axis tracking mechanism)*	**3**

	Sketch: 1.5 Mark ; Explaination : 1.5 Mark	
1C.	Calculate monthly average hourly global and hourly diffuse radiation during month of December on horizontal surface at Bangalore (2.9716° N, 77.5946° E) with the given data. Time 2 : 10 PM (Standard time).(Equation of time correction 10 min) The average number of sunshine hour per day is 8.5 ; a = 0.27 b=0.43 for Monthly average daily solar radiation. Klein's recommendation for the month of December is 10. For Monthly average hourly radiation a = 0.409+0.5016 sin (Ϣs - 60) ; b = 0.6609-0.4767 sin (Ϣs - 60).	**4**
2A.	With neat sketch explain the free and forced convection solar drier.  *Solar air heater* **Sketch: 1.5 Mark ; Explaination : 1.5 Mark**	**3**
2B.	Explain the parameters which effects the performance of solar flat plate collector. Selective surfaces Absorber plate surfaces which exhibit the characteristic of a high value of absorptivity for incoming solar radiation and a low value of emissivity for outgoing re- radiation are called selective surfaces. Such surfaces are desirable because they maximize the absorption of solar energy and minimize the emission of the radiative loss. They yield higher collector efficiencies. Number of covers : It is observed that the highest efficiency is obtained with one cover if the absorber plate is selective. With the addition of more covers, the efficiency goes on decreasing. On the other hand, when the absorber surface is non-selective, the efficiency increases as the number of cover is increased from one to two. Thereafter, the efficiency goes on deceasing with the addition of more covers. Thus it is optimum to use only one cover if the absorber plate is selective and two covers if the surface is non-selective. Spacing: The proper spacing to be kept between the absorber plate and the first cover, or two covers is very important from the point of view that the heat loss from the top, the values of the convective heat transfer coefficients are minimized. The variation of convective heat transfer coefficient is a function of temperature difference, tilt and service conditions. Optimum spacing is difficult to achieve. Spacing of 4 to 8cm is suggested. Effect of shading : The main problem associated with the use of large spacings is that shading of the absorber plate by the side walls of the collector casing increases. Some shading always occurs in every collector and needs to be corrected for. The shading is particularly important in the early morning and late evening hours.	**3**

	Collector tilt: The flat plate collectors are stationary in nature. They do not track the sun. Thus the tilt given at installation is critical based on maximum insolation. The parameters are latitude of the location, application (space heating or refrigeration which depends upon season), etc. Cover transmissivity : The transmissivity of the cover affects the performance of a collector significantly. The higher the transmissivity(i.e. lower the extinction coefficient of the cover material), the better is the performance of the collector. **Any six parameters: 3 Marks**	
2C.	Data for a flat plate collector given below for location Bangalore (12.9716° N, 77.5946° E) on October 22 at 14:30-15:30 (Standard time). Pyranometer without shading ring give the reading of 800 W/m^2 and with shading ring gave 100 W/m^2. Collector inclination 25^0. Number of glass cover 2 ; FR = 0.82 ; τ = 0.88 ; $\boldsymbol{\alpha}$ = 0.98 ; U_L = 9.5 W/m^2C ; Fluid inlet temperature (T_{fi}) = 75^0 C ; Ambient temperature (Ta) =25^0 C . (1) Solar altitude angle (2) Useful heat gain (3) Total incident solar radiation energy (4) Collector efficiency.	**4**
3A.	A multi blade windmill lifts 1.03 m^3 /hour of water through a head of 28 m. Where the wind speed is 3.3 m/s. If diameter of the rotor is 4.5 m,and pump efficiency is 70% Calculate the (a) Wind power (b)Pump power required (c) Power coefficient.	**3**
3B.	With neat sketch explain the working of liquid dominated (wet steam) geothermal system.  (a) Single flash steam system **Sketch: 1.5 Mark ; Explaination : 1.5 Mark**	**3**
3C.	Mention biomass to energy conversion methods. With a neat sketch explain any one of the biomass energy	

	conversion method. Physical method, incineration (direct combustion), thermochemical method, and Biochemical method. **Incineration (Direct Combustion)** Incineration means direct combustion of biomass for immediate useful heat. The heat and/or steam produced are either used to generate electricity or provide the heat for industrial proccesses, space heating, cooking or direct heating. Furnaces and boilers have been developed for large-scale burning of various types of biomass such as wood, waste wood, black liquid from pulp industry, food industry waste, and MSW. The moisture content in the biomass and wide range of composition tends to decrease the efficiency of conversion. However, the economic advantage of cogeneration makes it attractive for adoption.	**4**
4A.	With a neat sketch explain Dolphin type wave energy converter.  **Sketch: 1.5 Mark ; Explaination : 1.5 Mark**	**3**
4B.	Explain the phenomena of tide formation.  Fig. *Origin of tides* **Sketch: 1 Mark ; Explaination : 2.0 Mark**	**3**
4C.	Differentiate between (a) Battery and fuel cell (b) Thermoelectric and Thermionic energy generation. (a) 2 Marks (Any two difference) ; (b) 2 Marks (Any two difference).	**4**

5A.	Define (a) Seeback effect (b) Thomson effect (c)Peltier effect The **Seebeck effect** is a phenomenon in which a temperature difference between two dissimilar electrical conductors or semiconductors produces a voltage difference between the two substances. **Thomson effect**, the evolution or absorption of heat when electric current passes through a circuit composed of a single material that has a temperature difference along its length. The **Peltier effect** is the phenomenon that a potential difference applied across a **thermocouple** causes a temperature difference between the junctions of the different materials in the **thermocouple**. **Each definition : 1 Mark**	**3**
5B.	With neat sketch explain the working of a closed cycle MHD generator.  **Sketch: 1.5 Mark ; Explaination : 1.5 Mark**	**3**
5C.	Discuss the advantage & disadvantages and application area of the following energy conversion methods. (a) Micro hydroelectric power generation (b) OTEC power plant (a) 2 Marks (Any two points) ; (b) 2 Marks (Any two points).	**4**