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Program: B. Sc. Eng. (ME/IPE)
Semester: 6th

Date: 12 March 2024 (Morning)
Time: 10:00 AM – 11:30 AM

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course Code: ME 4659
Course Title: Conventional and Non-conventional Energy Resources

Summer Semester: AY 2022-23
Full Marks: 75
Time: 1 Hour 30 Minutes

There are **three** questions. Answer **all** of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable design data if necessary. Programmable calculators are not allowed.

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1 (a)	Define conventional energy and non-conventional energy resources with types. Discuss about the advantages and drawbacks of both the conventional and non-conventional energy systems.	**(10)** **(CO1)** **(PO1)** **K1**
(b)	Define solar constant and extra-terrestrial radiation. Explain why extra-terrestrial radiation varies throughout the year.	**(5)** **(CO1)** **(PO1)** **K1**
(c)	Explain the construction and working principle of a device for measuring complete solar radiation on any surface.	**(10)** **(CO1)** **(PO1)** **K1**
2 (a)	Define Fuel. Distinguish between primary and secondary fuel with example.	**(7)** **(CO3)** **(PO1)** **K1**
(b)	Explain about the combustible elements that are present in fuel.	**(5)** **(CO3)** **(PO1)** **K1**
(c)	Discuss about the origin of coal. Describe in details about the various theories of coal formation.	**(13)** **(CO3)** **(PO1)** **K1**
3 (a)	Find the day's total solar radiation on a horizontal surface in the absence of atmosphere, at latitude 23° N on May 10. Also calculate the amount of solar radiation received on that surface between the hours 9 AM to 3 PM. (Deduce the equation from given list).	**(10)** **(CO4)** **(PO2)** **K4, P1, P2**
(b)	Calculate solar altitude angle, solar azimuth angle, zenith angle, profile angle and time of sunrise for a 50° sloped surface facing 25° west of south at 16:30 solar time on March 12 at a latitude of 45°. Also find the time of sunrise and sunset on the surface.	**(15)** **(CO4)** **(PO2)** **K4** **P1, P2**

Formula Sheet

$$\delta = 23.45 \sin\left(360\frac{284+n}{365}\right)$$

$$\begin{aligned}\cos\theta = {} & \sin\delta\sin\phi\cos\beta - \sin\delta\cos\phi\sin\beta\cos\gamma \\ & + \cos\delta\cos\phi\cos\beta\cos\omega + \cos\delta\sin\phi\sin\beta\cos\gamma\cos\omega \\ & + \cos\delta\sin\beta\sin\gamma\sin\omega\end{aligned}$$

$$\cos\theta_z = \cos\phi\cos\delta\cos\omega + \sin\phi\sin\delta$$

$$\gamma_S = \text{sign}(\omega)\left|\cos^{-1}\left(\frac{\cos\theta_z\sin\phi - \sin\delta}{\sin\theta_z\cos\phi}\right)\right|$$

$$\cos\omega_s = -\frac{\sin\phi\sin\delta}{\cos\phi\cos\delta} = -\tan\phi\tan\delta$$

$$\tan\alpha_p = \frac{\tan\alpha_s}{\cos(\gamma_s - \gamma)}$$

$$\begin{aligned}H_o = {} & \frac{24\times 3600 G_{sc}}{\pi}\left(1 + 0.033\cos\frac{360n}{365}\right) \\ & \times\left(\cos\phi\cos\delta\sin\omega_s + \frac{\pi\omega_s}{180}\sin\phi\sin\delta\right)\end{aligned}$$

For $\omega_s \le 81.4^\circ$

$$\frac{H_d}{H} = \begin{cases} 1.0 - 0.2727K_T + 2.4495K_T^2 - 11.9514K_T^3 + 9.3879K_T^4 & \text{for } K_T < 0.715 \\ 0.143 & \text{for } K_T \ge 0.715 \end{cases}$$

and for $\omega_s > 81.4^\circ$

$$\frac{H_d}{H} = \begin{cases} 1.0 + 0.2832K_T - 2.5557K_T^2 + 0.8448K_T^3 & \text{for } K_T < 0.722 \\ 0.175 & \text{for } K_T \ge 0.722 \end{cases}$$