

UCL Mechanical Engineering 2021/2022

MECH0024 Thermodynamics Coursework

RFLH9

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1 Question 1

1.1 Solar power available

Solar declination:

$$\theta_d = -12^\circ \quad (1.1)$$

Polar angle at latitude 51.5° :

$$\theta = 90 - 51.5 = 38.5^\circ \quad (1.2)$$

Hour angle at 11am:

$$\phi = \frac{11 \cdot 360}{24} - 90 = 75^\circ \quad (1.3)$$

Solar azimuth angle:

$$\cos \psi = \cos \theta_d \sin \theta \sin \phi + \sin \theta_d \cos \theta \quad (1.4)$$

$$\psi = \arccos [\cos (-12) \sin (38.5) \sin (75) + \sin (-12) \cos (38.5)] \quad (1.5)$$

$$\psi = 64.82^\circ \quad (1.6)$$

Air mass ratio:

$$M = \frac{L}{h} = \sec \psi \quad (1.7)$$

$$M = 2.35 \quad (1.8)$$

1.2 Viability of proposed provision

2 Question 2

2.1 a

2.1.1 Irreversibility associated with increase in steady flow exergy of steam

2.1.2 Maximum theoretical work available

2.2 Relative advantages and disadvantages of four primary energy sources utilised in thermal power generation

3 Question 3

3.1 a

3.1.1 Mass of methane present

3.1.2 Approximate level of CO in exhaust gases

3.2 Effects of fuel molecular composition on ignition, temperatures and formation of exhaust pollutants during combustion

4 Question 4

4.1 a

4.1.1 Ideal operating voltage

4.1.2 Anode area

4.1.3 Heat loss

4.2 Limitations of hydrogen oxygen fuel cell vehicles