(29)

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

Date: 28 May 2024 (Morning)
Time: 10:00 AM – 1:00 PM

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

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

Summer Semester: AY 2022-23
Full Marks: 150
Time: 3 Hours

There are **six** 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) Distinguish between the Conventional and Non-conventional Energy systems. Explain why Non-conventional or Renewable Energy is regarded as a clean energy source? Describe the key factors which is driving the world to shift towards Renewable based power generation. (5) CO1 PO1

   (b) Discuss different types of hydro turbines used for hydropower extraction. Prove that the efficiency of an impulse turbine in ideal case is 100%. (10) CO1 PO1

   (c) What is gaseous fuel? Discuss the various features of the most useful gaseous fuels with their sources, composition and uses. (10) CO1 PO1

2. (a) Describe the basic methods for solar energy conversion with illustration. Discuss different types of solar cells with their applications. (10) CO2 PO1

   (b) Explain the working principle of Evacuated Tube Collector (ETC) and Linear Fresnel Reflector (LFR) with illustration. (10) CO2 PO1

3. (a) Briefly discuss how wind energy can be extracted? What is Betz criterion? Derive an expression to show that the maximum power coefficient of a wind turbine is 0.59 (16/27). State all assumptions. (15) CO4 PO2

   (b) A wind turbine maintains a tip-speed ratio of 6 at all wind speeds. (10) CO4 PO2 P1

   (i) At which wind speed will the blade tip exceed the speed of sound?
   (ii) If the blade diameter is given 120 m. At what rotor speed (frequency) will the tip-speed exceed the speed of sound?

4. (a) What is petroleum exploration? Explain different procedures and methods of petroleum exploration. (10) CO3 PO1

   (b) Define petroleum drilling operation with brief explanation on characteristics and classification of drill holes. (10) CO3 PO1

   (c) Briefly explain the advantages of mechanical drilling and describe the Rotary Drilling operations with different systems. (10) CO3 PO1

5. (a) Derive an expression to calculate the potential heat output from Hot Dry Rock. State all assumptions and show illustration. (10) CO4 PO2

(b) i) Calculate the useful heat content per square kilometre of dry rock granite to a depth of 8 km. The geothermal temperature gradient G is constant at 40°C/km. The minimum useful temperature for power generation is 140 K more than the surface temperature T_0. The rock density is 2500 kg/m^3, specific heat capacity 800 J/kg-K (15) CO4 PO2 P1, P2

ii) Calculate the time constant for useful heat extraction using a water flow rate 0.8 m^3/s-km^2.

iii) What is the useful heat extraction rate initially and after 12 years?

6. (a) Define refractories. Describe different types of refractories and their usage. (10) CO1 PO1

(b) Write short notes on: (5x3=15) CO1 PO1

(i) Reservoir Fluids
(ii) Insulators
(iii) Pumped Hydro Storage System

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