Program: B. Sc. in ME
Semester: 1st

Date: 8 December, 2023
Time: 01:30 pm – 04:30 pm
(Group B - Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination
Course Number: ME 4101
Course Title: Introduction to Mechanical Engineering

Winter Semester: 2022 - 2023
Full Marks: 150
Time: 03 Hours

There are 06 (Six) Questions. Answer all of them.

Marks in the Margin indicate full marks. Don't write on this question paper. Symbols carry their usual meanings. **Assume reasonable values for any missing data**. Programmable calculators are not allowed.

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1. **(a)** Explain the technologies used in solar water heating systems and solar thermal conversion systems, and provide relevant schematic diagrams? **[10+15]**

(b) Discuss the classification of biofuel energy, providing relevant examples for each category. Additionally, explain the working principle of a biogas plant, complemented by a detailed schematic diagram. **(CO1) (PO1)**

2. **(a)** State Euler's turbomachinery equation of Torque and define each term. **[17+8]**

Suppose a turbomachinery rotates at $\omega = 100$ **rad/s** and radius at point 1 and 2 is $r_1 = 0.05$**m** and $r_2 = 0.15$**m**. Now, if at the inlet absolute velocity of the flow is $V_1 = 10$ **m/s** with an angle of **60°**. And at the outlet, the flow exits with a relative angle of **60°** as shown in the Fig. 1. Absolute velocity of the exit flow, $V_2 = 13$ **m/s**. Characterize the following turbomachine (**pump or turbine**) and discuss the reason behind it? **(CO2) (PO2)**

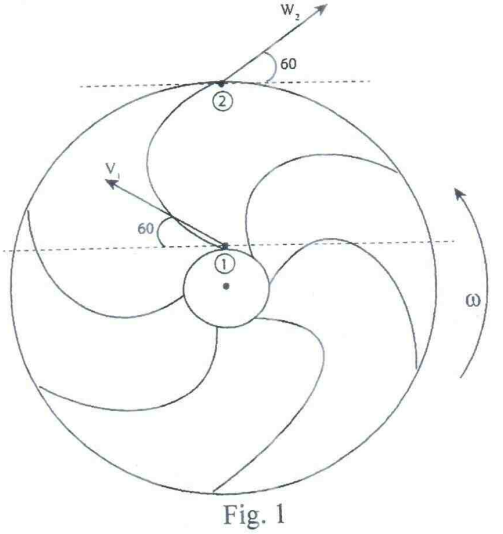


Fig. 1

(b) Write a short description on gear pump and explain why priming is required in centrifugal pumps.

3. **(a)** Draw schematics of different kinematic pairs **according to the type of relative motion between the elements**. Also, state the degrees of freedom (DOF) for each classification. **[7+8+10]** (CO1) (PO1)

(b) Define and explain the term- "Psychrometry" with its significance and discuss the properties which ensure human comfort.

(c) Explain the working principle of Vapor Absorption Refrigeration system, including its schematic diagram. Also state its advantages and disadvantages over Vapor Compression Refrigeration (VCR) system.

4. **(a)** Discuss the accessories that reuse flue gas to enhance a boiler's efficiency. Include T-S diagrams to illustrate their functions. **[8+7+10]** (CO1) (PO1)

(b) Draw schematic diagram of a water tube boiler, labeling its various components.

(c) Discuss the classification of non-flow thermodynamic processes, and illustrate them with Pressure-Volume (P-V) diagrams

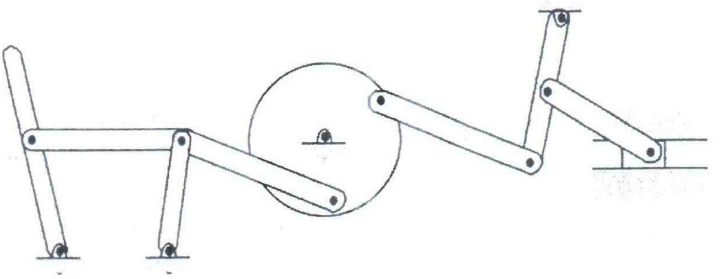
5. **(a)** Explain the difference between impulse and reaction turbines using the appropriate illustration. **[10+15]** (CO2) (PO2)

(b) Air flows through a chamber. The following data are applicable at the inlet and outlet.

State 1	Relative Humidity, $RH_1 = 40\%$	Dry Bulb Temperature, $DBT_1 = 40^0C$
State 2	Relative Humidity, $RH_2 = 20\%$	Wet Bulb Temperature, $WBT_2 = 15^0C$

i. Find the Wet Bulb temperature, and dew point temperature of state 1.
ii. Find the Dry Bulb temperature, and dew point temperature of state 2.
iii. Find the difference between specific humidity and enthalpy between state 1 and state 2.

6. **(a)** Identify the number of links, full joint and half joint in the following mechanism. Determine the Degree of freedom of the mechanism using Gruebler's equation and draw associated diagram. **[10+15]** (CO2) (PO2)

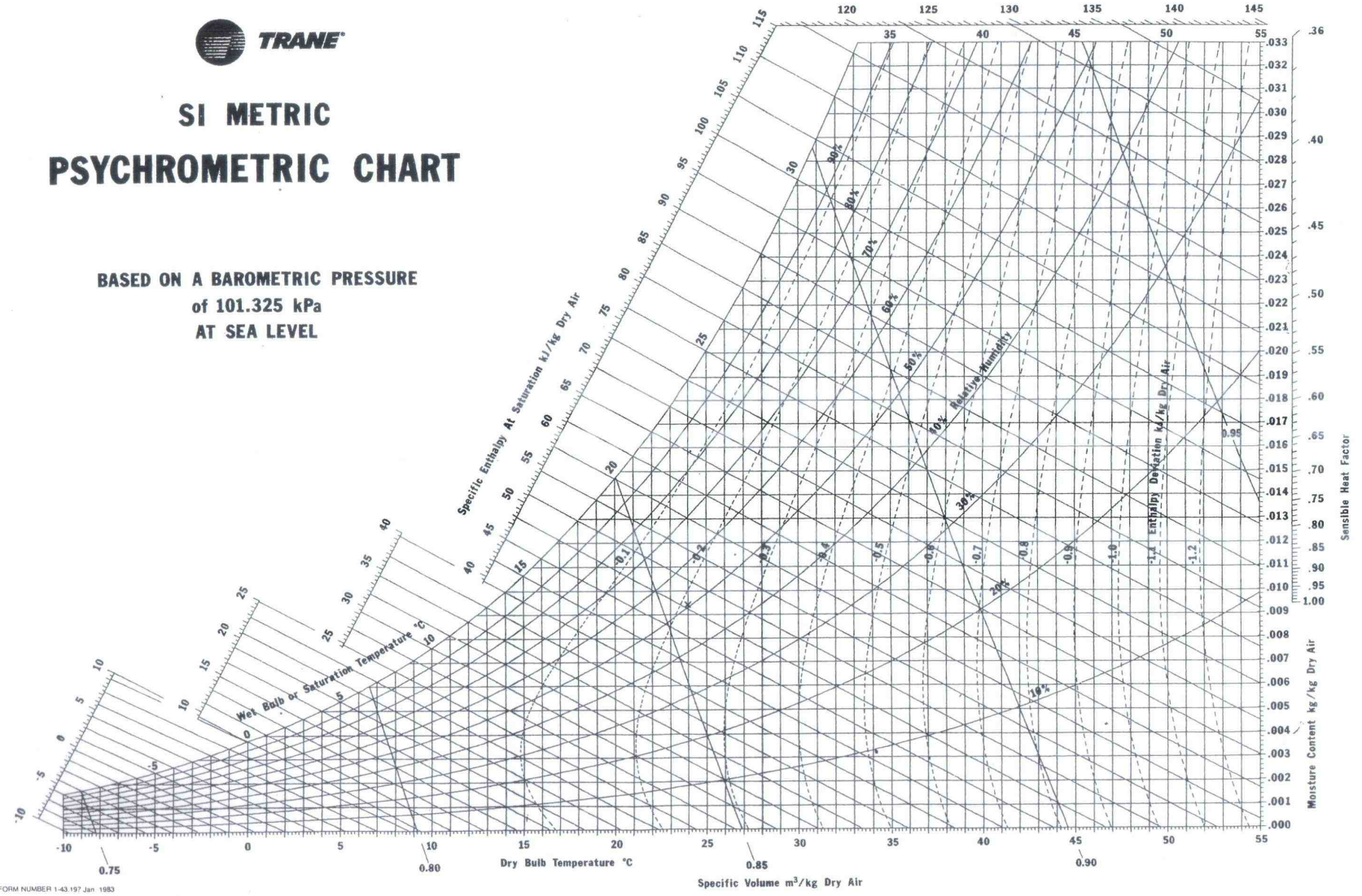


(b) Describe a four-stroke gasoline engine with an illustration of each stroke and a schematic of the valve timing diagram.
Also discuss the primary differences between gasoline and diesel engines.

TRANE

SI METRIC
PSYCHROMETRIC CHART

BASED ON A BAROMETRIC PRESSURE
of 101.325 kPa
AT SEA LEVEL



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