الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا
كلية عمان البحرية الدولية
International Maritime College Oman

ACADEMIC YEAR 2023 – 2024

Program	Year	Semester	Paper
MEO	3	1	Midterm

MODULE NAME:	**THERMODYNAMICS 1**

MODULE CODE:	**MTHERMO I**	**EXAM DATE:**	**08/11/2023**
TEACHER'S NAME:	**Nauryzbek Bekpembetov**	**DURATION:**	**120 Min**

Questions to be answered on:	Allowed requirements	Number of pages
Space provided on the question paper	Pen, Pencil & Calculator	(Incl. Cover Page): 9

Points of Attention:

- For each question, the maximum earned points are mentioned between brackets at the end of each question.
- Write very clearly! Answers that are not readable are not marked and do not get points!
- Make sure your answers are written to the point.
- All answers should be written **in English**.
- Write all the answers **in BLUE or BLACK pen only (NO PENCIL)**.
- Answer written in **PENCIL** will not be marked.
- Use the **pencil** only for **diagrams & graphs & drawings**.
- Show all the calculation steps in the given space.
- When finished submit the question paper, together with the answer scripts and the signed cover page to the invigilator.
- Any cheating/copying may result in an instant failing of the examination.

STUDENT NAME:	
STUDENT ID:	

FINAL MARKS

	30
	10

Number of answer scripts: …… **Invigilator:** …….....

Student's signature: …… **Time of receipt:** …….....

ANSWER ALL QUESTIONS

Question 1: **[4 Marks]**

Choose the correct answer:

The specific heat capacity is (1 M):

a) A measure of capacity for carrying out work;
b) The quantity of heat required to raise the temperature of the unit mass of the substance by 1 degree;
c) The quantity of heat required to evaporate or melt 1 kg of substance.
d) The heat required to raise the temperature of the unit mass until the evaporating point.

The Efficiency is (1 M):

a) A ratio of the work output from a machine relative to the work put in it;
b) A ratio of the input power to the output power;
c) The ratio of gravity force to the friction force;
d) The ratio of power to the work done.

What is meant by absolute pressure (1 M):

a) Atmospheric pressure at 0ºC;
b) Atmospheric pressure + gauge pressure;
c) Pressure on the bottom;
d) Atmospheric pressure – gauge pressure.

What is the unit of specific volume (1 M):

a) m^3
b) m^3/kg
c) kg/m^3
d) $m^3/kg*K$;

Question: 2 **[6 Marks]**

Give the definitions of the below terms:

a) Thermodynamics (2M)
b) Energy (2M)
c) Heat (2M)

Question 3: **[2 Marks]**

Determine the water equivalent of 2.64 kg of steel. Take the specific heat of steel 0.420 kJ/kgK and water 4.18 kJ/kgK.

Question 4: **[4 Marks]**

The crankshaft of a diesel engine transfers 100 kN of force to the piston to compress the air. The work done by the piston is 25 kJ in one stroke. The piston bore diameter is 180 mm.

a- Find the stroke length; (2 M)

b- Calculate the developed pressure above the piston (2 M)

Question 5: **[3 Marks]**

A furnace with an inside temperature of 2250 K has a circular viewing glass of 6 cm diameter. If the transmissivity of the glass is 0.08, make calculations for the heat loss from the glass window due to radiation.

Question 6: **[6 Marks]**

One insulated wall of a cold-storage compartment is 4 m long by 2.3 m high and consists of an outer plate 16 mm thick and an inner wood wall 20 mm thick. The steel and wood are 80 mm apart to form a cavity that is filled with cork. If the temperature drop across the extreme faces of the composite wall is 25 K,

a) Calculate the heat transfer per 2 hours through the wall. (4M)
b) Find the temperature drop across the thickness of the cork. (2M)

Take the thermal conductivity for steel 45 W/mK, cork 0.045 W/mK and wood 0.18 W/mK.

Question 7: **[5 Marks]**

Calculate the heat required to be given to $\mathbf{8}\ \boldsymbol{kg}$ of ice at $\mathbf{-15}$℃ to change it into steam at atmospheric pressure. Specific heat of ice is 2.04 kJ/kgK, latent heat of fusion is 335 kJ/kg and latent heat of evaporation is 2256.7 kJ/kg, specific heat of water 4.2 kJ/kgK.

Formula Sheet Themodynamics 1

$F = ma$	$Work\ done\ = Force \times Distance\ moved$
$Power = \frac{Work\ done}{Time}$	$\eta = \frac{Output\ power}{Input\ power}$
$Pressure = \frac{Force}{Area} = pascal$	$Friction\ force = \mu \times force$
$Volume\ flow = Area \times Velocity$	
$Mass\ flow = Volume\ flow \times Density$	
$Q = m \times c \times (T_2 - T_1)$	
Conduction: $Q = \frac{KAt\Delta T}{S}$	
Composite wall: $\Delta T = \frac{Q_1 S_1}{K_1 A_1 t_1} + \frac{Q_2 . S_2}{K_2 A_2 t_2} + \frac{Q_3 S_3}{K_3 A_3 t_3}$	Cylindrical wall: $Q = \frac{2\pi KLt(T_1 - T_2)}{Ln\left(\frac{r_2}{r_1}\right)}$
Radiation: $Q = 5.67 \times 10^{-11} \times \varepsilon At(T_1^4 - T_2^4)$	Combination Modes: $T_D = \frac{Q}{At}\left\{\frac{1}{h_A} + \frac{S_p}{K_P} + \frac{1}{h_B}\right\}$
Heat exchangers: $Q = UAt\theta_m\ [j]$	$\theta_m = \frac{\theta_1 - \theta_2}{\ln\left(\frac{\theta_1}{\theta_2}\right)}$

MLO & Bloom`s Level of Complexity

Q#	MLO Adressed	Complexity Level	Mark	Remark
1	1	Remembering	4	
2	2	Application	6	
3	3	Analysing	2	
4	3&4	Analysing/ Evaluating	4	
5	3&4	Analysing/ Evaluating	3	
6	4	Evaluating	6	
7	4	Evaluating	5	