

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

**B.TECH. DEGREE II SEMESTER EXAMINATION IN MARINE ENGINEERING
JUNE 2020**

19-208-0202 APPLIED THERMODYNAMICS
(2019 Scheme)

Time: 2hrs 30 Minutes [30 Minutes for Answering and Scanning/Uploading the page of the Answer Sheet per module]

Max. Marks: 70 (10 per module)

INSTRUCTIONS

1. You have to be available in Google Meet on demand by the faculty.
2. You have to share your '**live location**' to the faculty before uploading the answer sheet.
3. You have to answer only one question per module.
4. Answer may not exceed one page of an A4 size paper in a standard handwriting, as far as possible.
5. If at all an answer goes beyond one page, (due to your handwriting) another page can also be used. In such a situation, the page number should be given as 1/2, 2/2.
6. You have to put dated signature along with Register Number, Subject Code, Module/Group Number (as given in the Question Paper) in each page.
7. You have to put the Question Number correctly.
8. After answering the question, you have to scan and upload the answer page.

MODULE - I

(Answer **ANY ONE** question)

- I(1). (a) State and explain first and second law of thermodynamics. What are the limitations of first law? How it was overcome in second law? (5)
- (b) Determine whether the following cases represents the reversible, irreversible or impossible heat engine (5)
- (i) 900 KW heat rejected
 - (ii) 560 KW heat rejected
 - (iii) 108 KW heat rejected

In each case engine is supplied with 1120 KJ/S of heat. The source and sink temperature are maintained at 560 K and 280 K respectively.

OR

- I(2). (a) What are the entropy changes in various thermodynamic processes? (5)
- (b) A Carnot heat engine cycle works at maximum and minimum temperature of 1000°C and 40°C respectively. Calculate the thermal efficiency and work done if heat supplied is equal to 1010 KJ/s. (5)

MODULE - II

(Answer **ANY ONE** question)

- II(1). (a) Differentiate between fire tube and water tube boilers. (5)
(b) Draw neat sketch of a La Monte boiler and explain its working. (5)

OR

- II(2). (a) Explain with sketch binary vapour cycle. (5)
(b) Steam at 10 Mpa and degree of superheat of 89°C is supplied to a Rankine cycle. (5)
The condenser pressure is 10 Kpa. For mass flow rate of 1 kg/s, determine the
power output and efficiency. Given $t_s = 311^\circ\text{C}$, Enthalpy at turbine inlet 3100
KJ/kg and outlet 1967 KJ/kg, $h_f = 191\text{KJ/kg}$; $v_f = 0.001010\text{ m}^3/\text{kg}$.

MODULE - III

(Answer **ANY ONE** question)

- III(1). (a) What is a steam nozzle and its uses? Explain different types of steam nozzles. (5)
What is critical pressure ratio and its significance?
(b) What is supersaturated steam flow? Explain it with HS diagram. (5)

OR

- III(2). (a) Explain the compounding of impulse turbine with sketches. (5)
(b) The following data refers to a single stage impulse turbine: (5)

Steam velocity = 800 m/s

Blade speed = 300 m/s

nozzle angle = 20°

blade outlet angle = 25°

Neglecting effect of friction, calculate the power developed by the turbine for steam flow rate of 25 kg/s. Also calculate the axial thrust on bearings.

MODULE - IV(Answer *ANY ONE* question)

- IV(1). (a) Differentiate between four stroke and two stroke engines. (5)
- (b) In an air standard Otto cycle the pressure at the beginning and end of compression are 1 bar and 15 bar respectively. The maximum pressure is 30 bar. Determine the compression ratio and thermal efficiency. (5)

OR

- IV(2). (a) Explain the following: (5)
- (i) Indicated power
 - (ii) Brake power
 - (iii) Friction power
 - (iv) Mechanical efficiency
 - (v) Thermal efficiency
- (b) In a Morse test with a four cylinder, four stroke petrol engine the following results were obtained. Estimate the mechanical efficiency of the engine. (5)
- | | |
|--|-------------|
| Brake Power with all cylinders working | = 14.7 KW |
| Brake Power with No.1 cut off | = 10.14 KW |
| Brake Power with No.2 cut off | = 10.3 KW |
| Brake Power with No.3 cut off | = 10.36 KW |
| Brake Power with No.4 cut off | = 10.21 KW |
| Petrol consumption | = 5.5 kg/hr |
| CV of petrol | = 44 MJ/kg |
| Diameter of cylinder | = 8 cm |
| stroke of piston | = 10 cm |
| Clearance volume | = 0.1 litre |

MODULE - V(Answer *ANY ONE* question)

- V(1). (a) Explain Gibbs- Dalton's law for gas mixtures. (5)
- (b) Determine the apparent molecular weight of dry air, which is a gas mixture consisting of nitrogen, oxygen, and small amounts of Argon. Composition of air is given below: (5)
- Nitrogen 78%
 - Oxygen 21%
 - Argon 1%
 - Molecular weight of Argon = 40

OR

- V(2). (a) Define and explain Psychometric chart, Specific humidity, Relative humidity, dew point. (5)
- (b) A certain gas has $C_p = 1.968$ and $C_v = 1.507$ kJ/kgK, find its molecular weight and gas constant. A constant volume chamber of 0.3 m^3 capacity contains 2 kg of this gas at 5°C . Heat is transferred to the gas until the temperature is 100°C . Find the work done, the heat transferred, and change in enthalpy, entropy and internal energy. (5)
