JHARKHAND Rai University
RANCHI

PRACTICE SET

End Semester Examination, Spring- 2026

Program: B. Tech (Mining)
Semester: IV
Subject: Thermodynamics & Fluid Mechanics
Subject Code: 8ESC202

Course Outcomes	Description
CO1	Understand the basic thermodynamics systems & concept of temperature and heat.
CO2	To identify and formulate power production based on the fundamental laws of thermal engineering.
CO3	Understand the various cycles and its implications in real practical applications.
CO4	Understand the basic fluid properties & their types.
CO5	Understand the concept of fluid flow & losses that happen due to their flow in small cross-sections like pipe.

UNIT-I

Section II (Each carries 10 marks)

1. Define thermodynamics. What is system, surrounding and boundary? CO 1 (Remember)
2. Explain the following terms: Isolated System, closed system & Open System CO 1 (Understand)
3. Illustrate Work and Heat in thermodynamics. What is Specific heat? CO 1 (Remember)
4. Explain quasi-static process with diagram? CO 1 (Understand)
5. Explain briefly zeroth law of thermodynamics. What is reversible and irreversible process? CO 1 (Understand)

Section III (Each carries 20 marks)

6. *(i)* Explain the adiabatic process. Derive the equation of work done in a closed system for an adiabatic process. CO1 (Evaluate)
   (ii) A fluid at a pressure of 3 bar and with specific volume of 0.18 m^3/kg is contained in a cylinder behind a piston. The fluid expands reversibly to a pressure of 0.6 bar according to the law $p = \frac{C}{v^2}$, Where C is a constant. Calculate the work done by the fluid on the piston. CO 1 (Apply)

7. One kg of air is expanded slowly in a piston-cylinder arrangement from 6 bar and 0.015 m^3 to a final volume of 0.1 $m^{3.}$ During the process, heat is exchanged with the surroundings at a rate sufficient to make the process isothermal. Make calculations for final pressure, work done, change in internal energy and heat interaction. CO1 (Apply)

UNIT II

Section II (Each carries 10 marks)

8. State and explain the first law of thermodynamics. Write the sign convention of heat transfer.CO 2 (Understand)
9. Define Enthalpy. What is perpetual motion machine of first kind (PMM 1)? CO 2 (Remember)
10. State the assumptions of Steady Flow Energy Equation. Write the general energy equation for a steady flow system.CO 2 (Understand)

Section III (Each carries 20 marks)

11. 2 kg of an ideal gas is compressed adiabatically from pressure 100 kPa and temperature 220 K to a final pressure of 400 kPa. Make calculations for: (a) initial volume, (b) final volume and temperature (c) work performed, (d) heat added to or subtracted from the system and (e) change in internal energy. It may be presumed that for the given ideal gas Cp = 1kJ/Kg K and Cv = 0.707k J/Kg K. (Apply)
12. A steam turbine operates under steady flow conditions receiving steam at the following state: pressure 15 bar; internal energy 2700 kJ/Kg; specific volume 0.17 m^3/kg and velocity 100 m/s. The exhaust steam from the turbine is at 0.1 bar with internal energy 2175 kJ/Kg, specific volume 15 m^3/kg and velocity 300 m/s. The intake is 3 m above the exhaust. The turbine develops 35 kW and heat loss over the surface of turbine is 20 kJ/Kg. Determine the steam flow rate through the turbine. CO2 (Apply)

UNIT III

Section II (Each carries 10 marks)

13. Illustrate PMM 2? Why is it impossible? CO 3 (Understand)
14. Explain Kelvin-Planck & Clausius Statement. CO 3 (Remember)
15. It is proposed to design a refrigeration plant for a food store which is to be maintained at -5°C. The ambient temperature is 25°C and the estimated heat transfer from the store is at the rate of 5 kW. If the system operates on reversed Carnot heat engine cycle, determine the minimum power required to operate the refrigeration plant. CO 3 (Evaluate)
16. A reversible heat engine delivers 0.6 kW power and rejects heat energy to a reservoir at 300 K at the rate of 24 kJ/min. Make calculations for the engine efficiency and the temperature of the thermal reservoir supplying heat to the engine. CO 3 (Evaluate)
17. State and Explain Carnot cycle with schematic diagram. CO 3 (Understand)
18. Compare between heat engine & refrigerator with neat schematic diagram. Three Carnot heat engines are arranged in series. The first engine takes 4000 kJ of heat from a source at 2000 K and delivers 1800 kJ of work. The second and third engines deliver 1200 kJ and 500 kJ of work respectively. Make calculations for the exhaust temperature of the second and third Carnot engine. CO 3 (Apply)

Section C (Each carries 20 marks)

19. (i) Contrast on Heat engine and Heat pump with diagram. CO 3 (Analyze)
    (ii) Two reversible heat engines A and B are arranged in series. Engine A rejects heat directly to engine B. A receives 200 kJ at a temperature of 421°C from the hot source while engine B is in communication with a cold sink at a temperature of 5°C. If the work output of A is twice that of B, find
    (a) Intermediate temperature between A and B,
    (b) Efficiency of each engine, and
    (c) Heat rejected to the sink. CO 3 (Apply)
20. Two reversible engines E1 and E2 are kept in series between a hot reservoir at temperature T1 of 600K and a cold reservoir at a temperature T2 at 300K. Engine E1 receives 500kJ of heat from the reservoir at T1. Presuming both the engines have equal thermal efficiency, determine: -
    (a) The temperature at which heat is rejected by engine E1 and is received by engine E2.
    (b) The thermal efficiency of the engine.
    (c) The work done by engine E1 and E2 and
    (d) The heat rejected by the engine to cold reservoir. CO3 (Apply)

UNIT IV

Section II (Each carries 10 marks)

21. Define fluid. What are the different types of fluid? CO4 (Remember)
22. Explain mass density, weight density, specific gravity, viscosity, kinematic viscosity and surface tension. CO4 (Understand)
23. Calculate the specific weight, specific mass, specific volume and specific gravity of a liquid having a volume of 6 m^3 and weight of 6 kN. CO4 (Apply)

UNIT V

Section II (Each carries 10 marks)

What are different types of fluid flow. CO 5 (Remember)

24. Explain Bernoulli's theorem and write the assumptions of Bernoulli's equation.CO 5 (Understand)
25. Illustrate Coefficient of discharge. CO 5 (Remember)
26. Derive the equation of calculating discharge by using Venturimeter.CO 5 (Evaluate)
27. Explain the use of Orifice meter and Pitot tube with diagram. CO 5 (Understand)
28. Articulate the laws of fluid friction for laminar and turbulent flow. CO 5 (Understand)

Section C (Each carries 20 marks)

29. Determine the minimum size of glass tubing that can be used to measure water level, if the capillary rise in the tube is not to exceed 0.3 mm. Take surface tension of water in contact with air as 0.0735 N/m. CO 5(Evaluate)
30.
    (a) An oil of specific gravity 0.8 is flowing through venturimeter having inlet diameter of 20cm & throat diameter 10cm. The mercury differential manometer shows a reading of 25cm. Calculate discharge of oil through horizontal venturimeter. Take Cd = 0.98. CO 5 (Apply)
    (b) Calculate the velocity of flow in a pipe of diameter 300 mm at a point where the stagnation pressure head is 5m and the static pressure head is 4m. Given the coefficient of the pitot tube is 0.97. CO 5 (Evaluate)

Summary Sheet:

CO Wise

CO	Q. No	Marks
CO1	1,2,3,4,5,6,7	90
CO2	8,9,10,11,12	70
CO3	13,14,15,16,17,18,19,20	100
CO4	21,22,23	30
CO5	24,25,26,27,28,29,30,31	100
Total		**390**

Unit Wise

Unit	Q. No	Marks
Unit 1	1,2,3,4,5,6,7	90
Unit 2	8,9,10,11,12	70
Unit 3	13,14,15,16,17,18,19,20	100
Unit 4	21,22,23	30
Unit 5	24,25,26,27,28,29,30,31	100
Total		**390**

Blooms Taxonomy Level (BTL) Wise

BTL	Q. No	Marks
LOT	1,2,3,4,5,8,9,10,13,14,15,16,17,18,21,22,23,24,25,26,27,28,29	230
HOT	6,7,11,12,19,20,30,31	160
Total		**390**

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Disclaimer: - This is a Practice set The Question in End term examination may differ from the Practice set. This Practice set is meant for practice only.