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Daffodil International University

Department of Electrical and Electronic Engineering
Faculty of Engineering
Final Examination, Spring-2025

Course Code: 0715-121 | Course Title: Basic Mechanical Engineering
Section: A, B, C, D, E, F | Level-Term: L1-T2 | Teacher's Initial: SS
Full Marks: 40 | Exam Date: June 18, 2025 | Time: 2 Hours

[Notes: All of the questions are Compulsory]

Q1. (a) **Discuss** the comparative advantages and disadvantages of Split-type and Window-type air conditioners. CO-3 (C1) [3]

(b) On a certain day, the dry and wet bulb temperatures are measured 33 °C and 27 °C respectively. **Determine** using the Psychrometric Chart: CO-3 (C2) [5]

(i) The absolute humidity
(ii) The relative humidity, and
(iii) The dew point temperature of air.

Q2. (a) **Define:** CO-1 (C1) [2]

i) Clearance Volume
ii) Valve Overlap

(b) **Draw** (i) the Actual Indicator Diagram and (i) the Valve Timing Diagram of a 4-stroke CI Engine with proper identifications. **Show** the valve overlap position on the Valve Timing Diagram. CO-1 (C2) [6]
With the help of the diagrams, **Illustrate** the working principle of a 4-stroke CI Engine.

Q3. (a) We know that theoretically the efficiency of IC engines increases when the compression ratio is increased, why don't we increase this ratio too much? **Explain.** CO-1 (C2) [4]

(b) A four-cylinder two-stroke engine with a compression ratio r = 8 produces a torque of 1000 Nm at a speed of 1200 rpm. It has a square cylinder with a bore of 160 mm. CO-1 (C2) [4]
Determine:
i. The displacement volume and the clearance volume of one cylinder.
ii. The engine brake work, and mean piston speed.

Q4. (a) **Describe** the factors that affect knocking in SI engines. CO-1 (C1) [2]

(b) In a Diesel cycle, Compression begins at 0.18 MPa, 35° C. The heat added is 1.75 MJ/kg and the compression ratio is 17. **Determine:** CO-1 (C2) [6]
(i) the maximum temperature in the cycle,
(ii) work done per kg of air
(iii) the cycle efficiency
(iii) the temperature at the end of the isentropic expansion

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(iv) the cut-off ratio, and

(v) the MEP of the cycle.

(C_p and C_v of air are 1.005 and 0.718 kJ/kg.K, respectively, and Gas Constant of Air, R = 287 J/kg. K)

Q5. (a) **Describe** the working principle of the Vapor Compression Refrigeration Cycle with proper diagram. CO-3 (C1) [3]

(b) A simple vapor compression refrigeration cycle uses refrigerant-134a as the working fluid and operates between 0.16 and 1 MPa. If the mass flow rate of the refrigerant is 0.07 kg/s, **Determine**: CO-3 (C2) [5]

i. the rate of heat removal from the refrigerated space and the power input to the compressor,
ii. the rate of heat rejection to the environment, and
iii. the COP of the refrigerator.