

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

**Course Code: ME467**  
**Course Name: Cryogenic Engineering**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer any three full questions, each carries 10 marks.*

Marks

- |   |                                                                                                                                                                                                                                                               |      |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1 | a) List four major historical developments in cryogenics since 1877.                                                                                                                                                                                          | (2)  |
|   | b) Determine the thermal conductivity of air at 250 K and 101.3 kPa if the mean free path of air at this condition is 49 nm, the gas constant for air is 287 J/kg K, the specific heat ratio is 1.4 and the specific heat at constant volume is 716.5 J/kg K. | (5)  |
|   | c) Discuss any three applications of cryogenics in space technology.                                                                                                                                                                                          | (3)  |
| 2 | a) Explain i) Meissner effect    ii) Fountain effect                                                                                                                                                                                                          | (4)  |
|   | b) Explain the terms i) Transition temperature and ii) Critical current of superconductors.                                                                                                                                                                   | (3)  |
|   | c) Sketch and explain the variation of specific heat of liquid helium 4 at near absolute zero temperature.                                                                                                                                                    | (3)  |
| 3 | Explain the Joule Thomson effect. Show the inversion curve of a real gas on a T-p diagram. Prove that an ideal gas will not experience a temperature change upon isenthalpic expansion.                                                                       | (10) |
| 4 | a) Prove that COP of an ideal Stirling cycle cryocooler is the same as that of a Carnot cycle.                                                                                                                                                                | (5)  |
|   | b) With the help of a neat sketch, explain the magnetic cooling process.                                                                                                                                                                                      | (5)  |

**PART B***Answer any three full questions, each carries 10 marks.*

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|---|-----------------------------------------------------------------------------------------------------------|------|
| 5 | a) With a neat schematic and T-s diagram, explain the working of a liquefaction system used for neon.     | (8)  |
|   | b) Explain why the simple Linde-Hampson system does not work for gases such as neon, hydrogen and helium. | (2)  |
| 6 | With a neat sketch and T-s diagram explain the working of Simon helium liquefaction system.               | (10) |

- 7 a) With a neat sketch and T-s diagram explain the working of a Claude refrigeration system. Derive an expression for COP assuming that expander work is utilized to compress the gas. (7)
- b) Draw the T-s diagram and derive an expression for COP of a thermodynamically ideal isobaric source cold - gas refrigerator. (3)
- 8 With the help of a schematic and T-s diagram explain the working of a Phillips refrigerator. Derive an expression for its COP. (10)

**PART C**

*Answer any four full questions, each carries 10 marks.*

- 9 With a neat sketch explain the functions of different components of a typical cryogenic liquid storage vessel. (10)
- 10 Explain in detail the different types of insulations used in cryogenic equipments. (10)
- 11 Explain the various features of cryogenic fluid transfer systems. (10)
- 12 With a neat sketch explain the working of a constant-volume gas thermometer. (10)
- 13 Explain with a neat diagram the working of a capacitance type liquid level gauge. (10)
- 14 Explain the working of i) Turbine flow meter ii) Vapour pressure thermometer (10)

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