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

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**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **16AE2004** | **Duration :** | **3 hrs** |
| **Sub. Name :** | **CRYOGENIC PROPULSION** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Define cryogenic temperature limits. | CO1 | 2 |
| b. | Explain the thermal behaviour in pure and impure metal when subjected to cryogenic temperatures . | CO1 | 18 |
| (OR) | | | | |
| 2. |  | Explain Debye theory and how Debye theory is used to determine specific heat of solid at low temperatures? | CO1 | 20 |
|  |  |  |  |  |
| 3. |  | Explain the thermodynamic ideal liquefaction system and derive the equation for work required to liquefy a unit mass of gas. | CO3 | 20 |
| (OR) | | | | |
| 4. |  | Illustrate the working of a precooled Linde-Hampson system with suitable diagram. | CO3 | 20 |
|  |  |  |  |  |
| 5. |  | In an ideal claude liquefaction system for nitrogen, the gas enters the compressor at 101.3 kPa (1 atm) and 20 oC (68 oF) and is compressed to 4.05 MPa (40 atm). Determine the expander flow rate ratio required for a liquid yield of 0.200, if the gas enters the reversible adiabatic expander at 4.05 MPa (40 atm) and 240 K (-27.7 oF). | CO3 | 20 |
| (OR) | | | | |
| 6. | a. | Explain the working principle of claude system with a neat sketch. | CO3 | 10 |
| b. | Derive the yield obtained from the claude system. | CO3 | 10 |
|  |  |  |  |  |
| 7. | a. | State the need for insulators in cryogenic vessels. | CO2 | 4 |
| b. | Describe any two types of insulators used for insulating cryogenic storage vessels. | CO2 | 16 |
| (OR) | | | | |
| 8. |  | A spherical shell with LN2 has radius of outer dia 2.4 m and inner dia of 2 m. MLI (24 layers/cm) is applied at each stage. The emissivity of shield is 0.05. Solid conductance of spacer is 0.0851 W/m2K. LN2 boils off from 294 K to 77 K. Calculate boil off of LN2 on per day basis. | CO2 | 20 |
|  | |  |  |  |
|  | | **Compulsory**: |  |  |
| 9. |  | Write short note on the following cryogenic fluids   1. Liquid Oxygen. 2. Liquid Hydrogen. 3. Liquid Helium. 4. Application of Cryogenic liquids in Rockets engines | CO1 | 4  4  4  8 |