

Birla Institute of Technology and Science, Pilani

ME G536-Thermal Equipment Design Mid Semester Exam (Open Book)

Date: 16/03/2023, Time:1600 – 1730 hrs; Max Marks :60

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1x30=30M

1. Gasoline (65° API gravity) flow rate of 450 Kg/min with a small boiling range at 200° C is to be vaporized to form 280 kg/min vapor at an operating pressure of 200 psig. Use gas oil (30° API gravity) on tube side, in the temperature range from 315 to 260 °C at 120 psig operating pressure as the heating medium. Design a suitable Kettle re-boiler using a 25 in ID Kettle re-boiler containing a six-pass 15^{1/4} in circular bundle, which contains 68 No 1 in OD, 14 BWG tubes 12'0" long on 1^{1/4} in square pitch. The bundle is baffled only by quarter-circle support plates. Assume wall temperature as 240 °C.

Will the re-boiler be satisfactory? What are the dirt factor and pressure drops?

1x30=30M

2. An engine bleed Primary Heat Exchanger is required for the air-conditioning system of unmanned aircraft. The hot bleed air 26 kg/min at 6 bar g is needs to be cooled from 530°C to 210°C. The Ram air 150 kg/min and at 1.25 bar g is available at a temperature of 70°C. The available space for a single pass cross flow plate-fin compact heat exchanger is 180 mmx200 mmx140 mm. If you use Strip or Offset fins (20 FPI, 5 mm fin height, 3.175 mm offset length and 0.1 mm fin thickness) on hot side and wavy fins (11.5 FPI, 9.5 mm wave length, 2 mm amplitude, 0.075 mm fin thickness and 9.5 mm fin height) on Ram air side, will it meet the space and hot air outlet temperature requirements, using stainless steel throughout? Assume the separating plates thickness is 0.2 mm.