

**UNIVERSITY OF TECHNOLOGY, JAMAICA**

**COLLEGE/ FACULTY:** Engineering and Computing

**SCHOOL/ DEPARTMENT:** ChemicalEngineering

**Mid-semester Examination 2, Semester 1**

**Module Name:** Chemical Engineering Thermodynamics 1

**Module Code:** CHE3003

**Date:** November 20, 2012

**Theory/ Practical:** Theory

**Groups:** B.ENG.3C

**Duration:** 2 hours

**Instructions**

1. **ANSWER ALL QUESTIONS**
2. **EACH QUESTION MUST BEGIN ON A NEW PAGE**
3. **LEAVE TWO LINES BETWEEN PARTS OF A QUESTION**
4. **READ EACH QUESTION CAREFULLY BEFORE ANSWERING**
5. **SHOW CLEARLY ALL EQUATIONS USED FOR CALCULATIONS**
6. **THE INTENDED MARK IS INDICATED AT THE BEGINNING OF EACH QUESTION**
7. **ANSWER MUST BE NUMBERED IDENTICAL TO THE QUESTION BEING ANSWERED**
8. **A FORMULA SHEET AND UNIT CONVERSION CHART ARE ATTACHED.**

**\*\*\* DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO \*\*\***

**Question #1 [25 marks] = 33.3%**

A tank with a capacity of 30 m3 contains 14 m3 of liquid n-butane in equilibrium with its vapour at 298.15 K. Estimate the mass of n-butane vapour in the tank using the Redlich/Kwong (RK) equation. The vapour pressure of n-butane at the given temperature is 2.43 bar.

**Question #2 [25 marks] = 33.3%**

1. Calculate Zand V for ethane at 323.15 K and 15 bar using the truncated virial equation, with a value of B from the generalized Pitzer correlation.
2. Handbook value for the latent heat of vaporization for pure liquid methanol at 273.15 K is given as 1189.5 J/g. Calculate:
3. The value of the latent heat at *Tn,* using Watson’s equation.
4. The value of the latent heat at *Tn,* using Riedel’s equation.

**Question #3 [25 marks] = 33.4%**

A process for the production of 1,3-butadiene results from the catalytic dehydrogenation at atmospheric pressure of 1-butene according to the reaction:

C4H8(g) C4H6(g) + H2(g)

To suppress side reactions, the 1-butene feed stream is diluted with steam in the ratio of 10 moles of steam per mole of 1-butene. The reaction is carried out *isothermally* at 698.15 K, and at this temperature 68% of the 1-butene is converted to 1,3-butadiene. How much heat is transferred to the reactor per mole of entering 1-butene?

**Total Marks = 75**

**\*\*\*\*\* END OF PAPER \*\*\*\*\***

**Christmas come early…**

Formula Sheet

*For Vapour and Vapour-like Roots*

Start with

*For Liquid and Liquid-like Roots*

Start with

*Generalized Pitzer Correlation*

*Riedel’s equation*

Where, *P****c*** is the critical pressure in bars and *Trn* is the reduced temperature at *Tn.*

*Watson’s equation*







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