

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT  
 TEST 2 EXAMINATION- OCT. 2019  
 B.Tech (BT) III<sup>rd</sup> Semester

COURSE CODE: 18B11BT313

MAX. MARKS : 25

COURSE NAME: Thermodynamics and Chemical processes

COURSE CREDITS: 4

MAX. TIME: 1:30 Hrs

*Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means*

- Q1(a). Explain the law of increase of entropy. Deduce the law. 3
- (b). Differentiate between Lineweaver-Burk plot and Lamngmuir plot of Michaelis-Menten kinetics. 3
- Q2(a). Xanthan gum is produced using Xanthomonas campestris in batch culture. Laboratory experiments have shown that for each gram of glucose utilised by the bacteria, 0.23 g oxygen and 0.01 g ammonia are consumed, while 0.75 g gum, 0.09 g cells, 0.27 g gaseous CO<sub>2</sub> and 0.13 g H<sub>2</sub>O are formed. Other components of the system such as phosphate can be neglected. Medium containing glucose and ammonia dissolved in 20 000 litres water is pumped into a stirred fermenter and inoculated with X. campestris. Air is sparged into the fermenter; the total amount of off-gas recovered during the entire batch culture is 1250 kg. Because of the high viscosity and difficulty in handling xanthan-gum solutions, the final gum concentration should not be allowed to exceed 3.5 wt%. Draw flow chart and mass balance table (name of rows and columns only). 5
- Q3(a). Absolute or 100% ethanol is produced from a mixture of 95% ethanol and 5% water using the Keyes distillation process. A third component, benzene, is added to lower the volatility of the alcohol. Under these conditions, the overhead product is a constant-boiling mixture of 18.5% ethanol, 7.4% H<sub>2</sub>O and 74.1% benzene. Use the following data to calculate the volume of benzene which should be fed to the still in order to produce 250 litres. Absolute ethanol: (density 100% alcohol = 0.785 g cm<sup>-3</sup>); (density benzene = 0.872 g cm<sup>-3</sup>). 7
- (b). Anaerobic digestion of volatile acids by methane bacteria is represented by the equation:
- $$\text{CH}_3\text{COOH} + \text{NH}_3 \rightarrow \text{CH}_{1.4}\text{O}_{0.40}\text{N}_{0.20} + \text{CO}_2 + \text{H}_2\text{O} + \text{CH}_4.$$
- For each kg acetic acid consumed, 0.67 kg CO<sub>2</sub> is evolved. How does the yield of methane under these conditions compare with the maximum possible yield. 7