

**R09**

**Code No: C0301**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I - Semester Examinations, April/May 2012**

**MICROBIAL ENGINEERING**

**(BIOTECHNOLOGY)**

**Time: 3hours**

**Max. Marks: 60**

**Answer any five questions  
All questions carry equal marks**

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1. Describe the physical and chemical treatment of raw materials used for industrial fermentation.
2. Define heat of combustion. Explain heat of reaction at non – standard conditions.
3. Citric acid is manufactured using submerged culture of *Aspergillus niger* in a batch reactor operated at 30<sup>0</sup> C. Over a period of two days 2500 kg glucose and 860 kg oxygen are consumed to produce 1500 kg citric acid, 500 kg biomass and other products. Ammonia is used as nitrogen source. Power input to the system by mechanical agitation of the broth is about 15 KW; approximately 100 kg water is evaporated over the culture period. Estimate the cooling requirement. ( $\Delta h_u$  water at 30<sup>0</sup> C = 2430.7 KJ Kg<sup>-1</sup>) (heat of reaction at 30<sup>0</sup> C is - 460 KJg mol<sup>-1</sup>).
4. What is model cycle? Explain Monod model of microbial growth and its limitations.
5. Explain the kinetics of Maintenance and its effect on product yield.
6. Write short notes on
  - a) Studies of enthalpy for reaction and non reactive processes.
  - b) Filter sterilization of air.
7. Explain energy – balance equation for cell culture and its applications.
8. Describe thermal death kinetics of cells and spores with suitable illustrations.

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