

*Chen*

## BEL 702: Bioprocess Plant Design

### Minor Examination – I

15<sup>th</sup> February 2015

9.30 – 10.30 Hrs.

V – 315

*Maximum marks 15*

1. Product P is produced through batch fermentation of a complex media using a mold. The batch time, from inoculation to harvesting, is 24 hours. The fermented broth contains 2% (w/v) biomass. It also contains 1% P (w/v) on a biomass-free basis. P is an extra-cellular product and is miscible with water. The density of water, mold biomass and product P may all be taken as  $1000 \text{ kgm}^{-3}$  for calculation purposes. The biomass is removed from the fermented broth using a rotary vacuum filter. The filter cake contains 10% moisture. The filtrate is then concentrated to 40% of its volume by using a multiple effect evaporator. This concentrated solution is fed to a continuous crystallization unit where 80% of the product gets separated out as crystals. The crystals are washed, dried and then re-dissolved in distilled water such that the resulting solution contains 10% product. This is again taken to a multiple effect evaporator and concentrated to 40% of its volume. The concentrated solution is then taken to a crystallizer where 80% of the product gets separated as crystals, which are dried and taken to product storage. If the plant produces 100 tonnes of product per year, develop a flow-sheet for the process. The number of operating days in a year may be taken as 350. Superheated steam is available such that 0.2 kg steam is required to evaporate 1 kg of water in the multiple-effect evaporators.

(8 marks)

2. (i) What are the broad objectives of the control and instrumentation loops provided in a process plant?

- (ii) Sketch the control and instrumentation loops for control of pressure, temperature, flow and level as it appears in a typical P&I diagram for the case where the controller is (a) locally mounted (b) panel mounted with parameter indication and recording facilities.

(3+4 = 7 marks)

