Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER M.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: ADVANCED REACTION ENGINEERING (CHE-505)

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitably assumed.

1	Ethyl acetate is manufactured by esterification of acetic acid with ethanol in isothermal batch reactor with a production rate of 10 tons/day. The reactor is charged with 500 kg/m^3 ethanol and 250 kg/m^3 acetic acid. The remainder is water and small amount (negligible) of catalyst is present. The density of mixture is 1045 kg/m^3 and assumed to be constant through the reaction. The reaction is reversible CHCOOH + C2H5OH CH3COOC2H5 + H2O The reaction mixture is discharged when the conversion of acetic acid is 30%. A time of 30 min is required between batchs for discharging, cleaning, charging. Determine the volume required for the batch reactor.	**20**
2	Derive the performance equation for recycle plug flow reactor and prove that R→ 0 approaches leads to PFR and R→∞ approaches leads to MFR.	**20**
3	Derive the equations for $C_{R\ max.}$ and $t_{R\ max}$ for Plug flow reactor A→ R→ S (kinetic constants k1 & k2 are equal and both are 1st order reactions respectively) Where $C_{R\ max.}$ and $t_{R\ max}$ are maximum concentration of R and time required for that maximum concentration respectively.	**20**
4A.	Derive $E(t) = \frac{t^2}{2t^3}$ for Laminar Flow Reactor	**15**
4B.	What are the non-idealities present in MFR and PFR (mostly encountered)	**5**
5	Derive the performance equation of semi batch reactor for pseudo first order kinetics	**20**
6A	Prove that series of N Mixed reactors conversion will lead to one PFR of equal volume conversion (Nx one MFR volume = One PFR volume)	**15**
6B	After 8 min in batch reactor, reactant (C_{A0} = 1 mol/lit) is 80% converted. After 18 min conversion is 90%. Find a rate equation to represent this reaction.	**5**