**First Periodical, June 2021**
**M.E. (Chemical Engg), Ist year , 2nd sem.**
**Process Modeling & Simulation**

M.M. : 20 Time : 60 mins

*Note:*

- Mention your Univ. roll number, class and name at the top of all the pages/answer sheets.
- Scan all the pages/answer sheets as a single pdf file and upload the same in Google classroom.
- Attempt all questions.

1. Consider a spherical vessel with radius = 1 m, containing water initially (t=0) with liquid height of z = 1.5m. Water then starts to flow into the vessel with controlled flow rate of 2z ($m^3$/h) (the inflow is function of liquid height). At the same time, water from the vessel is withdrawn at a constant rate of 2 $m^3$/h. Develop suitable mathematical model to predict liquid height, z as a function of time, t. Using this model expression, compute the time it takes for the spherical tank to overflow. State clearly all your assumptions. (10)

2. Consider a process that contains two tanks in series. The feed stream to the first tank has volumetric flow rate $F_i$ and temperature $T_i$. The first tank has temperature $T_1(t)$ and constant volume $V_1$. This tank receives a heating input with rate = $Q = UA_h( Ts - T_1)$. Where, Ts is the temperature of steam used for heating. $A_H$ is the heat transfer area available for heat transfer. The outlet stream from the first tank is used as an inlet stream for the second tank. The second tank has temperature $T_2$ and variable volume $V_2$. The outlet flow from this tank is described as : $F_2 = C_v\ h_2^{0.5}$ , where $h_2$ is the liquid level in tank 2. Let $A_2$ be the cross sectional area of tank 2. Assuming $V_2/F_1 << 1$ , derive the dynamic model describing the second tank level $h_2$ and temperature $T_2$ (10)