CMCE

1. → To solve linear equations
   - (a) Matrix inversion method
   - (b) Cramer's rule
   - (c) guass elimination (naive becoz diagnal elements ≠ 0)
     - Pivoting is done to avoid diag elements 0
     - forward   Backward
   - (d) LU decomposition
   - (e) cholesky method → 'A' should be +ve definite symmetric matrix
     - $|A| \neq 0$
     - $A = A^T$
     - ~~dig~~ diag (A) = +ve
     - eigen values > 0
   - (f) guass jordan

lower slar matrix upper elements = 0

2. → Iterative methods to solve linear equations
   - (a) Jacobi method
   - (b) Guass seidel
   - (c) Successive relaxation

3. Non-linear algebraic equations (solution) (to find roots)
   - (a) Bracketing method
     - (i) Bisection method
     - (ii) False position method → bisection + secant
   - (b) Polynomial method
     - (i) muller's method
     - (ii) Chebyshev method
   - (c) Open method
     - (i) Secant method
     - (ii) Newton raphson

Convergence :- chebyshev > N-R > secant > false position > Bisection

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4. Differential equations (initial value problems)
   a. Euler method → forward → explicit; → backward → implicit (unconditionally stable)
   b. RK method → order of accuracy ??
   c. adam Bashforth (P-C method)

→ stiff systems :- Coexistence of fast and slow components
one species reaches equilibrium but other species changing slowly (more or less fixed).

→ Distillation read (notes). heat and mass transfer both occurs.

→ evaporation v/s distillation

5. ODE - BVP
   a. Finite difference method → central diff (CD) → forward diff → backward.
   b. shooting method
   c. finite element method.

6. PDE
   a. leap frog method → CD time, CD space.
   b. method of lines → FD space → and apply ODE, IVP ✓.
   c. lax - friedrichs scheme → FD time, CD space.
   d. crank - Nicolson method
   e. elliptic PDE

evaporator design??

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Heat exchanger design (double pipe)

1. Decide which fluid will pass through which pipe
2. list down all the properties required C_p, ρ, μ, Pr etc → at T_{avg}
3. Calculate the heat duty → $Q = \dot{m} C_p \Delta T$ (heat transfer rate)
4. Calculate LMTD (3 by 2 inch value)
5. Using TEMA guidelines find the diameter → based on IPS
6. find the individual heat transfer coefficients and find the overall HTC (from coulbourn J-factor plots) series
7. Find the heat transfer area → $Q = A U (\Delta T)_{LMTD}$
8. From the table find surface per foot length → based on IPS
9. Find no. of hairpins required
10. Find the Pressure drop required across the pipes
11. If it is satisfied ✓ OK - else series parallel arrangement should be done.

→ series ||el → flowrate half

Shell and tube

1. Where the fluids will pass.
2. Select front end head based on cost, maintenance, hazard etc → stationary.
3. Select rear-end head based on provision to remove tube bundle for cleaning, leakage, thermal stress.
4. find $Q = \dot{m} C_p \Delta T$
5. Assume U based on the fluids
6. determine LMTD and correction factor → Bcos we have counter and cross flow
7. From tables find OD, ID, length

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⑧ Calculate A

⑨ Find no: of tubes $\rightarrow \frac{A}{\pi d_o L}$

⑩ select Pitch

⑪ Select baffle

⑫ find h_i, h_o and calculate U

⑬ check whether calculated and assumed U are close otherwise iterate

⑭ calculate pressure drop → if exceeds allowable calculate again → iterate from U step.

Evaporator design

① Write down the properties and estimate U_1, U_2, U_3 —— ✓

② $F = V + L$ (mass balance).

$F x_F = L x_L$

Do mass balance and find V_1, V_2, V_3, L_1, L_2, L_3.

find BPE from duhring's plot. Find ΔT_{eff}. ✓.

find steam consumption → from enthalpy balance

find A_1, A_2, A_3.

If it converges ✓ → else iterate → change ΔT_{eff}.