B. Tech. Semester VI

Subject Name: Mathematical Methods in Chemical Engineering **Subject Code: BTCH13605**

Type of course: Professional Core Courses

Prerequisite: Mathematics – I & II, Numerical methods, Fluid flow operations, Heat transfer operations, Mass transfer -I

Rationale: The subject includes the application of mathematical methods in fluid flow operations, Heat transfer, Mass Transfer, Process Control, Stability and sensitivity analysis.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	0	3	60	15	25	0	0	100

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Chapter Details	Teaching Hrs	Module %Weightage
1.	**Vector algebra:** scalar & vector product, Numericals based on application to fluid flow problems, heat transfer and mass transfer problems.	12	22
2.	**Partial Differential Equation:** Study of 1D, 2D Heat conduction equations, Laplace, Poison's equation Wave equations, application to penetration theory, 2D conduction, counter-current heat exchanger, reaction, diffusion, Wetted wall column, dispersion model etc.	7	13
3.	**Fourier series, transforms:** Application to diffusion equations	7	13
4.	**Transforms:** Laplace & z, Application to process control	7	13
5.	**Linear algebra (matrix theory):** Application to stability analysis, scaling of equations	7	13
6.	**Bifurcation analysis:** Application to sensitivity analysis	7	13
7.	**Perturbation analysis:** Application for boundary flow problems, solution of equations, model reduction etc.	7	13

Suggested Specification Table with Marks (Theory): Distribution of Theory Marks for paper setting

R Level	U Level	A Level	N Level	E Level	C Level
10	15	15	10	10	00

Legends: R: Remembrance; **U:** Understanding; **A:** Application; **N:** Analyze; **E:** Evaluate; **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Text books:

Sr.No	Title	Publisher	Edition
1.	Pushpavanam, S. Mathematical Methods in Chemical Engineering	PHI	Eastern Economy, 2005
2.	Jenson, V.G. and Jeffreys, G.V. Mathematical Methods in Chemical Engineering	Academic Press; 2nd edition (12 December 1977)	2nd edition, 1977
3.	Applied Mathematical Methods in Chemical Engineering by N W Loney	CRC Press	3rd Edition, 2015

Reference books:

Sr.No	Title	Publisher	Edition
1.	Kreyszig, E. Advanced Engineering Mathematics.	Jhon Wiley and Sons	10th Edition
2.	Kundu, P. and Cohen, I.M. Fluid Mechanics.	Elsevier	6th edition, 2015

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Formulate a Chemical Engineering problem into a mathematical form.	15
CO-2	Solve ODE and PDE equations encountered in Chemical Engineering Applications	30
CO-3	Assess stability of Chemical Engineering systems.	20
CO-4	Perform sensitivity analysis for any chemical engineering systems.	15
CO-5	Formulate and solve the flow systems using vector algebra.	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	3	3	2	2	2	3	3	2	3	3	3	3	3
CO-2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO-3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO-4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO-5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Rationale *	15	15	15	15	14	13	14	15	15	14	15	15	15	15	15

Rationale*: Explaining why it is matching this particular program outcome

List of Open learning website:

- Video lectures available on the websites including NPTEL lecture series.
- MIT Open course lecture on Equipment design.

List of Open Source Software: SCILAB, Mathematics,**LAB SESSIONS: NIL**