



	PhD	Mark
	Subjects	
1.	Advanced Fluid Flow	
2.	Advanced Mass Transfer	
3.	Advanced Heat Transfer	
4.	Advanced Thermodynamics	
5.	Advanced Reactor Design	
6.	Advanced Process Control	
7.	Engineering Analysis	



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**Advanced Fluid Flow Transport Phenomena (Momentum Transport) - By:
R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, and Daniel J.
Klingenberg**

Chapter	Subject	Remarks
<u>One</u>	<u>The Equations of Change for Isothermal Systems</u> - The Equation of Continuity - The Equation of Motion	
<u>Two</u>	<u>Velocity Distributions in Turbulent Flow</u> - Comparisons of Laminar and Turbulent Flows - Time-smoothed Equations of Change for Incompressible Fluids - The Time-Smoothed Velocity Profile Near a Wall	
<u>Three</u>	<u>Interphase Transport in Isothermal Systems</u> - Friction Factors for Flow in Tubes - Friction Factors for Flow Around Spheres - Friction Factors for Packed Columns	
<u>Four</u>	<u>Macroscopic Balances for Isothermal Flow Systems</u> - The Macroscopic Mass Balance - The Macroscopic Momentum Balance - The Macroscopic Angular Momentum Balance - The Macroscopic Mechanical Energy Balance - Estimation of the Viscous Loss - Use of the Macroscopic Balances for Solving	



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Advanced Mass Transfer

Transport Phenomena- By Bird, Stewart and Lightfoot

Chapter	Subject	Remarks
<u>One</u>	<u>Diffusivity and the Mechanisms of Mass Transport</u> - Fick's law of binary diffusion - Theory of diffusion in gases at low density - Mass and molar transport by convection	
<u>Two</u>	<u>Concentration Distributions in Solids and in Laminar Flow</u>	
<u>Three</u>	<u>Concentration Distributions with More Than One Independent Variable</u> - Time-dependent diffusion - Steady-state transport in binary boundary layers - Dimensional analysis of the equations of change for binary mixtures	
<u>Four</u>	<u>Concentration Distributions in Turbulent Flow</u>	
<u>Five</u>	<u>Interphase Transport in Nonisothermal Mixtures</u>	
<u>Six</u>	<u>Macroscopic Balances for Multicomponent Systems</u>	



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Advanced Heat Transfer

Transport Phenomena - By R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot

Chapter	Subject	Remarks
<u>Nine</u>	- Thermal conductivity and the Mechanisms of energy Transport - Temperature and Pressure Dependence of Thermal Conductivity - Theory of Thermal Conductivity of Gases at Low Density - Theory of Thermal Conductivity of Liquids - Thermal Conductivity of Solids	
<u>Ten</u>	- Shell Energy Balances and Temperature Distributions in Solids and Laminar Flow - Shell energy balances; boundary conditions - Heat conduction with an electrical heat source - Heat conduction with a nuclear heat source - Heat conduction with a viscous heat source - Heat conduction through composition walls - Forced convection - Free convection	
<u>Eleven</u>	- The Equations of Change for Non-isothermal Systems - The energy equation - Special forms of the energy equation - The boussinesq equation of motion for forced and free convection - Use of the equations of change to solve steady-state problems - Dimensional analysis of the equations of change for non-isothermal systems	
<u>Twelve</u>	<u>Temperature Distributions with More Than One Independent Variable</u> - Unsteady heat conduction in solid - Steady heat conduction in laminar, incompressible flow - Steady potential flow of heat in solids	

	• Boundary layer theory for non-isothermal flow	
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Advanced Thermodynamics

Introduction To Chemical Engineering Thermodynamics - By (Smith, J.M., Van ness H.C. and Abbot, M.M., 7th Ed)

Chapter	Subject	Remarks
<u>Ten</u>	<u>Vapor/Liquid Equilibrium</u>	
<u>Elven</u>	<u>Solution Thermodynamics</u>	
<u>Twelve</u>	<u>Solution Thermodynamics Applications</u>	
<u>Thirteen</u>	<u>Chemical Reaction Equilibrium</u>	
<u>Fourteen</u>	<u>Topic in Phase Equilibrium</u>	



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Advanced Reactor Design Chemical Reaction Engineering, 3rd edition, John Wiley & Sons. - By Octave Levenspiel		
Chapter	Subject	Remarks
<u>Nine</u>	<u>Temperature and Pressure Effects</u> • Single Reactions	
<u>Eleven</u>	<u>Flow Patterns, Contacting, and Non-Ideal Basics of Non-Ideal Flow</u> • E, the Age Distribution of Fluid, the RTD • Conversion in Non-Ideal Flow Reactors	
<u>Thirteen</u>	<u>The Dispersion Model</u> • Axial Dispersion • Chemical Reaction and Dispersion	
<u>Fourteen</u>	<u>The Tanks-in-Series Model</u> • Pulse Response Experiments and the RTD • Chemical Conversion	
<u>Eighteen</u>	<u>Solid Catalysed Reactions</u> • The Rate Equation for Surface Kinetics • Porous Catalyst Particles • Heat Effects During Reaction	
<u>Twenty</u>	<u>Deactivating Catalysts</u> • Mechanisms of Catalyst Deactivation • The Rate and Performance Equations	



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Advanced Process Control		
Process Dynamics and Control - By Seborg, Edgar and Mellichamp		
Chapter	Subject	Remarks
<u>Four</u>	<u>Transfer Function and State Space models</u> State Space and Transfer Function Matrix Model	
<u>Fifteen</u>	<u>Feed-forward and Ratio Control</u> - Ratio Control - Feed-forward Controller Design Based on Steady state models - Feed-forward Controller Design Based on Dynamic models - Configurations for Feed-forward feed-back Control	
<u>Sixteen</u>	<u>Enhanced Single-loop Control Strategies</u> - Cascade Control - Inferential Control - Selective Control/Override Systems	
<u>Seventeen</u>	<u>Digital Sampling, Filtering and Control</u> - Sampling and Signal Reconstruction - The z-transform and Discrete Transfer Functions	
<u>Eighteen</u>	<u>Multiloop and Multivariable Control</u> - Process Interactions and Control Loop Interactions - Pairing of Controlled and Manipulated Variables - Decoupling and Multivariable Control Strategies - Strategies for Reducing Control Loop Interactions	



Competitive Exam - Post-Graduate (PhD Program) 2025-2026		
Engineering Analysis Advanced Engineering Mathematics By C. Ray Wylie		
Chapter	Subject	Remarks
<u>One</u>	<u>Differential Equations</u> - First Order Differential Equations (Separable, Homogeneous, Exact Equations), First Order Differential Equations (Linear Equations, Bernoulli Equation) - Second Order Differential Equations (Homogeneous, un-determent Coefficient), Second Order Linear Differential Equations, Differential Operators. - Higher Order of Linear Differential Equations, Simultaneous Linear Differential Equations	
<u>Two</u>	<u>Power Series</u> Power Series Solutions	
<u>Three</u>	<u>Special Functions</u> Special Functions, Error Function, Gamma Function, Beta Function	
<u>Four</u>	<u>Laplace Transform</u> - Laplace Transform, The Transform of Special Functions, The Differentiation and Integration of Transforms - The Shifting Theorems, Step Functions - Solving Differential Equations by Laplace Transform	
<u>Five</u>	<u>Fourier Series</u> Fourier Series, The Euler Formulas, Half Range Expansion	
<u>Six</u>	<u>Partial Differential Equations</u> Partial Differential Equations, Separation of Variables	