

Contents

Preface	xi
About the Authors	xiii
1 Introduction	1
The Flight Environment, 1	
Basic Quantities, 1	
Forces, 2	
Mass, 3	
Scalar and Vector Quantities, 4	
Moments, 5	
Equilibrium Conditions, 6	
Newton's Laws of Motion, 6	
Linear Motion, 7	
Rotational Motion, 8	
Work, 8	
Energy, 8	
Power, 9	
Friction, 9	
Symbols, 10	
Equations, 11	
Problems, 12	
2 Atmosphere, Altitude, and Airspeed Measurement	13
Properties of the Atmosphere, 13	
ICAO Standard Atmosphere, 15	
Altitude Measurement, 16	
Continuity Equation, 19	
Bernoulli's Equation, 19	
Airspeed Measurement, 22	
Symbols, 26	
Equations, 27	
Problems, 27	
3 Structures, Airfoils, and Aerodynamic Forces	31
Aircraft Structures, 31	
Airfoils, 37	
Development of Forces on Airfoils, 42	
Aerodynamic Force, 44	

Aerodynamic Pitching Moments. 45
Aerodynamic Center. 46
Symbols. 46
Problems. 47

4 Lift 49

Introduction to Lift. 49
Angle of Attack Indicator. 49
Boundary Layer Theory. 51
Reynolds Number. 53
Adverse Pressure Gradient. 54
Airflow Separation. 55
Stall. 56
Aerodynamic Force Equations. 57
Lift Equation. 58
Airfoil Lift Characteristics. 60
High Coefficient of Lift Devices. 61
Lift During Flight Maneuvers. 65
Symbols. 67
Equations. 67
Problems. 68

5 Drag 71

Drag Equation. 71
Induced Drag. 71
Ground Effect. 77
Laminar Flow Airfoils. 81
Parasite Drag. 82
Total Drag. 85
Lift to Drag Ratio. 87
Drag Reduction. 88
Symbols. 90
Equations. 91
Problems. 91

6 Jet Aircraft Basic Performance 95

Thrust-Producing Aircraft. 95
Principles of Propulsion. 96
Thrust-Available Turbojet Aircraft. 100
Specific Fuel Consumption. 101
Fuel Flow. 102
Thrust-Available–Thrust-Required Curves. 103
Items of Aircraft Performance. 104
Symbols. 113
Equations. 113
Problems. 114

7	Jet Aircraft Applied Performance	117
	Variations in the Thrust-Required Curve, 117	
	Variations of Aircraft Performance, 121	
	Equations, 125	
	Problems, 125	
8	Propeller Aircraft: Basic Performance	129
	Power Available, 129	
	Principles of Propulsion, 131	
	Power-Required Curves, 133	
	Items of Aircraft Performance, 139	
	Symbols, 145	
	Equations, 146	
	Problems, 146	
9	Propeller Aircraft: Applied Performance	149
	Variations in the Power-Required Curve, 149	
	Variations in Aircraft Performance, 153	
	Equations, 157	
	Problems, 157	
10	Takeoff Performance	161
	Definitions Important to Takeoff Planning, 161	
	Aborted Takeoffs, 164	
	Linear Motion, 166	
	Factors Affecting Takeoff Performance, 168	
	Improper Liftoff, 171	
	Symbols, 174	
	Equations, 175	
	Problems, 175	
11	Landing Performance	179
	Prelanding Performance, 179	
	Improper Landing Performance, 185	
	Landing Deceleration, Velocity, and Distance, 190	
	Landing Equations, 194	
	Hazards of Hydroplaning, 197	
	Symbols, 199	
	Equations, 199	
	Problems, 200	
12	Slow-Speed Flight	203
	Stalls, 203	
	Region of Reversed Command, 210	
	Spins, 212	

Low-Level Wind Shear. 216
Aircraft Performance in Low-Level Wind Shear. 218
Effect of Ice and Frost. 221
Wake Turbulence. 222
Problems. 224

13 Maneuvering Performance 227

General Turning Performance, 227
Equations, 242
Problems, 243

14 Longitudinal Stability and Control 245

Definitions, 245
Oscillatory Motion, 246
Airplane Reference Axes, 248
Static Longitudinal Stability, 248
Dynamic Longitudinal Stability, 260
Pitching Tendencies in a Stall, 261
Longitudinal Control, 264
Symbols, 266
Equations, 266
Problems, 266

15 Directional and Lateral Stability and Control 269

Directional Stability and Control, 269
Static Directional Stability, 269
Directional Control, 276
Multi-Engine Flight Principles, 280
Lateral Stability and Control, 284
Static Lateral Stability, 284
Lateral Control, 288
Dynamic Directional and Lateral Coupled Effects, 288
Symbols, 293
Equations, 293
Problems, 293

16 High-Speed Flight 295

The Speed of Sound, 295
High-Subsonic Flight, 297
Design Features for High-Subsonic Flight, 298
Transonic Flight, 301
Supersonic Flight, 305
Symbols, 316
Equations, 316
Problems, 316

17 Rotary-Wing Flight Theory	319
<i>Momentum Theory of Lift.</i>	320
Airfoil Selection.	320
Forces on Rotor System.	321
Thrust Development.	323
Hovering Flight.	324
Ground Effect.	326
Rotor Systems.	328
Dissymmetry of Lift in Forward Flight.	330
High Forward Speed Problems.	333
Helicopter Control.	334
Helicopter Power-Required Curves.	336
Power Settling, Settling with Power, and Vortex Ring State.	338
Autorotation.	340
Dynamic Rollover.	341
Problems.	343
Answers to Problems	345
References	349
Index	353