

TABLE OF CONTENTS

Chapter No.	Title	Page No.
1	Introduction to Hybrid Electric Vehicles	1-15
	1.1 Evolution and History of HEVs 1.2 Types: Series, Parallel, Series-Parallel 1.3 HEV vs ICE, BEV, PHEV 1.4 Benefits, Limitations, and Applications 1.5 Market Trends and Environmental Impact	
2	Vehicle Dynamics and Fundamentals	16-29
	2.1 Longitudinal Dynamics of Vehicles 2.2 Tractive Effort and Powertrain Load 2.3 Drive Cycles (FTP-75, WLTP, etc.) 2.4 Energy Flow in Conventional vs. Hybrid Vehicles	
3	Hybrid Drivetrain Components	30-46
	3.1 Internal Combustion Engine Overview 3.2 Electric Motors: BLDC, PMSM, IM 3.3 Battery Types: Li-ion, NiMH, BMS 3.4 Power Electronics: Converters, Inverters 3.5 Hybrid Transmission Systems	
4	Energy Management and Control Strategies	47-62
	4.1 Rule-Based and Optimization-Based Control 4.2 Real-Time Energy Management 4.3 Mode Selection (Engine/Motor Operation) 4.4 Regenerative Braking Control 4.5 Thermal Management	
5	Modeling and Simulation of HEVS	63-74
	5.1 Mathematical Modeling of HEV Systems 5.2 MATLAB/Simulink and Simscape Models 5.3 Battery and Power Converter Models 5.4 Drive Cycle-Based Performance Simulation	
6	Design and Optimization of HEVS	75-86
	6.1 Sizing of Motor, Battery, Engine 6.2 Trade-off Analysis (Cost, Weight, Efficiency) 6.3 Optimization Methods (GA, PSO, etc.) 6.4 Lifecycle and Economic Analysis	
7	Charging Infrastructure and Grid Interface	87-97
	7.1 Charging Types: Onboard/Offboard 7.2 PHEV and Smart Charging Concepts 7.3 Vehicle-to-Grid (V2G) Communication 7.4 Charging Standards: ISO 15118, OCPP	

8	Testing, Standards, and Regulations	98-108
	8.1 Vehicle Testing Procedures 8.2 Safety Protocols for High-Voltage Systems 8.3 ISO, SAE, and UN Standards 8.4 Homologation and Certification Requirements	
9	Recent Trends and Research	109-121
	9.1 Plug-in HEVs and Range Extenders 9.2 AI/ML in Hybrid Energy Management 9.3 Solid-State and Next-Gen Batteries 9.4 Fuel Cell Integration in Hybrids	
10	Lab / Project Work	122-127
	10.1 HEV Simulation in MATLAB/Simulink 10.2 BMS and SOC Estimation Models 10.3 Energy Management Strategy Design 10.4 Industry-based Project (e.g., Toyota Prius Study)	