SRM University

M.Tech Automotive Hybrid Systems Engineering

(Collaborative program with NFTDC, Hyderabad)

(Proposed syllabus from the academic year 2015-16)

Core courses

		L	T	P	C
AH2104	**HEV / xEV SYSTEM DESIGN ARCHITECTURE**	**3**	**2**	**0**	**4**
	Total Contact Hours-75				
	Prerequisites				
	Nil				
PURPOSE					
To present an overview about hybrid electric vehicle system design architecture and its sub-systems.					

Design & Engineering – xEV

xEV : micro to mild to PHEV to HEV to REEV to EV - Hybrid-Electric Vehicle Power trains - Vehicle Energy Storage System (VESS) Design - Computational Systems Design (CSD) - Transportation Electrification

Introduction to Advanced Electric Vehicles: Fundamentals of xEVs and key challenges and opportunities of AEV technologies - Engineering philosophy of various xEVs (HEV, PHEV and BEV, REEV)

Component selection and design and architecture: Examples & Case studies;

Controls Modelling and Design for xEV: System and sub-systems, Modelling and design of xEVs as a system, principles of controls engineering for xEV.

Energy Storage Systems: Energy storage systems used; Battery electro-chemistry, battery design and construction, charging and discharging, power density, Battery interface with motive sources

Power Electronics for Electric Vehicles: Power electronics including switching, AC-DC, AC-AC conversion, electronic devices and circuits used for control and distribution of electric power

Electric Drives / Electromechanical Energy Conversion: Motors & motive power spilting concepts, and interface within power train system;

Innovation and System Architecture for xEVs: Case studies on proven systems and failed system architectures.

Hybrid Electrical Vehicles : Part 1: Introduction - **System Overview** - Power train architecture - Parallel, Series and Combined - Types of xEVs - Vehicle layout and packaging options. - Energy devices & combinations - examples & Case Studies - **Environmental Impact** - Regulatory Issues (CO_2 gas and particulate emissions) - Duty Cycles in Indian cities; performance (off cycle, durability) - Sustainability assessment; cradle to grave environmental impact. - **Industry Activity**

and Market Reaction - HEV market drivers and technology trends - Customer related issues - HEV technology readiness levels - **Vehicle Based HEV Performance specifications**.

Part II : **Vehicle Systems : Modelling, electrical and mechanical sub systems** - Systems Modelling and Simulation - Modelling methodologies for HEV energy management. - Control strategies for energy management and driveability. **Electrical System Design** - High voltage architecture options within HEVs and component selection. - Power electronics, including DC-DC converters (unidirectional and bidirectional) and machine drives. - Electrical machine designs, performance prediction, ancillary requirements and manufacturability. - Battery and ultra-capacitor technologies, vehicle integration, and performance characteristics (materials, performance, reliability, safety, recycling). **Regenerative Braking** - Real-world energy storage requirements and driver behaviour assessment. - Brake feel and customer acceptance - **Mechanical System Design**: New transmission options including split path design approaches and systems (planetary, CVT, dual clutch). - Engine calibration and optimisation. - New engine cycles and fuelling options. - Mechanical energy storage systems such as flywheels and hydraulic accumulators.

References:

1. Iqbal Husain, *"Electric and Hybrid Vehicles –Design Fundamentals"*, CRC Press
2. Mehrdad Ehsani, Yimin Gao, Sebastian E.Gsay, Ali Emadi, *"Modern Electric, Hybrid Electric and Fuel Celll vehicles-Fundamentals - Theory and Design"*, CRC Press
3. *"Bosch' Automotive Handbook"*, 8th Edition