SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Electrical and Electronics Engineering	LP: EE18703 Rev. No: 00 Date: 23/07/2021
B.E/B.Tech/M.E/M.Tech : B.E., EEE Regulation: 2018 PG Specialisation : -- Sub. Code / Sub. Name : EE18703 ELECTRIC VEHICLES Unit : I ARCHITECTURE AND SUB-SYSTEMS	

Unit Syllabus: Introduction to Electric and Hybrid Electric Vehicles: History of hybrid and electric vehicles, Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction. introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Objective: Introduce the drive-train topologies and power flow control strategies in Electric and Hybrid Electric Vehicles

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction to Electric and Hybrid Electric Vehicles	1, 5, 7	PPT
2	History of hybrid and electric vehicles	1, 5, 7	PPT
3	Basic concept of hybrid traction	1, 5, 7	PPT
4	Introduction to various hybrid drive-train topologies	1, 5, 7	PPT
5	Power flow control in hybrid drive-train topologies: Considerations, Power flow control in series hybrid & parallel hybrid	1, 5, 7	PPT
6	Power flow control in hybrid drive-train topologies: Power flow control in series-parallel hybrid & complex hybrid	1, 5, 7	PPT
7	Fuel efficiency analysis	1, 5, 7	PPT
8	Basic concept of electric traction,	1, 5, 7	PPT
9	Introduction to various electric drive-train topologies	1, 5, 7	PPT
10	Power flow control in electric drive-train topologies	1, 5, 7	PPT
11	Fixed and variable gearing, single and multi-motor drives, in-wheel drives	1, 5, 7	PPT
12	EV parameters, Efficiency analysis, CBS: An Architecture for In-Vehicle Networks	1, 5, 7, 8	PPT
Content beyond syllabus covered (if any): An Architecture for In-Vehicle Networks			

* Session duration: 50 minutes

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Sub. Code / Sub. Name: EE18703 ELECTRIC VEHICLES

Unit : II PROPULSION UNITS

Unit Syllabus: Configuration, modelling and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Brushless DC motor drives and Switched Reluctance Motor drives - Modes of operation - drive system efficiency

Objective: Develop mathematical models of drive machines and power electronic converters

Session No *	Topics to be covered	Ref	Teaching Aids
13	Electric propulsion – concept of EV motors – configuration	1, 2	PPT
14	Modelling and control of DC Motor drives – introduction	1, 2	PPT
15	Representative two quadrant chopper - Steady state analysis	1, 2	PPT
16	Ripple reduction in torque – modes of operation (CCM, DCM, UNCM, CCM in steady state) – operating point analysis – numerical examples	1, 2	PPT
17	Modelling and control of Induction Motor drives – introduction	1, 2	PPT
18	Vector control of AC motors – Induction motor dq model	1, 2	PPT
19	Rotor flux oriented vector control – indirect vector control - implementation	1, 2	PPT
20	Modelling and control of Permanent Magnet Motor drives, Brushless DC motor drives – introduction	1, 2	PPT
21	PMSM models – vector control – flux weakening, current and voltage controllers	1, 2	PPT
22	Switched Reluctance Motor drives – introduction – torque-speed characteristics	1, 2	PPT
23	Representative four-quadrant SRM converter – modes of operation – SRM controls – voltage-controlled drive & Current-controlled drive	1, 2	PPT
24	Drive system efficiency	9, 1, 2	PPT
Content beyond syllabus covered (if any): –			

* Session duration: 50 mins

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Sub. Code / Sub. Name: EE18703 ELECTRIC VEHICLES

Unit : III ENERGY STORAGE SYSTEM

Unit Syllabus: Energy storage technologies in electric and hybrid electric vehicles – battery, flywheel, fuel cell, ultra capacitors- comparison of different energy storage technologies - Hybridization of different energy storage devices.

Objective: Familiarize various energy storage technologies in HEVs and EVs

Session No *	Topics to be covered	Ref	Teaching Aids
25	Energy storage technologies in electric and hybrid electric vehicles - Introduction	1, 4	PPT
26	Battery Energy storage technology – traction batteries	1, 4	PPT
27	Battery cell structure – chemical reactions – battery parameters - Battery electric circuit models	1, 4	PPT
28	Range Prediction with Constant Current Discharge & Power Density approach	1, 4	PPT
29	Flywheel energy storage – introduction – advantages & drawbacks	1, 4	PPT
30	Fuel cell energy storage – introduction – basic fuel cell structure & characteristics	1, 4	PPT
31	Fuel cell types, Fuel cell model – Hydrogen storage systems, reformers	1, 4	PPT
32	Fuel cell-based electric vehicle architecture - Case Study: Toyota Mirai FCEV	1, 4	PPT
33	Ultra capacitor energy storage – symmetrical & asymmetrical ultra capacitors	1, 4	PPT
34	Ultra capacitor modeling	1, 4	PPT
35	Comparison of different energy storage technologies	1, 4	PPT
36	Hybridization of different energy storage devices	1, 4	PPT

Content beyond syllabus covered (if any):

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*** Session duration: 50 mins**

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Sub. Code / Sub. Name: EE18703 ELECTRIC VEHICLES

Unit : IV DRIVE SYSTEM SIZING

Unit Syllabus: Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Objective: Impart knowledge on drive system sizing and supporting subsystems

Session No *	Topics to be covered	Ref	Teaching Aids
37	Sizing the drive system – introduction	9, 3	PPT
38	Matching the electric machine and the internal combustion engine (ICE) - Epicyclic gear input–output relationships	9, 3	PPT
39	Automatic transmission architectures – Simpson, Wilson & Lepelletier type	9, 3	PPT
40	Sizing the propulsion motor – steps	9, 3	PPT
41	Torque and power, constant power speed ratio, Machine sizing	9, 3	PPT
42	Sizing the power electronics - Switch technology selection,	9, 3	PPT
43	Ripple capacitor design, Switching frequency and PWM	9, 3	PPT
44	Selecting the energy storage technology - Electrical overlay harness	9, 3	PPT
45	Communications - OSI 7-layer model – CAN communication – power & data networks	9, 3	PPT
46	Future communication: TTCAN, FlexRay - Diagnostic test codes (DTC)	9, 3	PPT
47	Supporting subsystems	9, 3	PPT
48	CBS: Sizing of a Battery Pack Based on Series/Parallel Configurations for a High-Power Electric Vehicle as a Constrained Optimization Problem	8, 9, 3	PPT

Content beyond syllabus covered (if any):

Sizing of a Battery Pack Based on Series/Parallel Configurations for a High-Power Electric Vehicle as a Constrained Optimization Problem

* Session duration: 50 mins

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COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: EE18703 ELECTRIC VEHICLES

Unit : V BATTERY CHARGING AND MANAGEMENT STRATEGIES

Unit Syllabus: Different charging technologies: Normal, fast and opportunity charging – Different charging algorithms: CCCV, Multistage charging, Pulse charging – Wireless power transfer – Effect of EV charging on grid – V2G technology – Peak shaving and coordinated charging. Battery management system: Battery parameters – SoC measurement – Battery cell balancing.

Objective: Familiarize battery charging and energy management systems.

Session No *	Topics to be covered	Ref	Teaching Aids
49	Battery Charging And Management Strategies – introduction	4, 6, 9	PPT
50	Different charging technologies: Normal, fast and opportunity charging	4, 6, 9	PPT
51	Different charging algorithms: CCCV	4, 6, 9	PPT
52	Multistage charging & Pulse charging	4, 6, 9	PPT
53	Wireless power transfer	4, 6, 9	PPT
54	Effect of EV charging on grid	4, 6, 9	PPT
55	V2G technology	4, 6, 9	PPT
56	Peak shaving and coordinated charging	4, 6, 9	PPT
57	Battery management system – introduction	4, 6, 9	PPT
58	Battery parameters – SoC measurement	4, 6, 9	PPT
59	Battery cell balancing	4, 6, 9	PPT
60	CBS: Remote Monitoring of Electric Vehicle Charging Stations in Smart Campus Parking Lot	4, 6, 8, 9	PPT

Content beyond syllabus covered (if any):

Remote Monitoring of Electric Vehicle Charging Stations in Smart Campus Parking Lot

*** Session duration: 50 mins**

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REFERENCES:

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3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second edition 2012.
4. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
5. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
6. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications With Practical Perspectives, Wiley Publication, 2011.
7. NPTEL lecture on "Electric Vehicles Part 1".
8. http://ieeexplore.ieee.org
9. John M Miller, Propulsion system for hybrid vehicles, IET Renewable Energy Series 7, The Institution of Engineering and Technology, London, United Kingdom, 2010

	Prepared by		Approved by
Signature			KR. Santha
Name	Dr.M.Sankar	Dr.R.Kannadasan	Dr.KR.SANTHA
Designation	AP/EEE	AP/EEE	Vice Principal, Professor & HOD/EEE
Date	23/07/2021		23/07/2021
Remarks *:	As there is no change in previous semester (July 2021 - Dec 2021) lesson plan, the same lesson plan is followed for this semester (July 2022 - Dec 2022)		
	Dr. M. SANKAR AP/EEE 24th2	Ms. S. ARULMOZHI AP/EEE 26/7/22	Dr. KR. SANTHA VICE PRINCIPAL, PROF & HOD, E KR. Santha 26.7.22
Remarks *:	The same lesson plan is followed for the AY (2023-24).		
	Dr. C. KAMAL C. Kamal	Dr. S. Arulmozhi 12/7/23	Dr. KR. Santha, Vice Principal, Professor & Head, EEE KR. Santha 12.7.23

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD