



Department of Automobile Engineering	LP: Sub Code AE18704
B.E/B.Tech/M.E/M.Tech : <u>B.E.</u>	Regulation:2018
PG Specialisation : -----	Rev. No: 00
Sub. Code / Sub. Name : AE18704 / MOTORS AND CONTROLS FOR HYBRID AND ELECTRIC VEHICLES	Date: 22.07.2021
Unit : I Modern Electrical Drives and Principles	

UNIT I

Unit Syllabus : Choice of electric propulsion system, block diagram of EV propulsion system, Electromagnetic Torque Control Principles, single motor and multi-motor configurations, fixed & variable geared transmission, In-wheel motor configuration, classification of EV motors, Sizing and Comparison of Electric Motors for EV applications.

Objective: To understand Modern Electrical drive system and drive dynamics.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Choice of electric propulsion system, types	1,2,3,8	PPT
2	Block diagram of EV propulsion system	1,2,3,8	PPT
3	Electromagnetic Torque Control Principles	1,2,3,8	PPT
4	single motor and multi-motor configurations	1,2,3,8	PPT
5	fixed & variable geared transmission	1,2,3,8	PPT
6	In-wheel motor configuration	1,2,3,8	PPT
7	classification of EV motors	1,2,3,8	PPT
8	Sizing and Comparison of Electric Motors for EV applications.	WS 1,2	PPT
9	Applications and design complexity of EV		
Content beyond syllabus covered (if any): Design complexity of EV			

* Session duration: 50 minutes



Sub. Code / Sub. Name: AE18704 / MOTORS AND CONTROLS FOR HYBRID AND ELECTRIC VEHICLES

Unit : II DC and BLDC Motor

Unit : II

Unit Syllabus : DC Series, Speed Control and Braking, traction application, DC motors with Permanent Magnets, Out-runner type BLDC Motor In-runner type BLDC Motor and its transmission system. Torque Equation, Speed-Torque Characteristics, Speed Control and Braking, Simulation of BLDC motor for two wheeler tractive effort.

Objective: To enable the students to understand the Construction, control and Braking of DC and Motor drive

Session No *	Topics to be covered	Ref	Teaching Aids
10	DC series motor, working principle, Characteristics	1,2,3,4,8	PPT
11	Speed Control and Braking, traction application	1,2,3,4,8	PPT
12	DC motors with Permanent Magnets	1,2,3,4,8	PPT
13	Working principle of BLDC motor - Outer runner type	1,2,3,4,8	PPT
14	Inner runner type BLDC motor and Transmission system	1,2,3,4,8	PPT
15	Torque equation,	1,2,3,4,8	PPT
16	Speed torque Characteristics	1,2,3,4,8	PPT
17	Speed Control and Braking, Importance features of BLDC in HEV	1,2,3,4,8	PPT
18	Simulation of BLDC motor for two wheeler tractive effort.	1,2,3,4,8	PPT

Content beyond syllabus covered (if any): Importance features of BLDC in HEV

* Session duration: 50 mins



Sub. Code / Sub. Name: AE18704 / MOTORS AND CONTROLS FOR HYBRID AND ELECTRIC VEHICLES

Unit : III Induction Motor Drive

Unit: III

Unit Syllabus : Three Phase Inverter Based Induction Motor Drive, Speed Control of Induction Motor, Field oriented control, Adaptive Control, Model Reference Adaptive Control (MARS), Sliding mode Control, Configuration of HEV (Series, Parallel, Series-parallel &Complex), Power Flow control, Examples. Power flow control in all HEV configurations, Examples of HEV system performance.

Objective: To enable the students to understand the Construction, control and Braking of Induction Motor drive

Session No *	Topics to be covered	Ref	Teaching Aids
19	Three Phase Inverter Based Induction Motor Drive	1,2,5,6	PPT
20	Speed Control of Induction Motor	1,2,5,6	PPT
21	Field oriented control, Adaptive Control	1,2,5,6	PPT
22	Model Reference Adaptive Control (MARS), Sliding mode Control	1,2,5,6	PPT
23	Configuration of HEV (Series, Parallel)	1,2,5,6	PPT
24	Configuration of HEV (Series-parallel &Complex)	1,2,5,6	PPT
25	Power Flow control, Examples.	1,2,5,6	PPT
26	Power flow control in all HEV configurations	1,2,5,6	PPT
27	Examples of HEV system performance. Importance of IM in EV design	1,2,5,6	PPT

Content beyond syllabus covered (if any):

Importance of IM in EV design

* Session duration: 50 mins



Sub. Code / Sub. Name: AE18704 / MOTORS AND CONTROLS FOR HYBRID AND ELECTRIC VEHICLES

Unit : IV PMSM and Synchronous Reluctance Motor

Unit: IV

Unit Syllabus : PMSM -Constructional features – Principle of operation, Torque equation-Drive circuits of Synchronous Reluctance Motor, Speed- torque Characteristics, Speed Control and Braking. Introduction - Constructional features of Synchronous Reluctance Motor– Principle of operation –Reluctance torque, Torque equation-Drive circuits of Synchronous Reluctance Motor, Speed- torque Characteristics, Speed Control and Braking. Comparison of PMSM, and SyRM for electric tractive effort.

Objective: To enable the students to understand the Construction, control and Braking of PMSM and Synchronous Reluctance Motor

Session No *	Topics to be covered	Ref	Teaching Aids
28	PMSM -Constructional features – Principle of operation,	1,2,5,7	PPT
29	Torque equation-Drive circuits of Synchronous Reluctance Motor	1,2,5,7	PPT
30	Speed- torque Characteristics	1,2,5,7	PPT
31	Speed Control and Braking. Introduction	1,2,5,7	PPT
32	Constructional features of Synchronous Reluctance Motor– Principle of operation	1,2,5,7	PPT
33	Reluctance torque, Torque equation-Drive circuits of Synchronous Reluctance Motor	1,2,5,7	PPT
34	Speed- torque Characteristics	1,2,5,7	PPT
35	Speed Control and Braking.	1,2,5,7	PPT
36	Comparison of PMSM, and SyRM for electric tractive effort, Importance of PMSM in EV design	1,2,5,7	PPT

Content beyond syllabus covered (if any):
Importance of PMSM in EV design

* Session duration: 50 mins



Sub. Code / Sub. Name: AE18704 / MOTORS AND CONTROLS FOR HYBRID AND ELECTRIC VEHICLES

Unit : V Auxiliary Electrical Machines in EVs

Unit : V

Unit Syllabus : Power Windows, Sun roof, Wiper-Motors and its control. Cooling system, Air-conditioner system and its control. Control view mirrors.

Objective: The student should be able to know the Constructional feature, importance of control and Braking of auxiliary electric machines for EV application.

Session No *	Topics to be covered	Ref	Teaching Aids
37	Power windows	1,5,6,7	PPT
38	Sun roof	1,5,6,7	PPT
39	Wiper motors and its control	1,5,6,7	PPT
40	Cooling system	1,5,6,7	PPT
41	Cooling system and its control		
42	Air conditioner system	1,5,6,7	PPT
43	Air conditioner system and its control	1,5,6,7	PPT
44	Control view mirrors	1,5,6,7	PPT
45	Application of special machines in automation	1,5,6,7	PPT

Content beyond syllabus covered (if any):

Application of special machine in automation

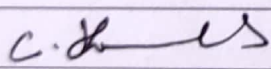
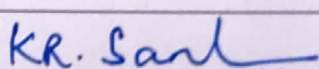
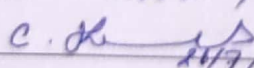
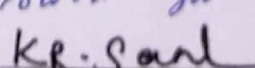
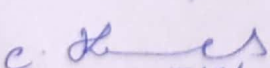
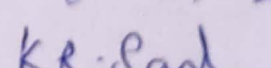
* Session duration: 50 mins



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REFERENCES:

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- 2 Ned Mohan, "Advanced Electric Drives-Analysis, Control, and Modeling Using MATLAB/Simulink", Wiley 2014
- 3 P.C. Krause, O. Wasynczuk, and S. D. Sudhoff, "Analysis of Electric Machinery", McGraw-Hill Book Company, 1986.
- 4 R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall.2002.
- 5 P. S. Bhimbra, "Generalized Theory of Electric Machines", Khanna Publication.2006
- 6 B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2011.
- 7 E.G. Janardanan, „Special Electrical Machines“, PHI learning Private Limited, Delhi, 2014.
- 8 T.J.E. Miller, „Brushless Permanent Magnet and Reluctance Motor Drives“, Clarendon Press,Oxford, 1989.

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Designation	Assistant Professor	Professor and Head
Date	22.07.2021	22.07.2021
Remarks *:	Same lesson plan being followed for AY 2022-23  24/7/2022 	
Remarks *:	Same lesson plan being followed for AY 2023-24  17/7/23  24.7.23	

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