



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000661

Course / Subject Name: Power Converters for Electrical Vehicles

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Power Electronics concepts, Electrical Motors, Battery.
Rationale:	Transportation is a fundamental requirement of modern life. Traditional, IC engine based, transportation has many issues. So, now days electrical vehicles (EV) are quickly replacing them. Because of the many advantages of EVs, it has become necessary to introduce the courses related to EVs in academics. This subject focuses on motor drives, battery charging, power converters used power converters used in EV etc.

Course Outcome:

After Completion of the Course, the student will be able to:

No	Course Outcomes
01	understand concepts of EV and its sub systems.
02	understand battery charging and BMS.
03	develop understanding of power electronic converters used for power conversion in EV.
04	select power converter for controlling subsystems of EV.

Teaching and Examination Scheme:

Teaching Scheme (in Hours/ week)			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightag
1.	Introduction: Concept of Electric vehicle configurations like Battery Electric Vehicle, Hybrid Electric, Fuel cell Electric Vehicle etc., Electrical vehicle requirements, Power Electronics in EV, Architecture of EV configurations,	6	15
2.	Motor Drive Systems for EV: Traction motors for EV, DC Series motors, BLDC Motor, PMSM, 3 Phase IM, SRM. Specifications for traction motors, Motor topologies, Characteristics of EV motors, Drivetrain architecture, Peak ratings and performance calculations etc.	8	20



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3.	Power Convertors for EV Motor Drives: Power converters topologies for DC Series motor, BLDC Motor, PMSM, 3 Phase IM, SRM, like DC-DC converter topologies, Inverter topologies	8	20
4.	Energy Storage for EV Power Converters for battery charging systems: Battery charging methods- CC, CV, Trickle, boost, multistage current etc. charging methods, Charger classification, AC and DC chargers, Level 1 Level 2, Level 3 chargers, power converter topologies for chargers like front end AC-DC converter, Isolated DC-DC converter topologies, wireless charger etc.	9	20
5.	Battery Management System and Cell Balancing: Cell Balancing Techniques, Power converters for different cell balancing techniques like Switched capacitors, Inductor based, Transformer based cell balancing topologies, relative comparison, advantages, disadvantages.	7	15
6.	Auxiliary Power Module: Auxiliary Power Module, concept, requirements, Low voltage load like AC, heater, lighting, viper and windows systems, Electronics systems, entertainment systems etc., Power converters.	7	10
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
30	20	20	20	10	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Edited by Ali Emadi, "Advanced Electric Drive Vehicles", CRC press
2. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles- Fundamentals, Theory, and Design", CRC Press
3. Edited by Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives"
4. John G. Hayes, G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", ISBN: 978-1 119-06364-3
5. James Larminie, John Lowry, "Electric Vehicle Technology Explained, 2nd Ed.", Wiley
6. Wei Liu, " Hybrid Electric Vehicle System Modeling and Control", ISBN:9781119279327, Wiley

(b) Open-source software and website:

1. <https://nptel.ac.in/>

Suggested Course Practical List:

The following list is for suggestions only. The subject teacher can change the list according to availability of resources. The subject teacher can also give simulation/ case study on various topics of the syllabus according to availability of resources



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1. Study of battery chargers
2. Study of wired chargers
3. Study of wireless chargers
4. Study of power converters for different motor drives of EV
5. Study of power converters for battery charging systems

List of Laboratory/Learning Resources Required:

PC/Laptop with installed MATLAB/ similar software, power converter hardware etc.

Any Other:

Data sheets and application notes from various semiconductor manufacturers. Some websites are as below

1. www.ti.com
2. www.stm.com

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