GUJARATECHNOLOGICALUNIVERSITY

Minor Degree – Minor/Hons. Program

Level: UG

Course/ Subject Code: BE040AL011

Subject Name: Fundamentals of Electric Vehicles

w.e.f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Core Courses

Prerequisite:	Basic Electrical Engineering
Rationale:	The advancement in the fields of Power Electronics and Electrical machines played an important role in making highly efficient electric vehicles having low pollution and better fuel economy. The EV has been the need of the time looking to the limitations of fossil fuels and harmful effects on the atmosphere due to vehicles run by conventional fuels. This subject will be helpful to understand the basics of Electrical Vehicle (EV) technology.

Course Outcomes:

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

No	Course Outcomes	% Weightage
01	**Describe** the architecture, components, and benefits of electric vehicles	15
02	**Analyze** vehicle dynamics and simulate performance using MATLAB tools	25
03	**Select and justify** appropriate electric motors and energy sources for EV applications	20
04	**Explain and compare** thermal management techniques used in EV systems.	20
05	**Assess** the role of green hydrogen in EVs and its integration with fuel cell technologies	20

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate ,CR: Create

TeachingandExaminationScheme:

Teaching-LearningScheme (in Hours per Semester)					Total Credits = TH/30	AssessmentPatternandMarks					Total Marks
						Theory		Tutorial/Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
60	30	30	30	150	05	70	0	0	30	50	150

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End- Semester Examination, PA = Progressive Assessment

Course Content:

Sr. No.	Course Content	No. of Hours
1.	**Introduction to Electric Vehicle Technology:** Electric Vehicle and automobile industry, Benefits of electric vehicle, Parameters of electric vehicle system, Block diagram of electric vehicle, EV architecture of Pure EV, Hybrid Electric Vehicle (HEV), architecture overview of Two, Three, Four wheeler as well as public transport (Bus)	10
2.	**Vehicle Characteristics:** Average power calculation, Power to weight ratio, Driving cycle, Force speed characteristics of vehicle, Torque speed characteristics of vehicle, Braking Performance	08
3.	**Electric Motors:** • Basics of Electric Motor, Induction motor, BLDC/PMSM motor, Switched Reluctance Motor, Emerging motors- **Axial Flux Motors, Hub Motors, Dual-Motor Systems**. • Selection of Motor for various applications based on cost, efficiency, torque-speed profile, control complexity.	12
4.	**Energy Sources for EV:** • Battery, Fuel Cell, Ultra-capacitor, Flywheel, Hybrid Energy Sources, Regenerative Braking • **Charging Infrastructure**: AC/DC chargers, fast charging stations, smart grids. • **Energy Storage Comparison**: Energy density vs power density plots. • **Safety Standards**: BIS/ISO/IEC standards for EV energy systems. • **Future Trends**: Solid-state batteries, wireless charging, second-life batteries.	14
5.	**Thermal Management System:** Introduction to thermal management system, Need of thermal management, Causes of battery and motor heating, Thermal Runaway Techniques of Battery Cooling, Heat Sink, Air cooling, Liquid Cooling, Direct Liquid Cooling, Indirect Liquid Cooling, Phase Change Material based Cooling, Thermo Electric Peltier Cooling	09
6.	**Green Hydrogen Technology for EVs:** Hydrogen production (electrolysis, SMR), storage, fuel cell integration, safety, sustainability, role in hybrid EVs	07
Total		60

Reference Books:

1. Modern Electric Hybrid Electric And Fuel Vehicles 3Rd Edition, Mehrdad Ehsani, CRC Press
2. Electric Vehicle Battery Systems, Sandeep Dameja, Newnes publication
3. Electric & Hybrid Vehicles, A.K. Babu, Khanna publication

4. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley
5. Advanced Electric Drive Vehicles, Ali emadi, CRC press
6. Electric Vehicle, Automobiles of the Future, Otto B. Bischof, Ted H. Tanaka, Berkeley, California
7. Thermal Management of Electric Vehicle Battery Systems, Halil S. Hamut , Wiley
8. Electric and Hybrid Vehicles: Design Fundamentals", Iqbal Hussein, CRC Press, 2003.

Suggested Course Practical List:

Simulations using tools like MATLAB may be done to obtain performance parameters Visit to Electric Vehicle manufacturing units may be arranged

List of Laboratory/Learning Resources Required:

1. PC with appropriate simulation software.
2. Learning resources: NPTEL website courses

Activities suggested under Self-learning/Teamwork:

Sr. No.	Nameofthe activity	No. of hours	Evaluation Criteria
1.	Industry/ Research laboratory visit	Visit = 5h, Report preparation = 5h Total= 10h	Based on report submitted. Report should contain observations and calculations based on industry/lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation=5h Total= 10h	Report /presentation based on video learning outcomes.
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each. Total=10h	Based on the assignment submitted.
4.	Problem solving/Analysis using SCILAB, MATLAB etc.	5 small simulation of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course based on the certificate produced.
6.	Complex problem solving	Maximum 2 problems. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.

Sr. No.	Nameofthe activity	No. of hours	Evaluation Criteria
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Reportpreparation=5h Total= 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research papers = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart /power point preparation on technical topics	Duration= 6h	Based on poster / chart Preparation and presentation skills
10	Working/non-working modelon technical topics	Working = 12 h non-working=8h	Based on inter department/ external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/ environment/ health/ any other issue	Duration = 10 h for industrial exposure Problem identification and tentative solution = 10 h Total= 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging / trending technical topics based on subject	Duration=1h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation=5h Total= 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.

Note:

- All the suggested activities should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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