MINOR DEGREE
in
Electric Vehicles

Mechanical Engineering Department
Faculty of Technology
Dharmsinh Desai University
Nadiad – 387 001, Gujarat, India

(Effective from 2025-26)

This page is intentionally left blank

Preface:

With a view to enhance the employability skills and impart deep knowledge in emerging areas, usually not being covered in Undergraduate Degree frame work, concept of 'Minor Degree / Specialization' in emerging areas is being introduced in Dharmsinh Desai University, Nadiad. Proposed Minor Degree/ Specialization will require the earning of 18 to 20 credits addition of regular undergraduate program.

The Minor in Electric Vehicles aims to give knowledge and skills in automobile hybrid and electric vehicles of current trends. This course offers a comprehensive understanding of the fundamental principles and key components of electric vehicles, including the electric drive train, battery technology, charging infrastructure, and energy management systems. The curriculum covers essential aspects such as power electronics, energy storage systems, thermal management, and overall vehicle efficiency. Additionally, students will gain insights into safety considerations, particularly in high-voltage systems and battery management. By the end of the course, students will be equipped with the expertise to design, analyze, operate, and maintain hybrid and electric vehicles. The program may also include topics on maintenance requirements, troubleshooting techniques, and best practices for servicing electric vehicles.

Eligibility for the student and registration:

- Minor program is an additional credential a student may earn if she/he does 18 credits worth of additional courses in a discipline other than her/his major discipline of B.Tech. degree.
- Students, may be permitted to do one minor/one honors.
- Number of credits for earning Minor specialization is 18 with courses, as prescribed by the Department.
- Courses for Minor specialization start from 5th Semester and the student is required to register for courses as per the Minor degree structure.
- After successful completion of the Minor specialization requirements, the student will be awarded a degree in "name of the discipline" with minor specialization in "name of the minor specialization".

Examples:

Computer Engineering -> Minor Course in Cyber Security (18-20 Credits)

Mechanical Engineering -> Minor Course in Electric Vehicles (18-20 Credits)

Case- 1: Within a discipline, the degree to be offered as…

B. Tech. (Hons.) Computer Engineering with Specialization in Cyber Security

B. Tech. (Hons.) Mechanical Engineering with Specialization in Electric Vehicles

Case-2: Interdisciplinary, the degree to be offered as…

B. Tech. Computer Engineering with a minor degree in Electric Vehicles

B.Tech. Mechanical Engineering with a minor degree in Cyber Security

In case a student drops from the Minor after earning a certain number of credits or is NOT able to fulfil all the requirements for the certification of Minor, within the maximum period of study permitted by UGC, the student will not receive the certification. Nevertheless, the transcript will be issued for whatever credits he/she has earned.

TEACHING SCHEME FOR HONOR / MINOR DEGREE

IN

ELECTRIC VEHICLES

Subject Code	Subject Title	Lect	Tut	Prac	Credits	semester
EV001	Automobile Systems	4	0	2	5	V
EV002	Fundamental of Power Electronics- NPTEL 12 week *	3	0	0	3	--
EV003	Computer Vision and Image Processing- Fundamentals and applications - NPTEL 12 week *	3	0	0	3	--
EV004	Electric & Hybrid Vehicle	4	0	2	5	VII
EV005	Project/Internship	0	0	2	2	--
	TOTAL	18	0	6	18	

* Or equivalent content and duration another course offered by NPTEL

Out of above mentioned three courses, **EV001**, **EV004** and **EV005** will be conducted by the department. To get the credits of the remaining courses i.e., **EV002**, **EV003**, students may register and get a certificate of two NPTEL courses as mentioned.

NPTEL Course details

Sr. No.	Course Title	Course duration	Course code
1.	Fundamentals of Power Electronics *	12 weeks	108101126
2.	Computer Vision and Image Processing - Fundamentals and Applications*	12 weeks	108103174

This page is intentionally left blank

HONOR / MINOR – ELECTRIC VEHICLES

SUBJECT: (EV001) AUTOMOBILE SYSTEMS (w.e.f. 2025-26)

Teaching Scheme (Hours)			Examination Scheme					Credit Structure			
Lect	Tut	Prac	Theory	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

DETAILED SYLLABUS:

1 VEHICLE PERFORMANCE AND STRUCTURE

Vehicle motion, resistances during motion, power required for acceleration and constant velocity motions, tractive efforts and draw bar pull, power required and engine characteristics, gear ratio requirement, study various vehicle layouts as front engine and front wheel drive, front engine and rear wheel drive, rear engine and rear wheel drive, components of transmission system, four-wheel drives. types of chassis frames and body, material, frameless construction

2 AUTOMATIC TRANSMISSION AND DRIVE LINES

Requirements, types, torque converter, epicyclic gearbox, continuously variable transmission, overdrive. propellers shaft, types of drive, final drive types, type of drive axles and differential

3 CLUTCH AND MANUAL TRANSMISSION

Functions, type of clutches, lining material, release mechanism, fluid flywheel, types of gear boxes, gear ratios, transfer case

4 STEERING AND SUSPENSION SYSTEMS

Steering requirements, steering system and linkages, steering gears, steering geometry, Ackermann linkages, power steering. purpose, types of suspension system, front and rear suspension, coil spring, leaf Spring, torsion bars, shock absorbers, air and rubber suspension, plastic suspensions, independent suspension, antiroll bar or stabilizer

5 BRAKES, WHEELS AND TYRES

Function, internal expanding brakes, brake lining material, properties, hydraulic braking system, pneumatic braking system, types of wheel rims, types of tyres, cross ply, radial and tubeless tyres, specifications of tyres, wheel balancing

6 BATTERY AND SAFETY TECHNIQUES

Introduction to hybrid electric vehicles, architecture of hybrid and electric vehicles, regenerative braking, control system for hybrid and electric vehicles, Battery: construction, working, methods of rating, charging methods, test, generator and cranking motor with drive purpose, modern technique, safety provisions, like air bags/ safety belts, traction control system

TEXT/REFERENCE BOOKS:

1. Heisler, H., 1985. Vehicle and Engine Technology. London: E. Arnold.
2. Heisler, H., 1999. Vehicle and Engine Technology (2nd edn). SAE (Society of Automotive Engineers) / Butterworth-Heinemann.
3. Giri, N. K., 2004. Automobile Technology. Khanna Publishers.
4. Gupta, R. B., 2021. Automobile Engineering (10th edn). Satya Prakashan.
5. Narang, G. B. S., 2009. Automobile Engineering. Khanna Publishers.
6. Crouse, W. H. & Anglin, D. L., 1984. Automobile Mechanics (9th edn). Gregg Division, McGraw-Hill.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1	Understand basic vehicle layout, structure and performance of vehicle.
CO2	Understand working of Automatic transmission. Explain the importance of Differential inautomobile.
CO3	Understand construction, working principles of clutch and manual gear boxes
CO4	Understand the construction and working principle of steering & suspension mechanisms.
CO5	Explain working of brake systems & constructional features of different types of tyres.
CO6	Understand the battery and auxiliaries.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	1	1	1	-	-	-	-	1	2	1
CO2	1	3	3	3	-	1	-	-	-	-	1	3	3
CO3	1	2	3	2	-	1	-	-	-	-	1	3	3
CO4	1	3	3	3	1	1	-	-	-	-	1	3	3
CO5	1	3	3	2	-	2	-	-	-	-	1	3	3
CO6	1	2	3	3	-	2	-	-	-	-	1	2	3

1-Slightly; 2-Moderately; 3-Substantially

SUBJECT: (EV004) ELECTRIC & HYBRID VEHICLE (w.e.f. 2025-26)

Teaching Scheme (Hours)			Examination Scheme					Credit Structure			
Lect	Tut	Prac	Theory	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

DETAILED SYLLABUS:

1 ELECTRIC VEHICLES

Basics of electric vehicles, current status and trends for EVs, Battery Electric Vehicles (BEVs), Fuel-Cell Electric Vehicles (FCEVs), electric machines for EV applications, EV Transmission: single-speed EV transmission, multiple ratio EV transmissions. comparison of ICE vehicle with HEVs and EVs. national policy for adoption of EVs

2 HYBRID POWERTRAIN

Series HEVs, parallel HEVs, series–parallel HEVs, complex HEVs, operating modes, degree of hybridization, comparison of HEVs, Plug-in Hybrid Electric Vehicles (PHEVs), real life examples of HEVs

3 ENERGY SOURCES FOR EV

Overview of energy sources for electric vehicle: batteries, fuel cell, ultra-apacitor and flywheel energy storage; hybridization of energy sources for electric and hybrid vehicles; comparison of sources. batteries: lead-acid battery, nickel-based batteries, sodium-based batteries, lithium batteries metal/air batteries; battery parameters, battery pack formation and testing, SoC & SoH, estimation of SoC. battery cell balancing, battery management system (BMS), thermal and safety considerations in battery pack design

4 TRACTION MOTORS

DC Machines- brushed and brushless DC motors (BLDC); AC Motors: induction motors (IM), permanent-magnet ac synchronous motor-surface-permanent-magnet (SPM) motors and interior-permanent-magnet (IPM) motors; PM materials; switched reluctance motor (SRM); basic construction details and working principles of each of the machine, in-wheel motors, comparison of traction machines; specifications of the motors, characteristic curves of a machines: constant-torque mode, constant-power mode, efficiency map

5 POWER CONVERTERS FOR EV DRIVE

Power conversion –basic principle, review of DC-DC converters, DC-AC converters used in EV applications; power topologies for IM, BLDC, PMSM and SRM motors. traction drives, modulation schemes: sinusoidal pulse width modulation, SPWM with third harmonic injection, space vector modulation, comparison of modulation techniques, converter / inverter loss calculation, heat-sinking: passive and active cooling

6 BATTERY CHARGING INFRASTRUCTURE

AC and DC charging, CC-CV charging, pulse charging; On-board and off-board charging; standards and protocols for charging; fast DC chargers, home and public charging infrastructure; wireless power transfer (WPT) technologies for EVs, move-and-charge technology, charging infrastructure-standardization and connectivity issues; SAE J1772, CHAdeMo, GB/T, CCS2 battery charging protocols. OCPP protocol impact on existing power grid, renewable energy-based charging infrastructure

TEXT/REFERENCE BOOKS:

1. Hayes, J. G. & Goodarzi, G. A., 2018. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles. Chichester: Wiley.

2. Xiong, R. & Shen, W., 2019. Advanced Battery Management Technologies for Electric Vehicles. Hoboken, NJ: John Wiley & Sons.
3. Ehsani, M., Gao, Y., Longo, S. & Ebrahimi, K. M. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. Boca Raton: CRC Press.
4. Chau, K. T. Electric Vehicle Machines and Drives: Design, Analysis and Application. Hoboken, NJ: Wiley-IEEE Press.
5. Fitzgerald, E. & Kingsley, C. Electric Machinery. McGraw Hill Education.
6. Nagrath, I. J. & Kothari, D. P. Electric Machines. McGraw Hill Education.
7. Sudhoff, S. D., Krause, P. C. & Wasynczuk, O. Analysis of Electric Machinery and Drive Systems. Hoboken, NJ: Wiley.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1	Understand basic of Electric vehicle and compare with IC engine vehicle.
CO2	Understand working of Hybrid vehicle powertrain.
CO3	Understand construction, working and different types of lithium-ion batteries.
CO4	Understand the construction and working principle of different traction motors used in EV vehicle.
CO5	Explain working of DC-DC and AC -DC convert for EV vehicle.
CO6	Understand the Fast charging and slow charging infrastrure details

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	1	1	1	-	-	-	-	1	2	1
CO2	1	3	3	3	-	1	-	-	-	-	1	3	3
CO3	1	2	3	2	-	1	-	-	-	-	1	3	3
CO4	1	3	3	3	1	1	-	-	-	-	1	3	3
CO5	1	3	3	2	-	2	-	-	-	-	1	3	3
CO6	1	2	3	3	-	2	-	-	-	-	1	2	3

1-Slightly; 2-Moderately; 3-Substantially